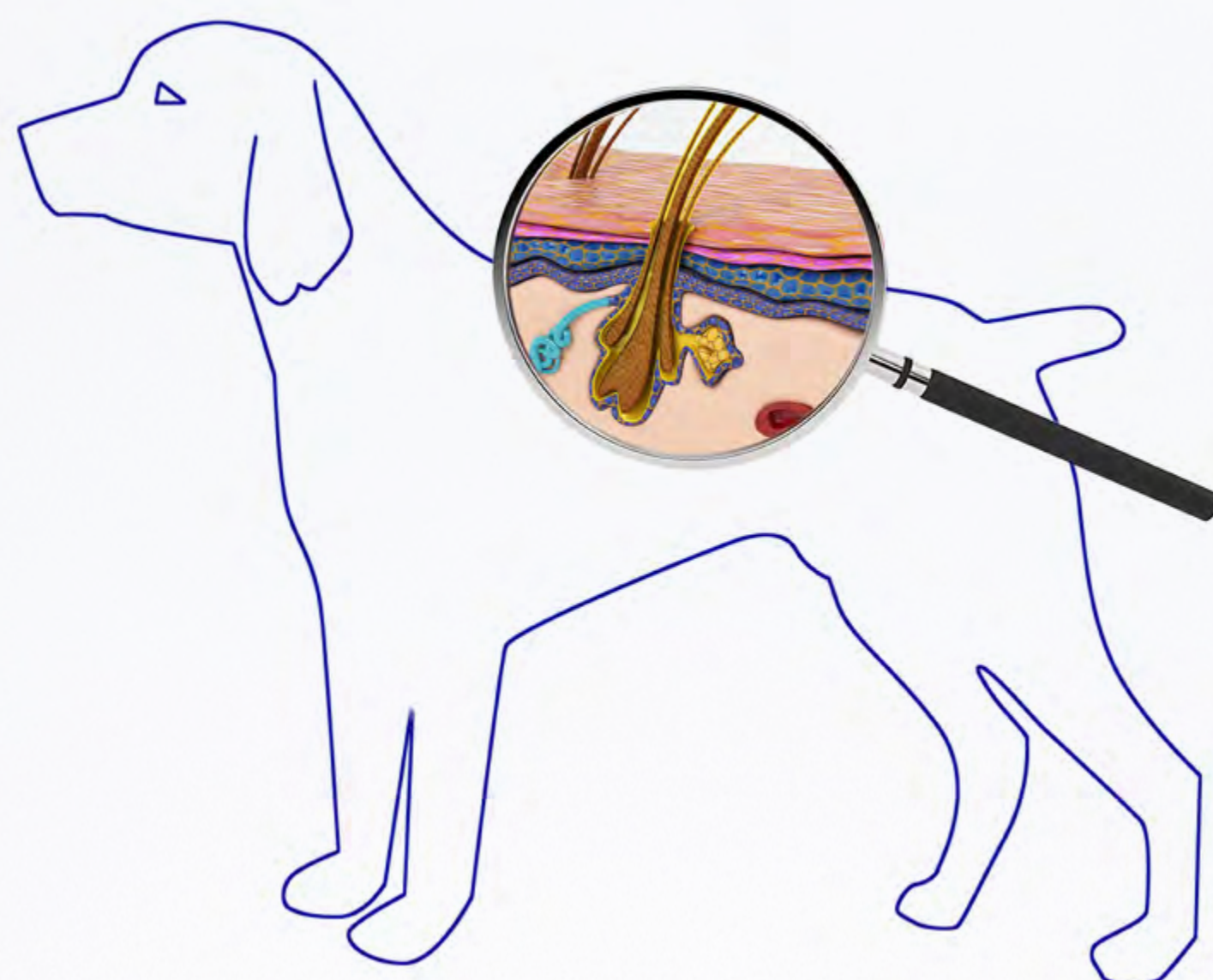


DAILYDERMA™

Clinical Handbook
on **Canine Dermatology**
Fourth Edition



FOREWORDS

Canine dermatology is, and will remain, a challenging field.

It requires a wide variety of knowledge that covers many topics including bacteriology, mycology, parasitology, immunology, allergology, endocrinology, oncology...

But it is also this variety that makes it so engaging and enthralling.

Dermatology may be frustrating at times, but it can also generate much satisfaction.

However complex this field is, keep in mind that a large number of cases may be treated successfully resulting in patient relief, owner satisfaction and gratification of the clinician. In order to accomplish this goal, it is necessary to follow a method, to master it, to refine it and to ultimately model it for itself.

May I with this handbook help you to achieve this. It is anyhow this ambitious intent that motivated me with passion all along its conception.

Pierre Jasmin, DVM

ORIGINAL PREFACE OF THE FIRST EDITION (©2000)

This book is a truly original manual of canine dermatology.

Many dermatological guides or handbooks are available and may be pleasant to read and convey a good understanding of canine dermatoses. However, this book puts forward a quite novel and stimulating approach.

Pierre JASMIN, its author, has developed the concept of classifying the dermatoses in a special way which facilitates the clinical approach. He distinguishes three groups of cutaneous diseases: first, a group of infectious and parasitic, primary or secondary dermatoses which are considered initially. A second group containing the most common primary dermatoses is then presented and, finally, a third group of rare primary dermatoses is considered. His practical approach is thus applied sequentially from group 1 through to group 3. These three steps are modulated according to the age of the animal, enabling dermatoses of young dogs to be distinguished from those of adult dogs.

A diagnostic approach to otitis externa is proposed separately.

This original and efficient approach is complemented by summaries of the essential elements of every dermatological consultation: history-taking and the clinical examination. Finally, Dr. JASMIN reviews one of the most useful but least understood of the dermatological complementary examination procedures: cutaneous histopathology.

An important feature is the presentation of the common dermatoses as monographs in the middle section of the handbook. These diseases are reviewed in a concise and consistent manner covering definition and general information, aetiology and pathogenesis, epidemiology, clinical signs, diagnosis and, of course, treatment. Case follow-up and prognosis are considered at the end of each monograph.

This practical, rigorous and well illustrated document provides a fertile source for the student and the aspiring clinician, as well as the experienced practitioner already interested in dermatology. It provides rapid access to a wide range of knowledge and data, relevant to dermatological practice and in this way simplifies and facilitates the diagnostic approach to dermatological cases.

This book should find a place in the clinic of every canine veterinary surgeon positioned for ready reference as the problems of canine dermatology are encountered in daily practice.

Didier Noël CARLOTTI, DVM, Diplomate ECVD

4TH EDITION PREFACE



Dear colleagues,

It is an honor—and a pleasure, indeed—to have been requested to preface this 4th edition of Dr. Pierre Jasmin's "Clinical Handbook on Canine Dermatology," which I had also been given the opportunity to help update.

From the time I began reading this manual in depth, I was seduced by its fairly unique content, focusing first on the approach to the canine patient with skin diseases (1st section), to monographs of the main canine dermatoses (2nd section – the largest), before moving on to the art of biopsying relevant skin lesions (3rd section) and, finally, providing a brief summary of relevant aspects of the skin physiology (4th section).

In each of these book's monographs, practitioners will find useful and relevant information divided into sections that encompass the epidemiology, clinical signs, diagnosis and treatment of major canine skin diseases; a shorter section on pertinent etio- and pathogenesis facts will also help better understand the various entities.

One of the caveats that I have encountered often in books supposedly-written for general practitioners is the extensive descriptions of diseases that veterinarians might see only one time in their careers. Unfortunately, more is not always better! This particular book by Pierre Jasmin does not fall into this trap! The—often in depth—disease monographs only cover those seen routinely by general practitioners. This "simplified" approach echoes the one that I used for decades in the education of veterinary students. Indeed, my classes only aimed at providing details on how to approach the main (less than 20?) diseases that would represent 90 % of their future caseload, the diagnosis and treatment of the remaining 10% being just a referral or a biopsy away!

I feel that this book should be of great help to veterinary students and general practitioners alike. This 4th edition is substantially changed in its content rather than format, as new information, especially on allergic and infectious diseases, has been included to update on the latest discoveries, trends, guidelines or hypotheses. The new digital format is welcome, as it will ensure the easiest and widest dissemination of the information. That it will be—as before—translated in multiple language will help the global sharing of knowledge. Finally, that it will be free for all appeals to my vision that knowledge should not be uniquely destined to those that can afford it.

For this worldwide and free sharing of relevant, practical, veterinary dermatology, I thank Pierre Jasmin and Virbac for the efforts, time and cost spent to generate this manual.

Enjoy the read!

**Thierry Olivry, DrVet, PhD, DipECVD, DipACVD
Riga, Latvia, January 14, 2021**

Virbac thanks everyone who has participated in the elaboration of this document for their invaluable collaboration.

Virbac has taken every effort to ensure the accuracy of the information in the Clinical Handbook on Canine Dermatology. However, Virbac S.A. makes no warranties or representations as to its accuracy and shall not be liable for any direct, incidental, consequential, indirect or punitive damages arising out of any errors, omissions, or inaccuracies in the content of this book.

Note that some agents mentioned in this document may not be licensed or available in your country.

The user should therefore always refer to the instructions enclosed with each product that have been approved by the regulatory authorities for use in the country concerned.

Copyright © 2020 VIRBAC

No part of this publication may be reproduced or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, or stored in any retrieval system of any nature, without the written permission of the copyright holder, application for which shall be made to Virbac.



TABLE OF CONTENTS

Presentation

7

1 The dermatological approach

11

Taking the history	13
Dermatological examination - Lesions	15
Differential diagnosis for groups of related dermatoses	21
1/ General approach	21
2/ Otitis externa	22
3/ Dermatoses of adult dogs	23
4/ Dermatoses of young dogs	24

2 Monographs of the major canine dermatoses

25

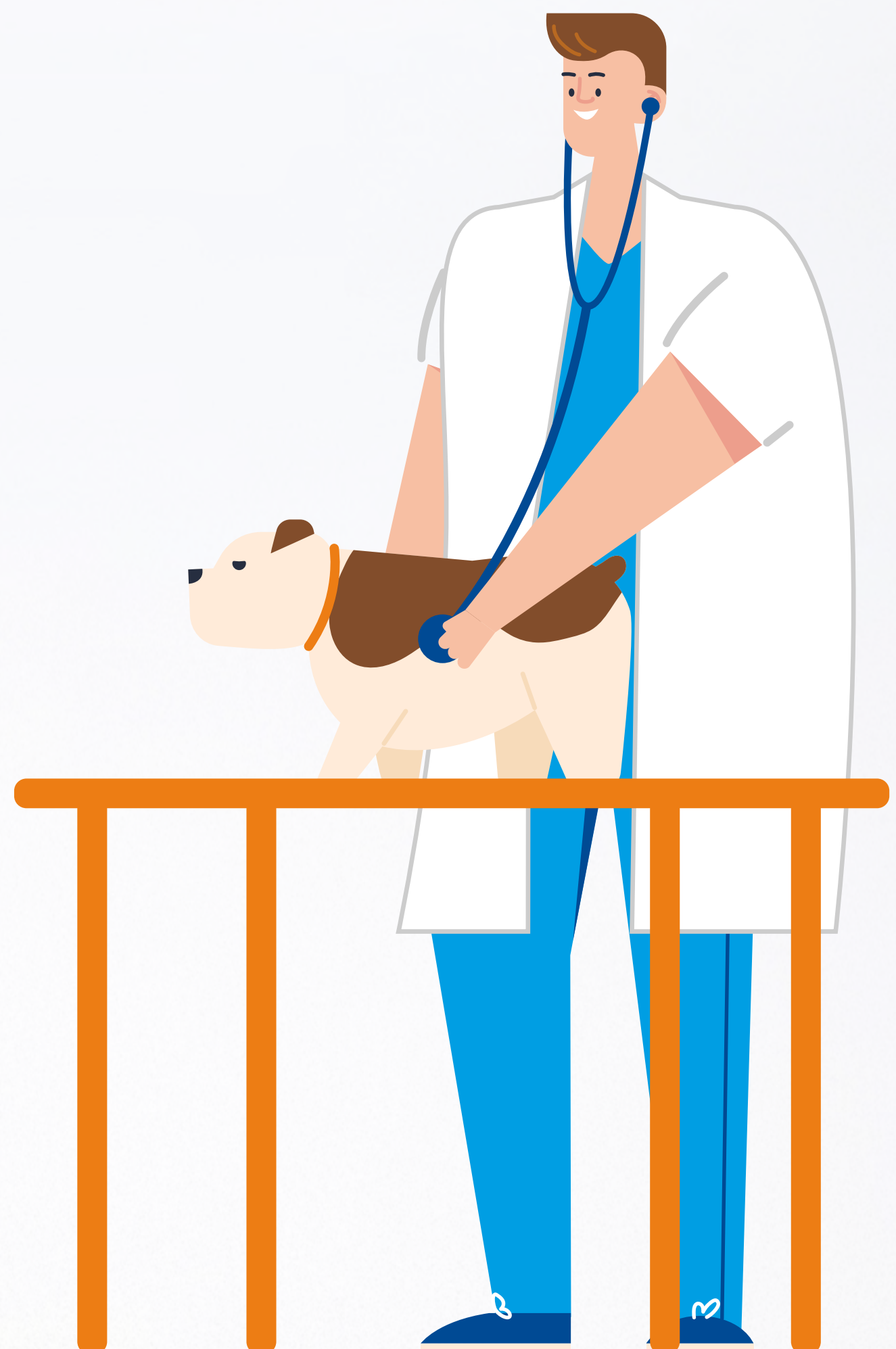
■ Dermatophytosis	27
■ Sarcoptic mange	37
■ Dermatoses associated with infestations by other parasites	43
■ Demodicosis and pyodermatitis (juvenile onset and adult onset)	49
■ Pyoderma - General presentation	57
■ Simple approach pyoderma	65
■ Complex approach pyoderma	73
■ <i>Malassezia</i> dermatitis and yeast overgrowth	85
■ Flea Allergy Dermatitis (FAD)	95
■ Skin manifestations of Food Allergy (FA)	111
■ Atopic Dermatitis (AD; Atopy)	119
■ Iatrogenic and spontaneous Cushing's syndromes (ICS and SCS)	133
■ Hypothyroidism	147
■ Otitis externa	153

3 Applications and use of skin biopsies

159

4 Elements of physiology and structure of healthy canine skin

171



PRESENTATION

At first, it will be important for users to read the presentation and first part of the handbook to gain a proper understanding of the aims and general philosophy of the dermatological approach proposed.

CONCEPT OF THE DOCUMENT

This document is designed to be used as a reference aid for the diagnosis and management of canine dermatological cases on a daily basis.

It is not an exhaustive bibliographic review, but should be used as a clinical handbook available for consultation at any time and presenting a rational approach to the diagnosis and management of canine dermatological cases. It aims to provide a practical and efficient pathway that, in most cases, will enable the practitioner to establish an accurate diagnosis and formulate an appropriate treatment or management plan.



THE NEED FOR A CLINICAL HANDBOOK

Why does dermatology remain such a difficult area of veterinary medicine, even though skin lesions are readily observed and the skin is easily accessible for detailed examination and sampling? There are three principal reasons for this paradox.

1

The skin has a limited range of reaction patterns, and so many different dermatoses have lesions which appear similar. Clinical signs are thus of limited diagnostic significance.

2

Although the skin lends itself to biopsy sampling, the value of histopathology (even though rich in information) is quite variable amongst different skin diseases. Indeed, the diagnostic potential of histopathology is in many cases inversely proportional to the frequency of the dermatosis.

3

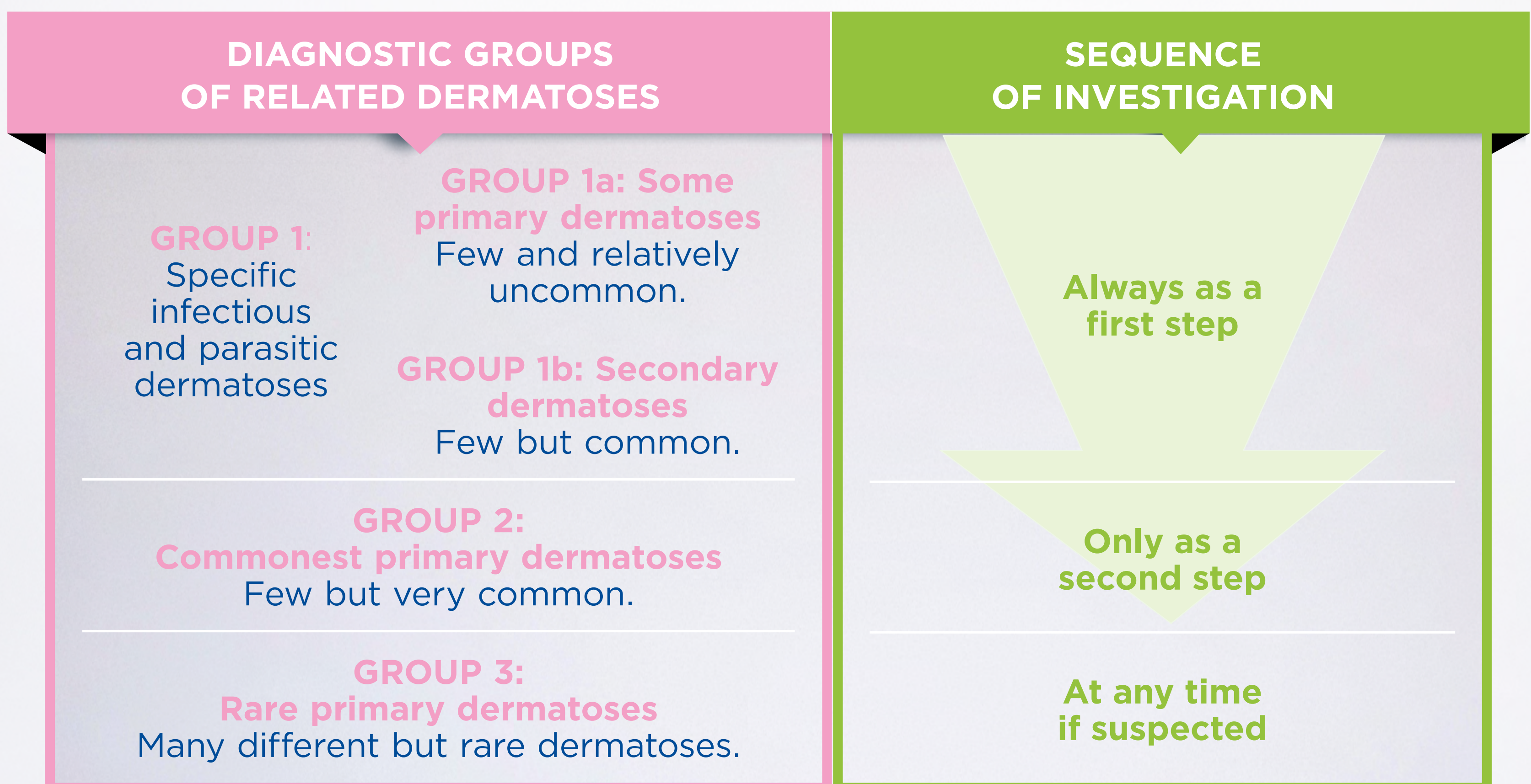
Several dermatoses may occur simultaneously on the same animal, presenting a complex picture. This may require sequential investigation, first of secondary dermatoses and then of the primary disease(s).

SOLUTIONS PROVIDED BY THE CLINICAL HANDBOOK

1. Grouping of Dermatoses by Frequency and Sequence of Investigation.

Fortunately, most dermatological cases seen in practice are caused by a small number of specific diseases. In all of these conditions a clinical approach is essential and histopathology is seldom useful. **We can divide these conditions into two groups (Groups 1 and 2) based on the sequence of investigative procedures which is required.** Group 1 includes a small number of dermatoses associated with infectious or parasitic agents. This group is subdivided into 1a, uncommon primary dermatoses, and 1b, common secondary dermatoses. Group 2 is made up of a small number of commonly occurring primary dermatoses that are typically associated with the secondary conditions of group 1b.

The other dermatoses, which are uncommon, but which encompass a much larger range of diseases, are placed in Group 3. These conditions require a more sophisticated approach, in which histopathology plays a very important part. Investigation should include the use of skin biopsy samples. Biopsies are also required in all cases in which other diagnostic procedures have failed to provide a precise diagnosis.



This approach must permit us to progress, in each case, toward the diagnosis of the dermatosis, because it explains in a concrete and practical way which dermatoses have to be previously excluded (or confirmed) in a first step, to be able to carry on toward a precise diagnosis.

2. Separation of Animals into Two Categories: Young and Adult Dogs.

A second fundamental classification in this approach is the separation of cases into two age ranges, young and adult dogs, where the division between the two categories is puberty.

Why this separation? Sexual maturity is associated with the development of a mature endocrine system and immune system, changes which have major clinical consequences in dermatology. Dermatological conditions in dogs are actually fundamentally different depending on whether the dog is “mature” or not. This necessitates a specific dermatological approach for each of these two categories.

In dogs, there is considerable variation between breeds in the age of acquisition of puberty. One year is a good marker for medium-sized breeds but in small breeds puberty will tend to occur earlier; in large breeds it will be later. Exceptions to this pattern may exist amongst specific breeds and between individuals.



Courtesy of: Pierre Jasmin

CONTENT OF THE CLINICAL HANDBOOK

Part 1

Presents the general approach and specific procedures to follow when faced with a dermatological problem:

1. How to initiate the approach and take the history.
2. Dermatological examination, identification of the principal lesions and use of a lesion map.
3. Identifying the different diagnostic groups (1a, 1b, 2 and 3), assembly of a list of appropriate differential diagnoses corresponding to each group and the sequence of diagnostic procedures.
 - The concept is presented first as a table which specifies the sequence of diagnostic procedures according to their groups.
 - Specific dermatoses to be considered in the two age groups, adult and young dogs, are listed for each group.
 - The management of otitis externa, which is considered as a specific dermatological problem, is described separately in a table. A specific monograph is devoted to otitis and describes a clinical method of investigation.

Part 2

Presents monographs in which each dermatosis or group of dermatoses is reviewed from a clinical and practical perspective. Only the useful key points essential to the proper management of the problem are described. The same general plan is followed for all the monographs, including definition, aetiology, pathogenesis, epidemiology, clinical signs, diagnosis, treatment, prognosis, follow-up and conclusions. Note that some agents mentioned in the treatment section may not be licensed or available in your country.

Part 3

Is devoted to a detailed analysis of the effective use of skin biopsies, enabling the reader to maximise the efficiency and diagnostic power of the histopathological examination.

Part 4

Presents some elements on canine skin physiology, structure, epidermis renewal, follicular cycle and differences with human skin.

PHILOSOPHY OF THE CLINICAL HANDBOOK

An analysis of cases encountered in practice led to the realisation that a diagnostic approach could be designed which would enable the small number of very common dermatoses to be efficiently diagnosed, using clinical procedures and differentiating the conditions suffered by young dogs and adults. Diagnosis of the many different but rarer dermatoses could be achieved with the aid of histopathological examination of skin biopsy specimens.

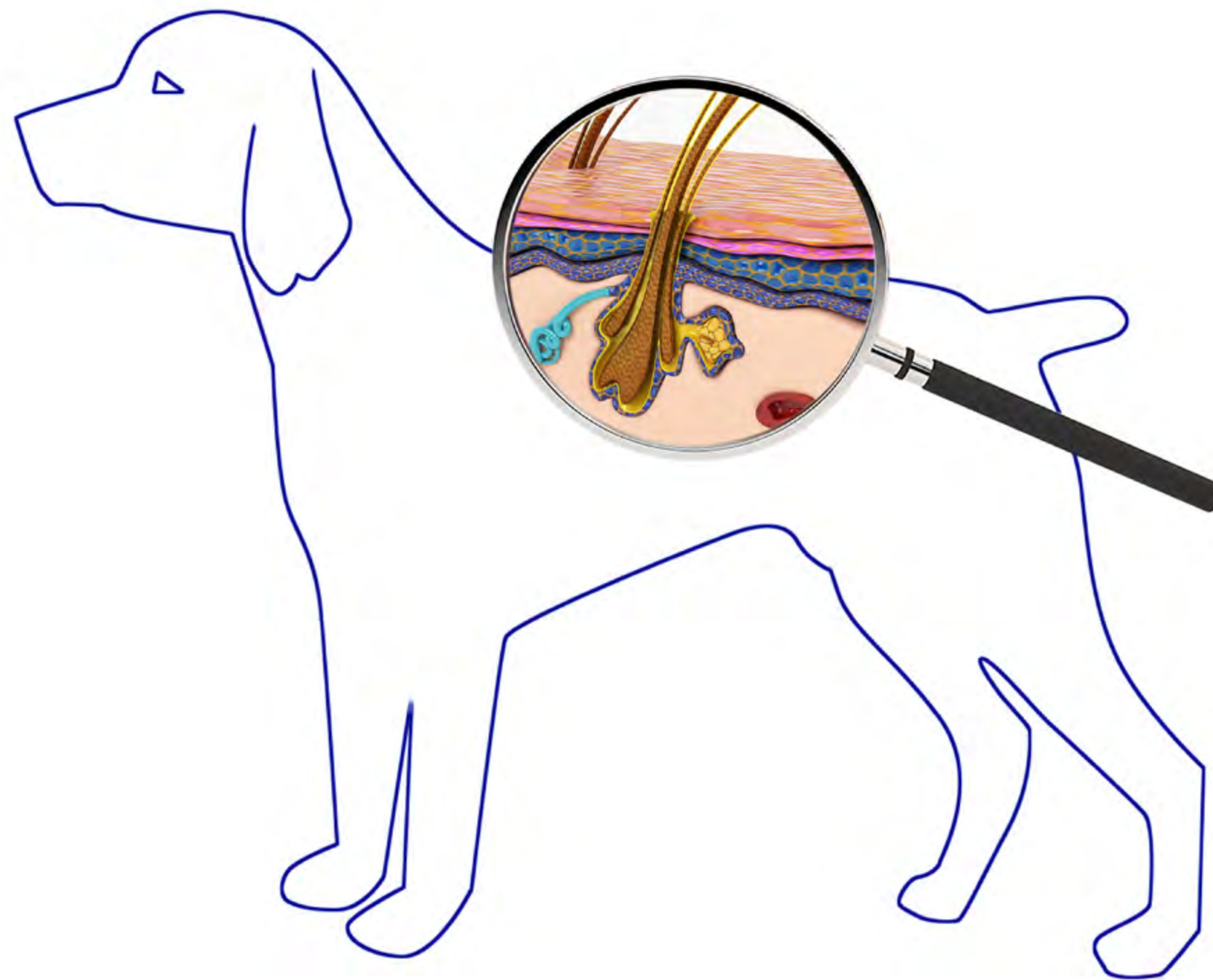
This approach has enabled us to provide a framework for diagnosis and management of a majority of cases without neglecting the diagnostic approaches required for rarer conditions.

This document is the product of this analysis and has been assembled with the collaboration of some of the best-known specialists in veterinary dermatology. Virbac, faithful to its philosophy, hopes that this book will address both your needs and your expectations.

DAILYDERMA™

Part. 1

The **dermatological** **approach**



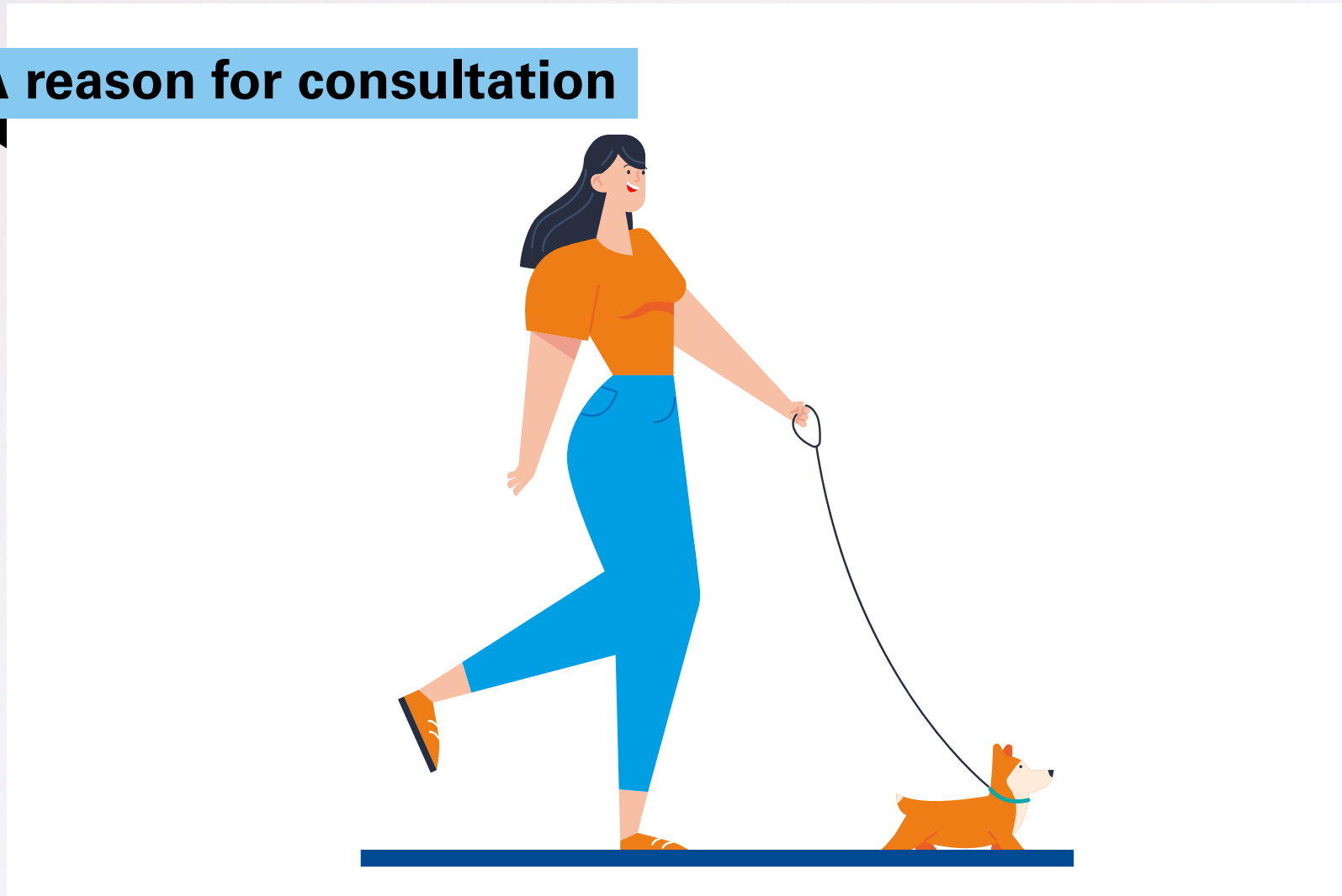
Clinical Handbook
on **Canine Dermatology**
Fourth Edition



TAKING THE HISTORY

A dermatological sign (Pruritus, Alopecia, Otitis...) can be:

A reason for consultation



Noticed during consultation



In every case, plan sufficient time to fill in the History Sheet and to initiate the approach.

HISTORY SHEET

Date:

Owner:

Dog's name: Age:

Breed: Sex: Weight:

GENERAL HISTORY

1/ Age when acquired and origin (breeder, pet store...):

2/ Geographical area of home, present and past (trips, kennels...):

3/ Way of life, environment (exercise, house, garden, flat...) and in-contact pets:

4/ Diet (current and previous):

5/ Reproduction (frequency of oestrus, pregnancy, behaviour of males...):

6/ Previous diseases and surgery:

7/ Unrelated previous dermatoses:

8/ Current non skin-related problems:

9/ Behavioural changes:

DERMATOLOGICAL HISTORY

1/ Chief complaint:

2/ Date of onset:

3/ Pruritus, severity and time of onset (before or after lesions):

4/ Specific clinical signs and related behaviour:

- Itching of feet (licking, chewing):
- Itching of head, lips, chin, periorbital area (scratching, rubbing):
- Otitis, itching of ear pinnae (scratching, shaking):
- Itching of anogenital area (rubbing, licking and chewing):
- Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretion):
- Upper respiratory signs, nasal discharge and/or sneezing:
- Lower respiratory signs, asthmatic problems:

5/ First cutaneous lesions observed and their development:

6/ Seasonal influences:

7/ Other affected animals (cohabiting, lineage) or human beings in contact:

8/ Presence of fleas and anti-parasitic treatments given:

9/ Shampoos and grooming:

10/ Owner's view (personal opinion, remarks) on the dermatosis of his dog:

11/ Previous treatments (date, products, dosage and duration) and responses:

Evaluate the time available to you and the owner. Allocate sufficient time to enable you to explain and initiate the approach.

You can give the history sheet to the owner and ask him/her to complete it in the waiting room.

Information on the sheet should be amplified by questioning the owner. You and the owner should be seated. Take the dog off the consultation table if it was first placed there.

Make a special appointment if necessary and give the owner the history sheet to fill in at home. Ask him/her to bring it back on the day of the appointment.

HISTORY SHEET

Date:

Owner:

Dog's name: Age:

Breed: Sex: Weight:

GENERAL HISTORY

1/ Age when acquired and origin (breeder, pet store...):

2/ Geographical area of home, present and past (trips, kennels...):

3/ Way of life, environment (exercise, house, garden, flat...) and in-contact pets:

4/ Diet (current and previous):

5/ Reproduction (frequency of oestrus, pregnancy, behaviour of males...):

6/ Previous diseases and surgery:

7/ Unrelated previous dermatoses:

8/ Current non skin-related problems:

9/ Behavioural changes:

DERMATOLOGICAL HISTORY

1/ Chief complaint:

2/ Date of onset:

3/ Pruritus, severity and time of onset (before or after lesions):

4/ Specific clinical signs and related behaviour:

• Itching of feet (licking, chewing):

• Itching of head, lips, chin, periorbital area (scratching, rubbing):

• Otitis, itching of ear pinnae (scratching, shaking):

• Itching of anogenital area (rubbing, licking and chewing):

• Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretion):

• Upper respiratory signs, nasal discharge and/or sneezing:

• Lower respiratory signs, asthmatic problems:

5/ First cutaneous lesions observed and their development:

6/ Seasonal influences:

7/ Other affected animals (cohabiting, lineage) or human beings in contact:

8/ Presence of fleas and anti-parasitic treatments given:

9/ Shampoos and grooming:

10/ Owner's view (personal opinion, remarks) on the dermatosis of his dog:

11/ Previous treatments (date, products, dosage and duration) and responses:

DERMATOLOGICAL EXAMINATION - LESIONS

STANDARD GENERAL EXAMINATION

Including weight, temperature, pulse, auscultation, lymph node and abdominal palpation, ophthalmological examination...



General examination. Courtesy of: D. Pin

THOROUGH DERMATOLOGICAL EXAMINATION

Search carefully for primary and secondary lesions with a magnifying lens if necessary.

Note all these lesions on the silhouette.

The entire skin and haircoat must be thoroughly investigated. This should be done first when the dog is standing up, starting from the face down to the tail, going through the back and the flanks. Then the dog is laid down to examine the ventral aspect and the limbs to their extremities.

Using the information provided by the history and the silhouette, and taking into account any abnormalities detected in the general examination, the list of differential diagnoses is developed and related to the defined disease group (see the table explaining the general approach to differential diagnosis for groups of related dermatoses).

These diseases are listed separately for the adult dog and the young dog in two different action plans. Adopt the plan appropriate to the age category of the case.*

The history and the lesion map are essential for the clinical approach but will also be found very useful in supporting interpretation of histopathological analysis and for the clinical follow-up.



Dermatological examination of standing animal. Courtesy of: D. Pin



Dermatological examination of lying animal. Courtesy of: D. Pin

* See the presentation of the handbook which defines the difference between young dog and adult dog.

PRIMARY LESIONS

DEFINITIONS AND CLINICAL ELEMENTS

ERYTHEMA	Dermal vasodilatation causing redness of the skin that disappears when pressure is applied, as in diascopy (a glass slide pressed against the skin): indicative of inflammation. The most frequently observed cutaneous sign, of little specificity . Sometimes the only sign. Commonly in the interdigital spaces in atopy, Malassezia dermatitis, microbial overgrowth (<i>Malassezia</i> and staphylococci), and in intertrigo where erythema is localised in cutaneous folds.
PAPULES	Raised, solid, circumscribed elevations of the skin, from 1 mm up to 1 cm diameter, usually indicative of a cellular infiltrate.
PUSTULES (SUPERFICIAL PUSTULES AND FURUNCLES)	Raised, circumscribed, normally thin-walled lesions containing pus (typically 1 to 3 mm). If follicular, consider follicular infections involving bacteria (pyoderma), <i>Demodex</i> (demodicosis), dermatophytes (ringworm). If non-follicular - consider impetigo in young dogs, pemphigus foliaceus in adults. Pustules may extend by rupture of hair follicles to form furuncles. Dermal involvement causes vascular damage; blood is commonly present in the more abundant purulent discharge as in furunculosis, pyodermatitis...
CRUSTED PAPULES	Papules surmounted with a small central crust, may need examination with a hand lens. Commonly found in sarcoptic mange .
VESICLES BULLAE	Small, raised, circumscribed, fluid-filled epidermal lesions. If larger than 1 cm are called bullae.
NODULES	Raised, solid cutaneous masses greater than 1 cm in diameter. Caused by inflammatory infiltrates or neoplasia within the dermis or rarely, in the subcutis.
TUMOURS	Solid masses involving any tissue in the skin or subcutis and usually caused by neoplasia or granuloma formation - usually circumscribed but may be diffuse.

SECONDARY LESIONS

DEFINITIONS AND CLINICAL ELEMENTS

SCALES*	Scales are released from the skin surface and composed of masses of cornified cells. Indicates defective keratinisation. Flakes are large scales.
CRUSTS*	Dried exudate adherent to the skin surface - may contain corneocytes, scales and blood. Often caused by rupture and desiccation of primary lesions containing pus or exudate, or following damage to the skin including self-trauma.
EROSIONS EXCORIATIONS	Superficial lesions confined to the epidermis and which heal without scar formation (consider " hot spots "). Excoriations are self-inflicted and often linear - seen in pruritic dermatoses .
ULCERS*	Lesions in which the epidermis is breached, there is damage to dermal tissues and a haemorrhagic exudate. They are associated with vesicular diseases and dermal or subcutaneous pathology. Scarring occurs. Ulcers may be present in cellulitis.
EPIDERMAL COLLARETTES	Scales arranged in a circular or arciform pattern, the lesion preceding being a small, elevated "pseudopustule". Suggestive of an exfoliative superficial pyoderma (where Staphylococci may produce particular exfoliative toxins).
FOLLICULAR CASTS*	They are characteristic of sebaceous gland destruction, like in sebaceous adenitis, with squames and sebaceous debris which have been cast around the hairs within a follicle, often matting together several hairs.
COMEDONES*	Plugs of corneocytes and sebum, which dilate hair follicles, initially pale in colour they darken with time. This material can be expressed by digital pressure. Consider demodicosis and dermatophytosis , or endocrinopathy, particularly Cushing's syndrome .
LICHENIFICATION HYPERPIGMENTATION*	Chronic thickening and hardening of the skin with exaggeration of the normal markings - usually associated with prolonged and continual friction, and accompanied by excessive accumulation of melanin - hyperpigmentation. Cause may be endocrine (diffuse pattern) but is usually more "post rubbing/scratching", post pruritic, and potentially linked to chronic inflammation. Alterations of hair colour may also occur commonly as a postinflammatory event. Consider atopic dermatitis or food allergy when there is discoloration of the paws due to continual licking.
ALOPECIA*	Abnormal hair loss - may be partial or complete, circumscribed or diffuse, symmetrical or asymmetrical. Note the general pattern first and then following close examination with a lens describe it clearly on the silhouette. Consider conditions altering hair development such as endocrine disorders (tend to be symmetrical), and those resulting in follicular damage, such as short-haired dog pyoderma, demodicosis and ringworm (asymmetrical and associated with areas or infection).

* Lesions which may be defined as primary in some dermatoses.

PRINCIPAL PRIMARY LESIONS

CLINICAL FEATURES



Erythema. Courtesy of: D.N. Carlotti



Erythema. Courtesy of: D.N. Carlotti



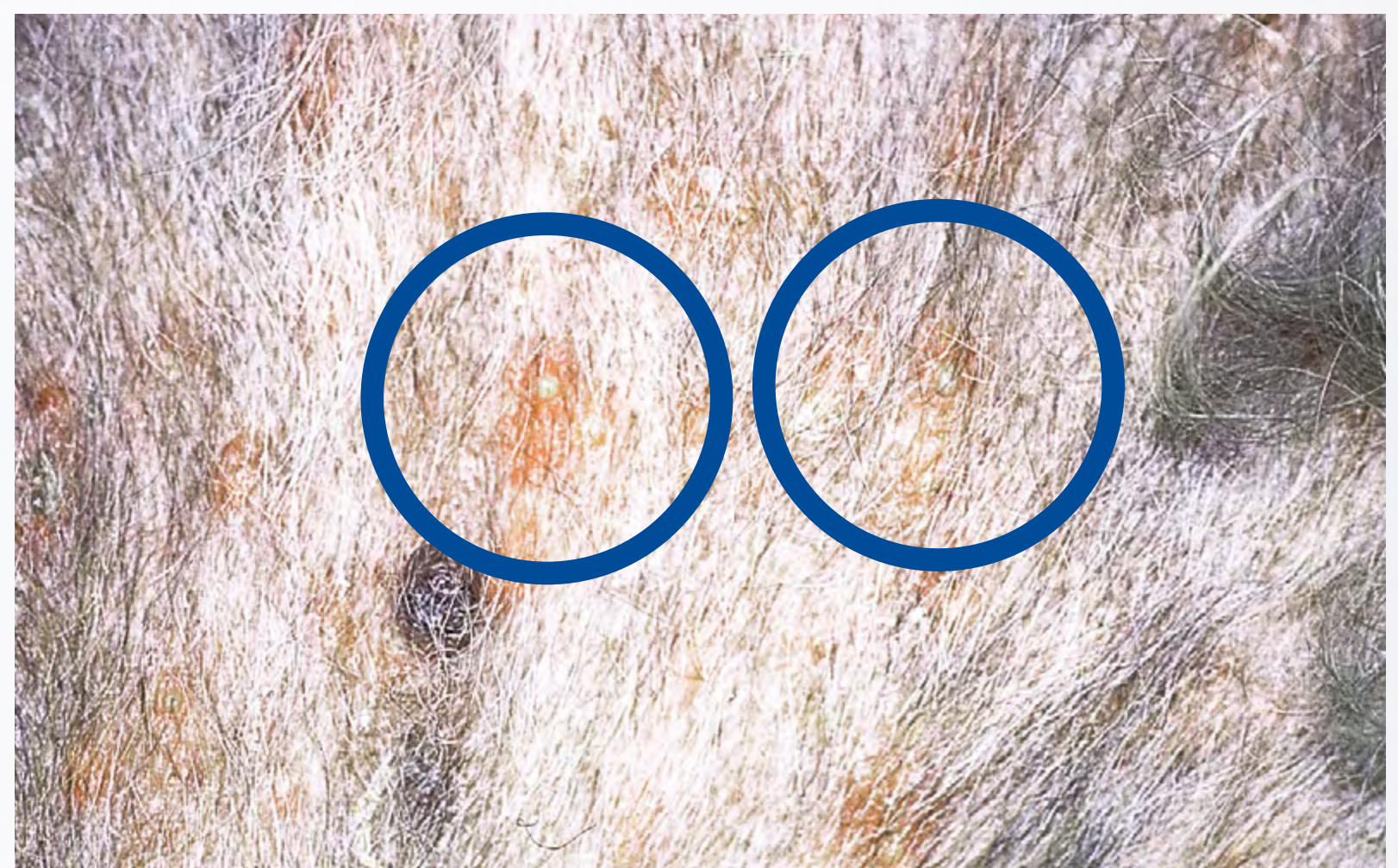
Papules. Courtesy of: D.N. Carlotti



Crusted Papule. Courtesy of: D.N. Carlotti



Non Follicular Pustules. Courtesy of: D.N. Carlotti



Follicular Pustules. Courtesy of: D.N. Carlotti



Furuncles. Courtesy of: D.N. Carlotti



Tumour (Mycosis fungoïde). Courtesy of: D.N. Carlotti

PRINCIPAL SECONDARY LESIONS

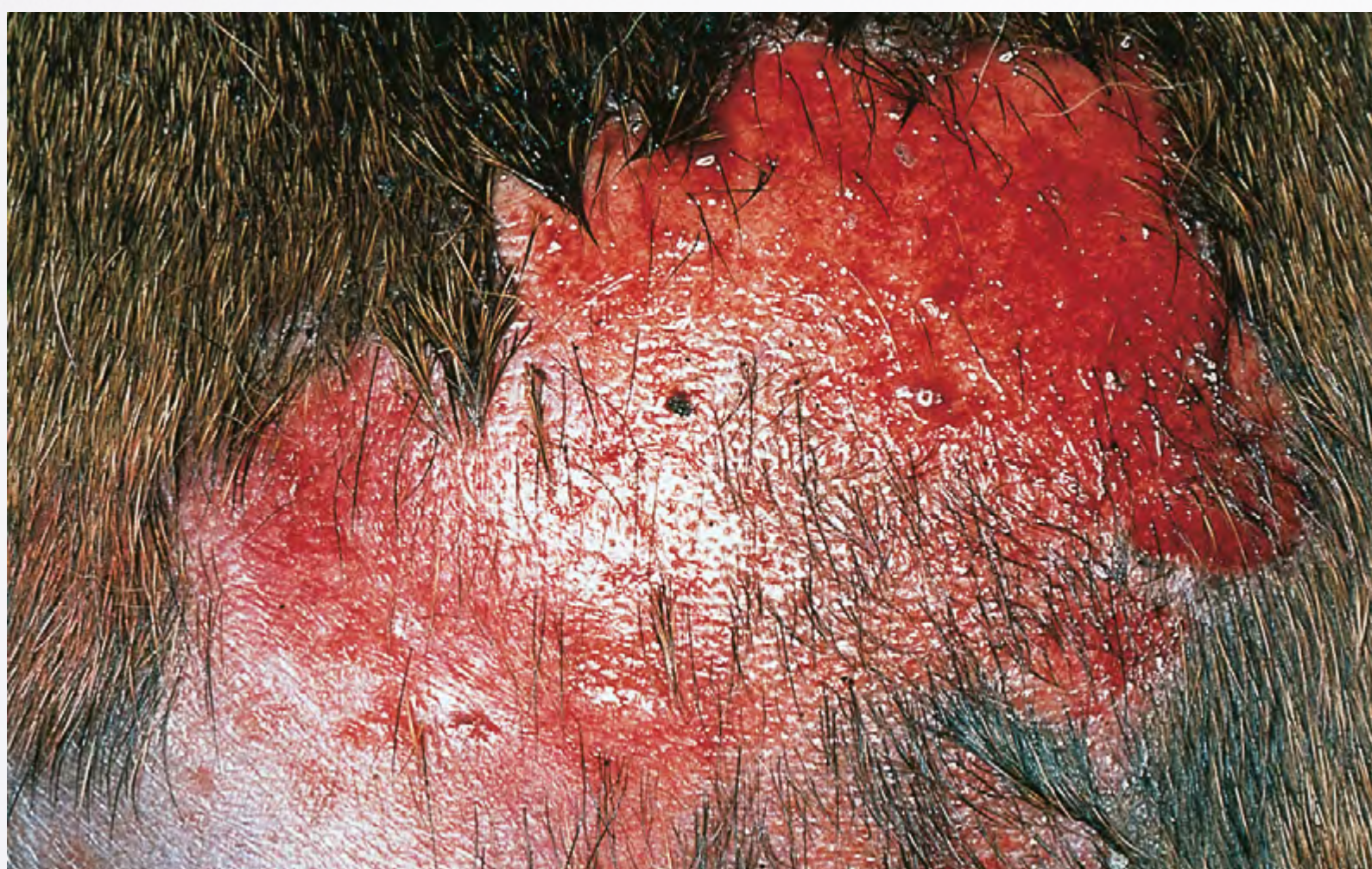
CLINICAL FEATURES



Scales. Courtesy of: D.N. Carlotti



Excoriations. Courtesy of: D.N. Carlotti



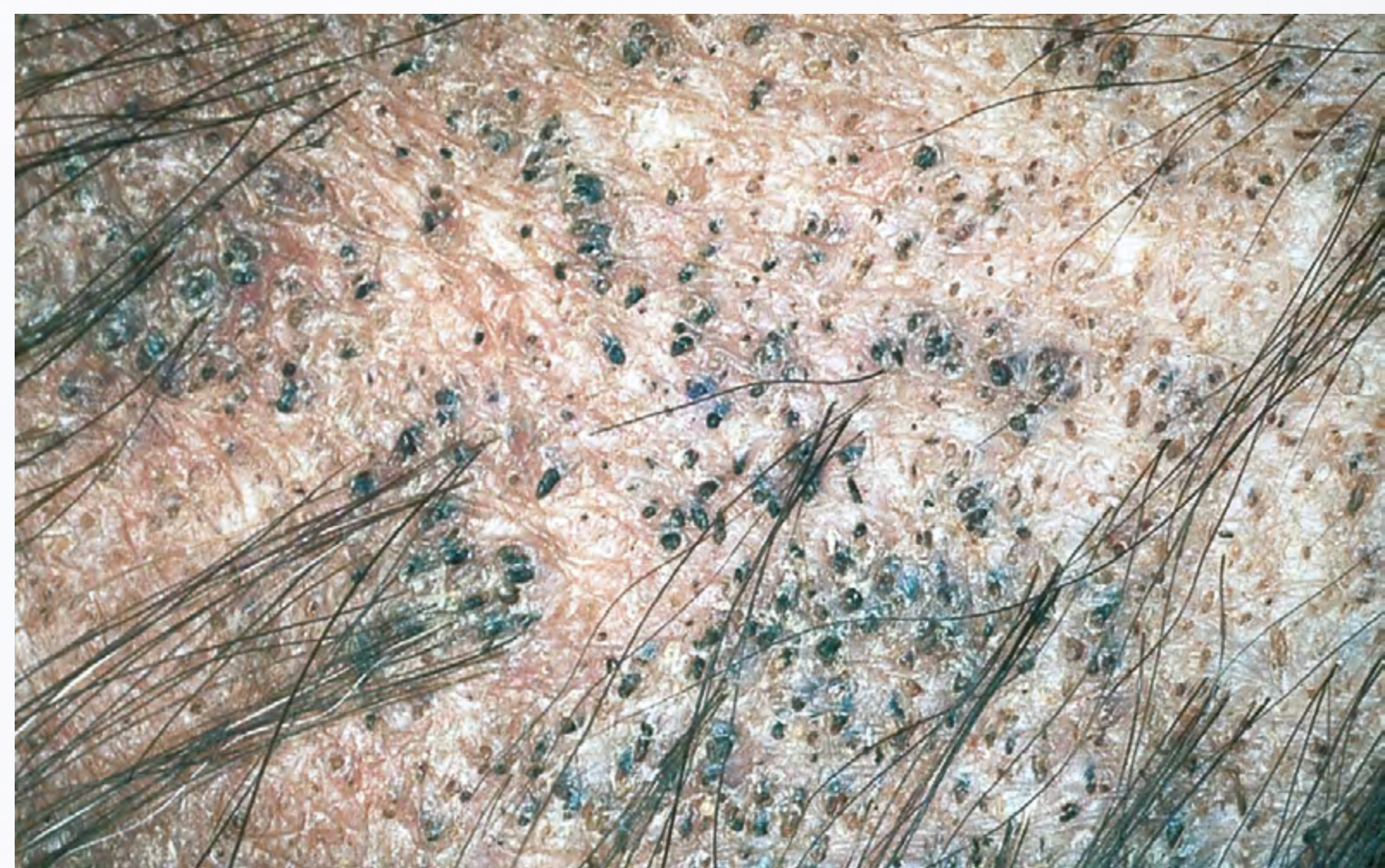
Erosions. Courtesy of: D.N. Carlotti



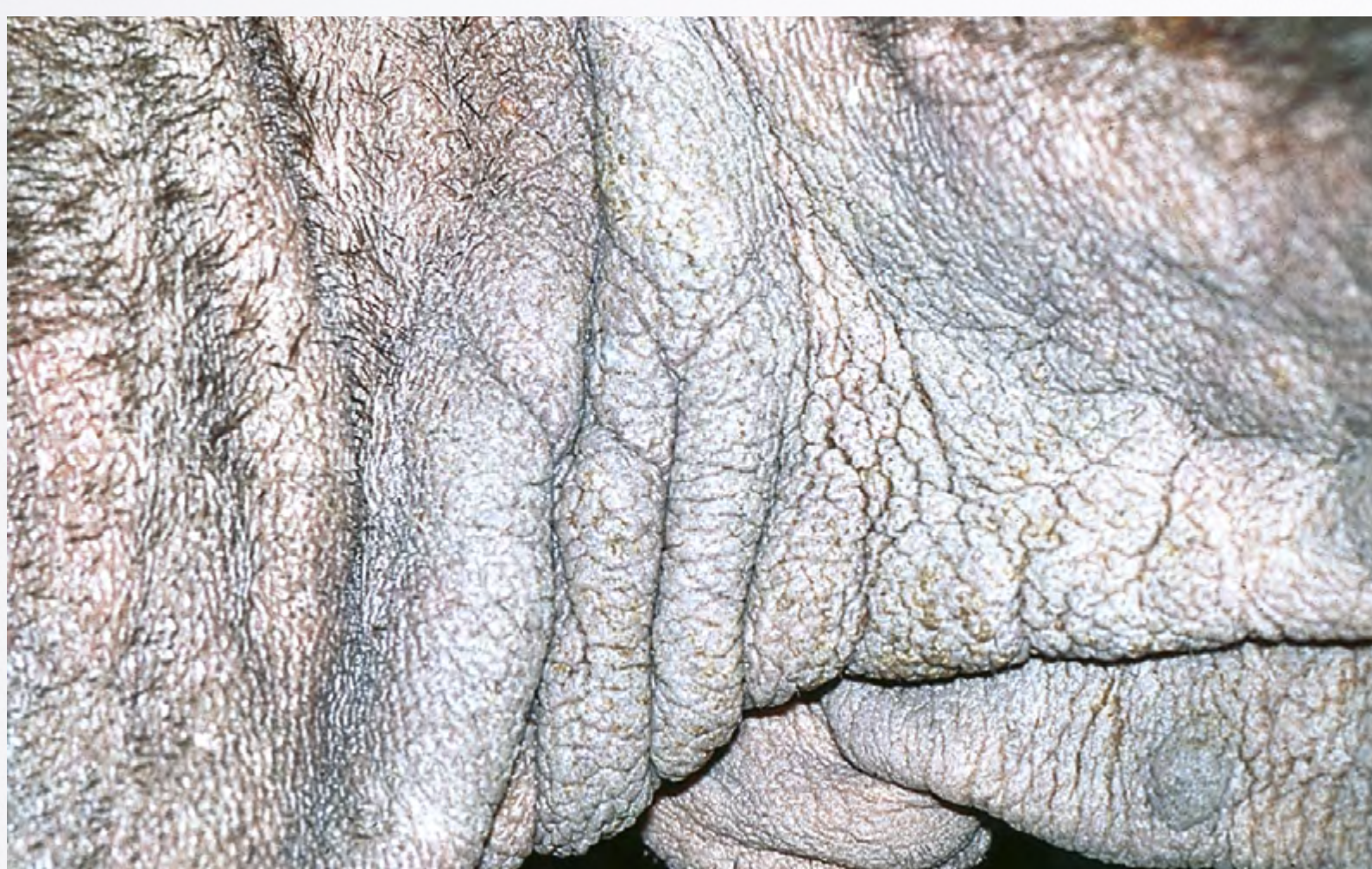
Ulcers. Courtesy of: D.N. Carlotti



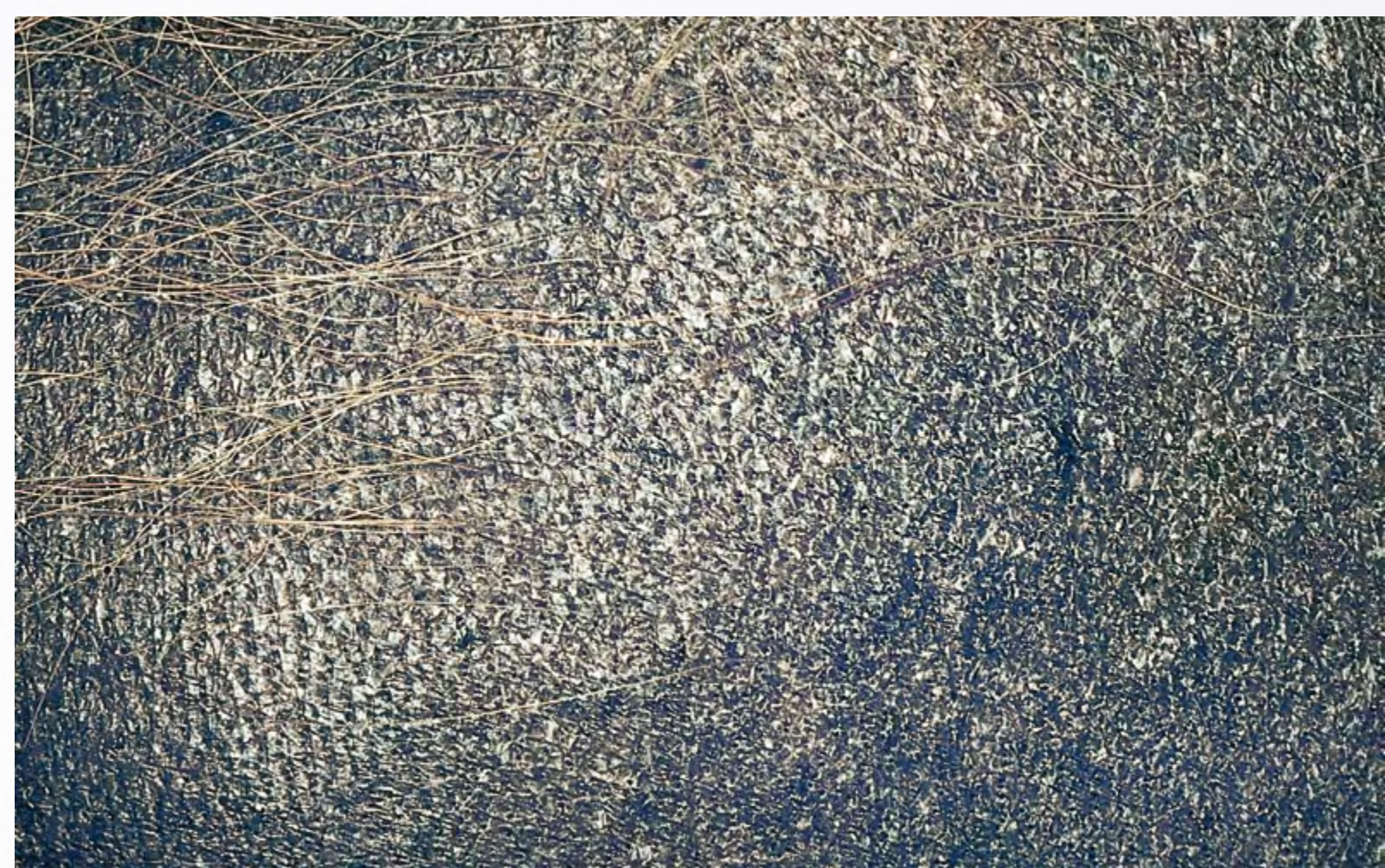
Follicular casts. Courtesy of: D.N. Carlotti



Comedones. Courtesy of: D.N. Carlotti



Lichenification / Hyperpigmentation. Courtesy of: D.N. Carlotti

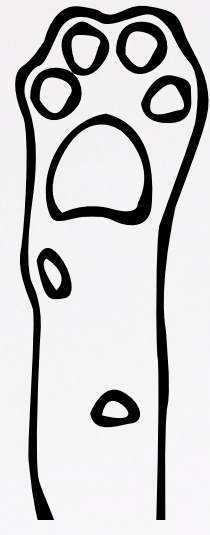


Alopecia. Courtesy of: D.N. Carlotti

SILHOUETTE



Right front side



Right front



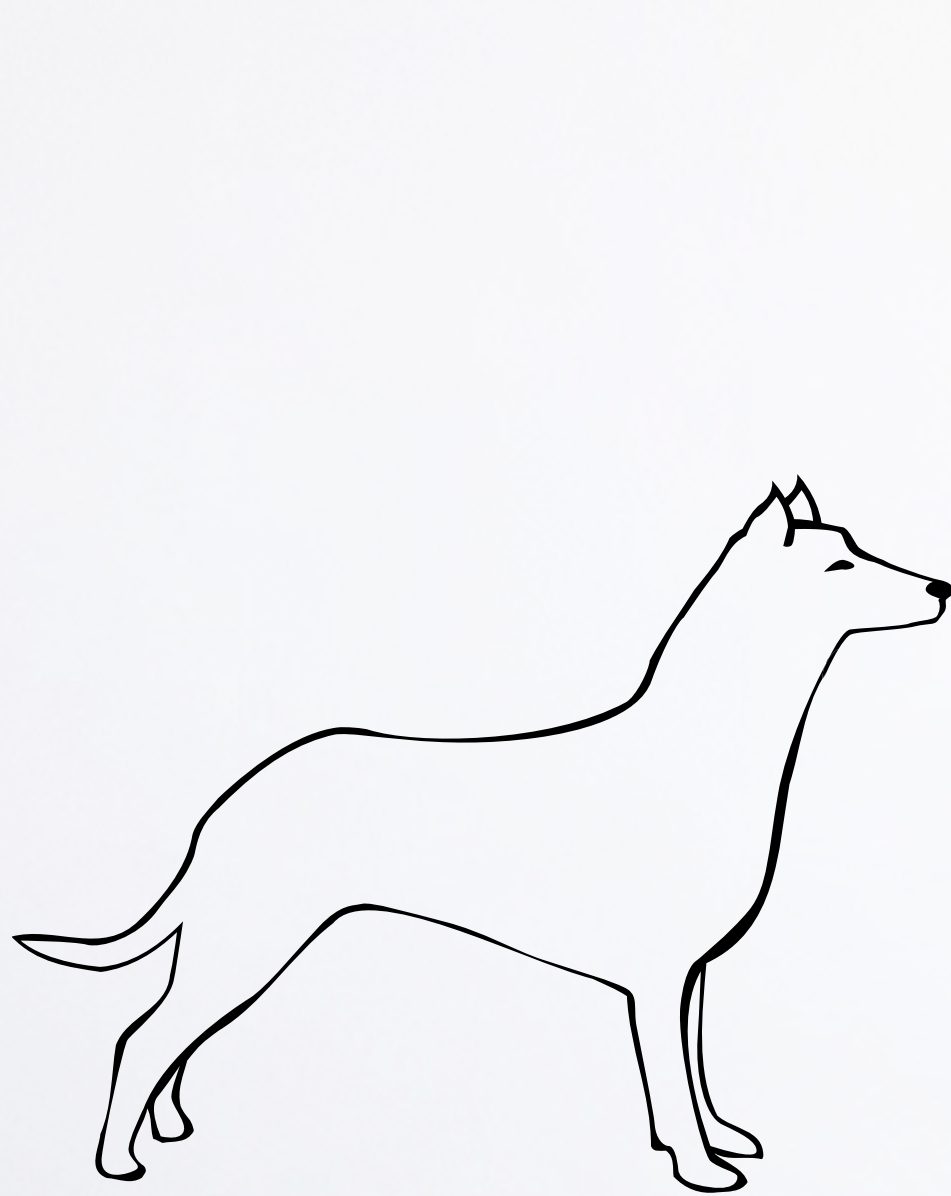
Left front



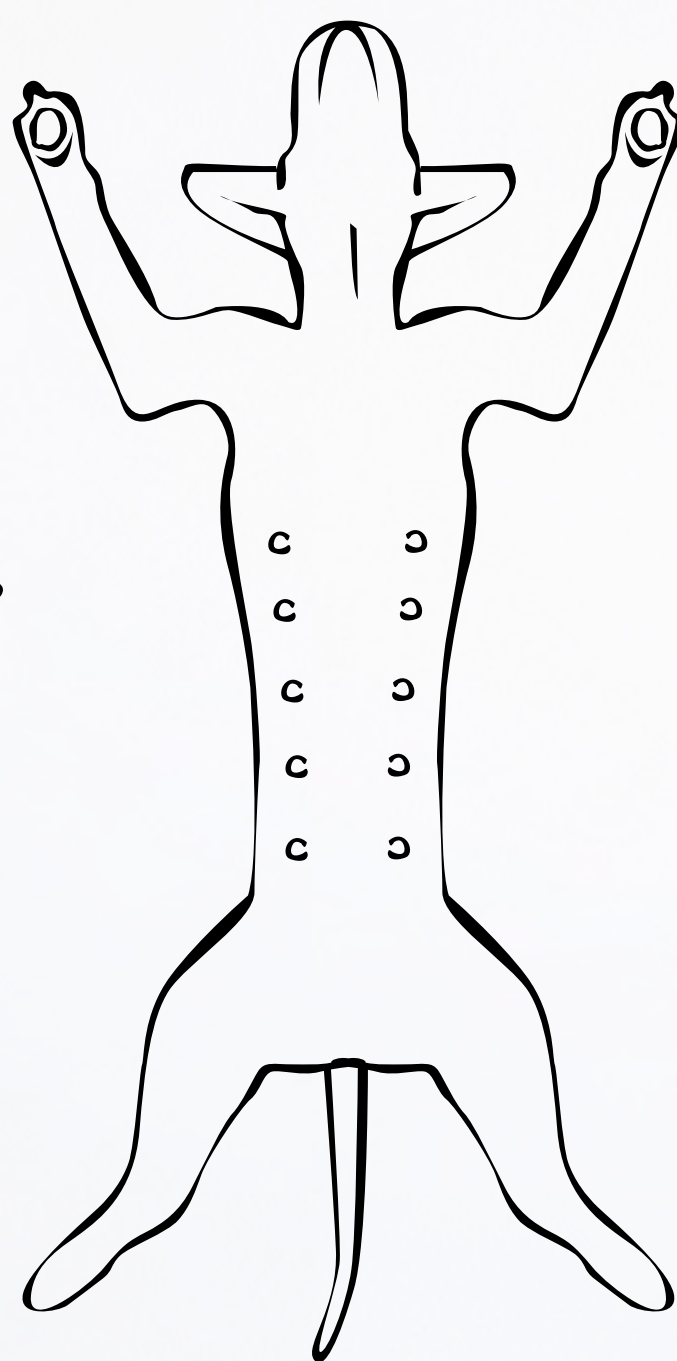
Right front



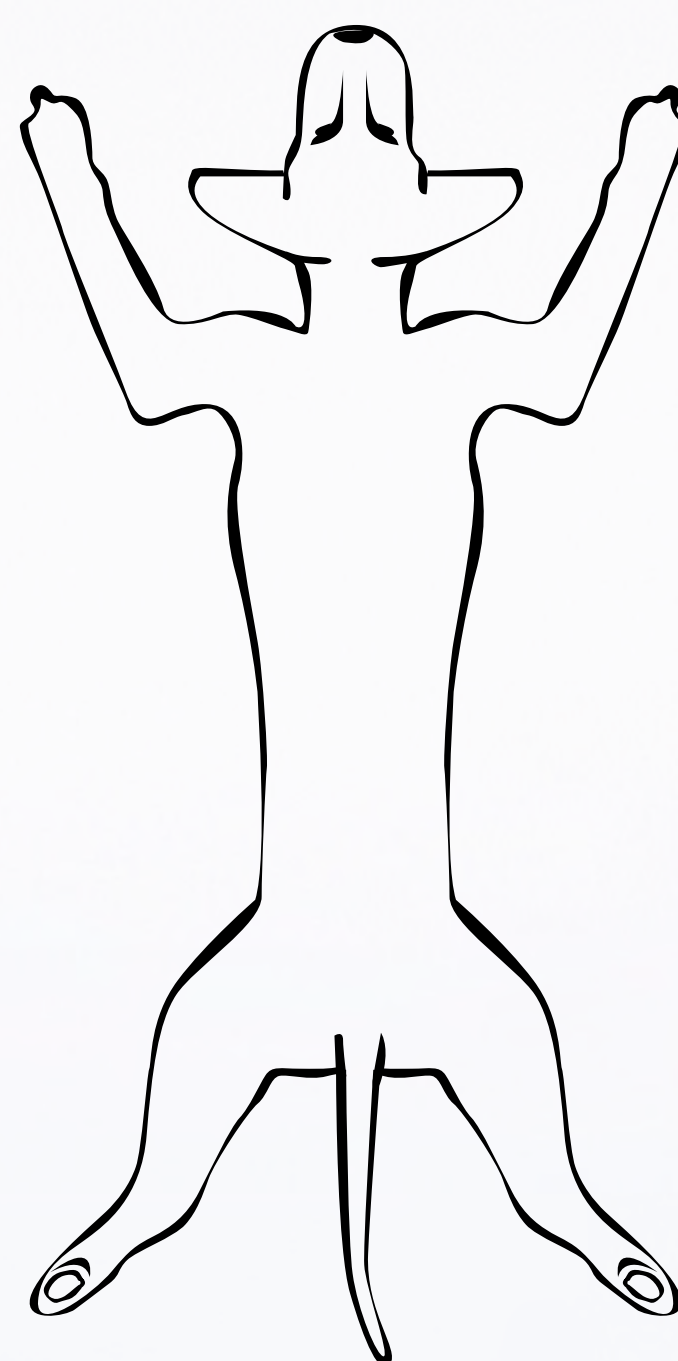
Left front side



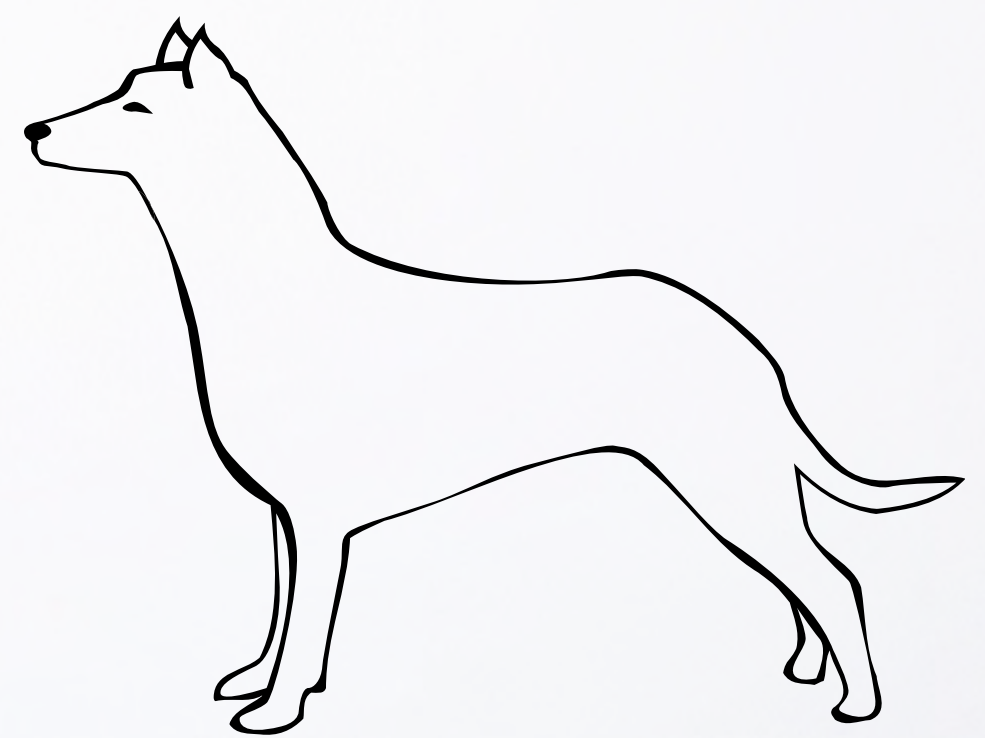
Right side



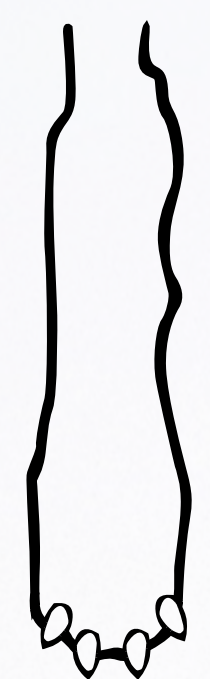
Under view



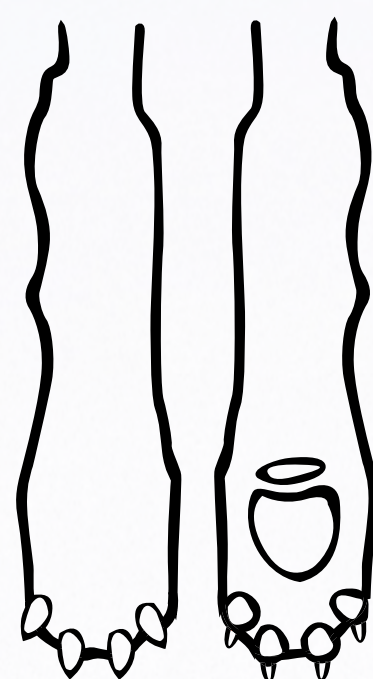
Upper view



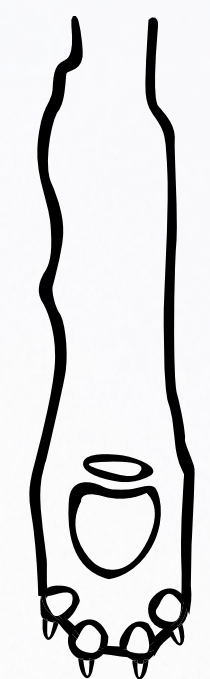
Left side



Right hind



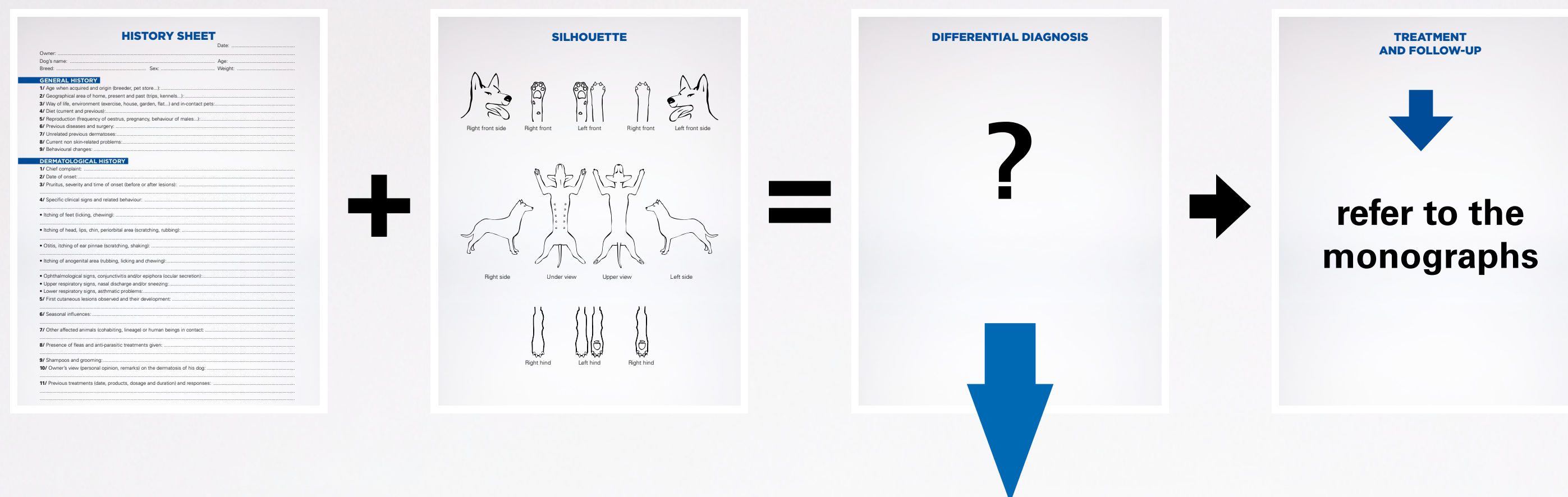
Left hind



Right hind

DIFFERENTIAL DIAGNOSIS FOR GROUPS OF RELATED DERMATOSES:

1. General approach



DIAGNOSTIC GROUPS OF RELATED DERMATOSES (see lists of the specific dermatoses)	SEQUENCE OF INVESTIGATION	PRIORITY IN THE LIST OF DIFFERENTIALS	TREATMENT	USEFULNESS OF HISTOPATHOLOGY
<p>GROUP 1a: Some primary dermatoses <i>Few and relatively uncommon.</i></p> <p>GROUP 1: Specific infectious and parasitic dermatoses</p> <p>GROUP 1b: Secondary dermatoses <i>Few but common. (occurring secondary to the primary dermatoses, essentially of group 2)</i></p>	<p>Always as a first step</p>	<ul style="list-style-type: none"> Eliminate these differentials definitively one by one, based on clinical criteria or on clinical pathology and/or therapeutic trials. More than one may be present at a time. 	<ul style="list-style-type: none"> Treat if one of these is present, with a rigorous follow-up. 	<p>Sometimes diagnostic. The clinical approach is essential.</p>
<p>GROUP 2: Commonest primary dermatoses <i>Few but very common. (very often associated with secondary dermatoses)</i></p>		<ul style="list-style-type: none"> Definitively eliminate the secondary dermatoses one by one, based on clinical criteria or on clinical pathology and/or therapeutic trials. More than one may be present at a time. 	<ul style="list-style-type: none"> Treat if one or several are present and consider a possible underlying dermatosis (of group 2) when analysing the signs remaining after treatment (especially pruritus). 	
<p>GROUP 3: Rare primary dermatoses <i>Many different dermatoses but rare.</i></p>	<p>Only as a second step</p> <p>At any time if suspected</p>	<ul style="list-style-type: none"> When all the dermatoses of group 1 have been eliminated from the list of differentials. When some signs persist after successful treatment of secondary dermatoses. When secondary dermatoses, successfully treated, reoccur. 	<ul style="list-style-type: none"> Treat if one of these is present and always check for the occurrence of secondary dermatoses. 	<p>Rarely diagnostic. May help the clinician to re-orientate his/her approach. The clinical approach is essential.</p>
		<ul style="list-style-type: none"> When an uncommon lesional picture is seen. When sudden and/or severe lesion development occurs. Rarer but generally more severe. 	<ul style="list-style-type: none"> Treat or control the rare primary dermatoses. If histopathology does not support such a diagnosis, re-evaluate your clinical approach and reconsider the group 1 and 2 diseases. 	<p>Diagnostic in the great majority of cases with good biopsies. Several to many skin biopsies are necessary.</p>

"All the diagnosed dermatoses can be treated at the same time, but all the suspected dermatoses have to be managed successively!"

2. Otitis externa

TYPE OF OTITIS EXTERNA	CLINICAL METHOD OF INVESTIGATION	PREVALENCE OF OTITIS AND ASSOCIATED DERMATOSES	
		Adult dog	Young dog
Otitis due to a Foreign Body (FBO)	Refer to the monograph	±	±
Parasitic Erythematous-Ceruminous Otitis (PECO)		±	+++
Non Parasitic Erythematous-Ceruminous Otitis (NPECO)	This method provides an accurate diagnosis for all types of otitis	+++	±
Suppurative Otitis (SO)		+	±
Associated dermatoses		+++ (group 2) ± (groups 1 and 3)	± (groups 1 and 3)

3. Dermatoses of adult dogs

DAILYDERMA™



SEQUENCE FOR THE DIFFERENTIAL DIAGNOSIS OF DERMATOSES IN ADULT DOGS

MORE LIKELY PRURITIC

MORE LIKELY ALOPECIC

1 ELIMINATE OR DIAGNOSE & TREAT PARASITES & INFECTIONS

PRIMARY DERMATOSES	SECONDARY DERMATOSES
<ul style="list-style-type: none"> • Sarcoptic mange <p>Sarcoptic mange: parasitic dermatitis due to <i>Sarcoptes scabiei</i></p> <ul style="list-style-type: none"> • Other ectoparasitoses • Intertrigo • Idiopathic folliculitis <p>Skin scrapings & visual exam for other parasites</p>	<p>COMMON AND VERY OFTEN SECONDARY TO ALLERGIES</p> <ul style="list-style-type: none"> • Folliculitis • <i>Malassezia</i> dermatitis • Exfoliative superficial pyoderma (epidermal collarettes) • Hot spot <p>Cytology smears on surface or on pustules</p> <p>Follicular pustule - Ex. bacterial folliculitis</p> <p>Malassezia dermatitis</p> <p>Mast cells • Lymphocytes • Neutrophils • Eosinophils • <i>Staphylococcus pseudintermedius</i></p>
<ul style="list-style-type: none"> • Dermatophytosis Idiopathic demodicosis 	<p>LESS COMMON AND VERY OFTEN SECONDARY TO ENDOCRINE DISORDERS</p> <ul style="list-style-type: none"> • (Pyo)Demodicosis • Deep Pyoderma

2 ONLY when step 1 completed & if still clinical signs PROCEED to differential diagnosis of ALLERGIES OR ENDOCRINE DISORDERS

IF PRURITUS or if it persists after cure of a secondary dermatosis or if it reappears after antipruritic drugs withdrawal	IF NO PRURITUS or if it has disappeared after treatment of secondary dermatoses
<p>FLEA ALLERGY DERMATITIS (FAD) FOOD ALLERGY (FA)</p> <p>Perfect flea control Therapeutic trial Elimination diet trial</p> <p>Dermal papule - Ex. Flea Allergy Dermatitis</p> <p>ATOPIC DERMATITIS (AD)</p> <ul style="list-style-type: none"> • Contact dermatitis by irritation or hypersensitivity • Other insect bite hypersensitivity <p>«Canine Atopic Dermatitis is the pruritic skin disease of which the dog is affected, when he is not, or no longer, affected by another one.»</p> <p>Atopic dermatitis: allergy to environmental allergens (<i>Dermatophagoides farinae</i> - house dust mites)</p>	<p>BEWARE</p> <p>of the previous use of corticosteroids or any other antipruritic drugs Investigate an ICS and/or wait for withdrawal if there is no real urgency</p> <p>IATROGENIC CUSHING'S SYNDROME (ICS) SPONTANEOUS CUSHING'S SYNDROME (SCS)</p> <p>Alopecia and skin atrophy - Ex. Cushing's syndrome</p> <p>HYPOTHYROIDISM OTHER ENDOCRINE DISORDERS</p> <p>Keratoseborrheic disorder with alopecia - Ex. Hypothyroidism</p>

AT ANYTIME

THINK to the likelihood of a RARE primary dermatosis
Particularly if unusual aspect or severity and/or rapid evolution

Autoimmune dermatoses / Neoplasia / Impetigo / Leishmaniasis should be considered in group 1 in enzootic areas / Cutaneous drug reactions / Sebaceous adenitis / Sterile nodular panniculitis / Many other dermatoses

Biopsy

DAILYDERMA™



SEQUENCE FOR THE DIFFERENTIAL DIAGNOSIS OF DERMATOSES IN **YOUNG DOGS**


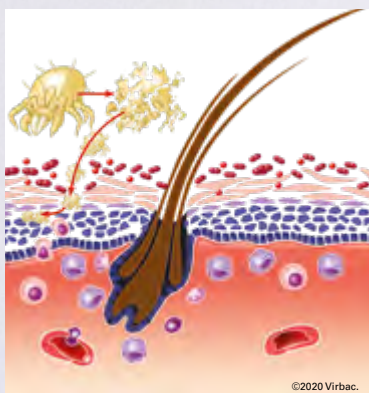
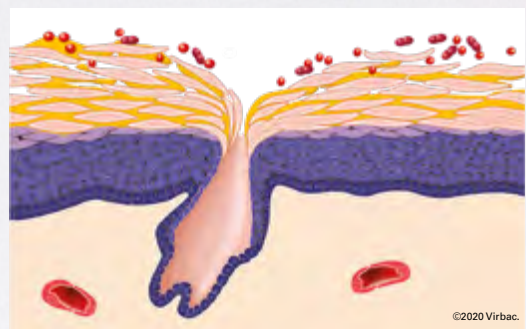
MORE LIKELY **PRURITIC**


MORE LIKELY **ALOPECIC**

1 ELIMINATE OR DIAGNOSE & TREAT **PARASITES & INFECTIONS**

PRIMARY DERMATOSES	SECONDARY DERMATOSES
<ul style="list-style-type: none"> • Sarcoptic mange  <p>Sarcoptic mange: parasitic dermatitis due to <i>Sarcoptes scabiei</i></p> <p>Neutrophils, Eosinophils, Staphylococcus pseudintermedius</p> <p>Skin scrapings & visual exam for other parasites</p> <ul style="list-style-type: none"> • Other ectoparasitoses • Intertrigo • Impetigo • Folliculitis 	<p>Very common in adults, should be rare in young dogs as underlying primary dermatoses (allergies and endocrine disorders) should be rare too in young dogs (immature immune and endocrine systems)</p> <p>Refer to the adult dogs table when in doubt</p>
<ul style="list-style-type: none"> • Dermatophytosis • Demodicosis 	

2 ONLY when step 1 completed & if still clinical signs PROCEED to differential diagnosis of **ALLERGIES** OR **ENDOCRINE DISORDERS**


IF PRURITUS or if it persists after cure of a secondary dermatosis or if it reappears after antipruritic drugs withdrawal	IF NO PRURITUS or if it has disappeared after treatment of secondary dermatoses
<ul style="list-style-type: none"> • FLEA ALLERGY DERMATITIS (FAD) • FOOD ALLERGY (FA) <p>«maybe not so rare»</p>  <p>Dermal papule - Ex. Flea Allergy Dermatitis</p> <p>Perfect flea control Therapeutic trial Elimination diet trial</p> <p>Neutrophils, Lymphocytes, Eosinophils, Staphylococcus pseudintermedius</p> <ul style="list-style-type: none"> • ATOPIC DERMATITIS (AD) <ul style="list-style-type: none"> • Contac dermatitis by irritation or hypersensitivity • Other insect bite hypersensitivity  <p>Atopic dermatitis: allergy to environmental allergens (Dermatophagoides farinae - house dust mites)</p> <p>«Canine Atopic Dermatitis is the pruritic skin disease of which the dog is affected, when he is not, or no longer, affected by another one.»</p> <p>Neutrophils, Lymphocytes, Eosinophils, Staphylococcus pseudintermedius, Malassezia pachydermatis</p>	<ul style="list-style-type: none"> • HYPOTHYROIDISM (very rare) • OTHER ENDOCRINE DISORDERS  <p>Keratoseborrheic disorder with alopecia - Ex. Hypothyroidism</p>



AT ANYTIME

THINK to the likelihood of a RARE primary dermatosis
Particularly if unusual aspect or severity and/or rapid evolution

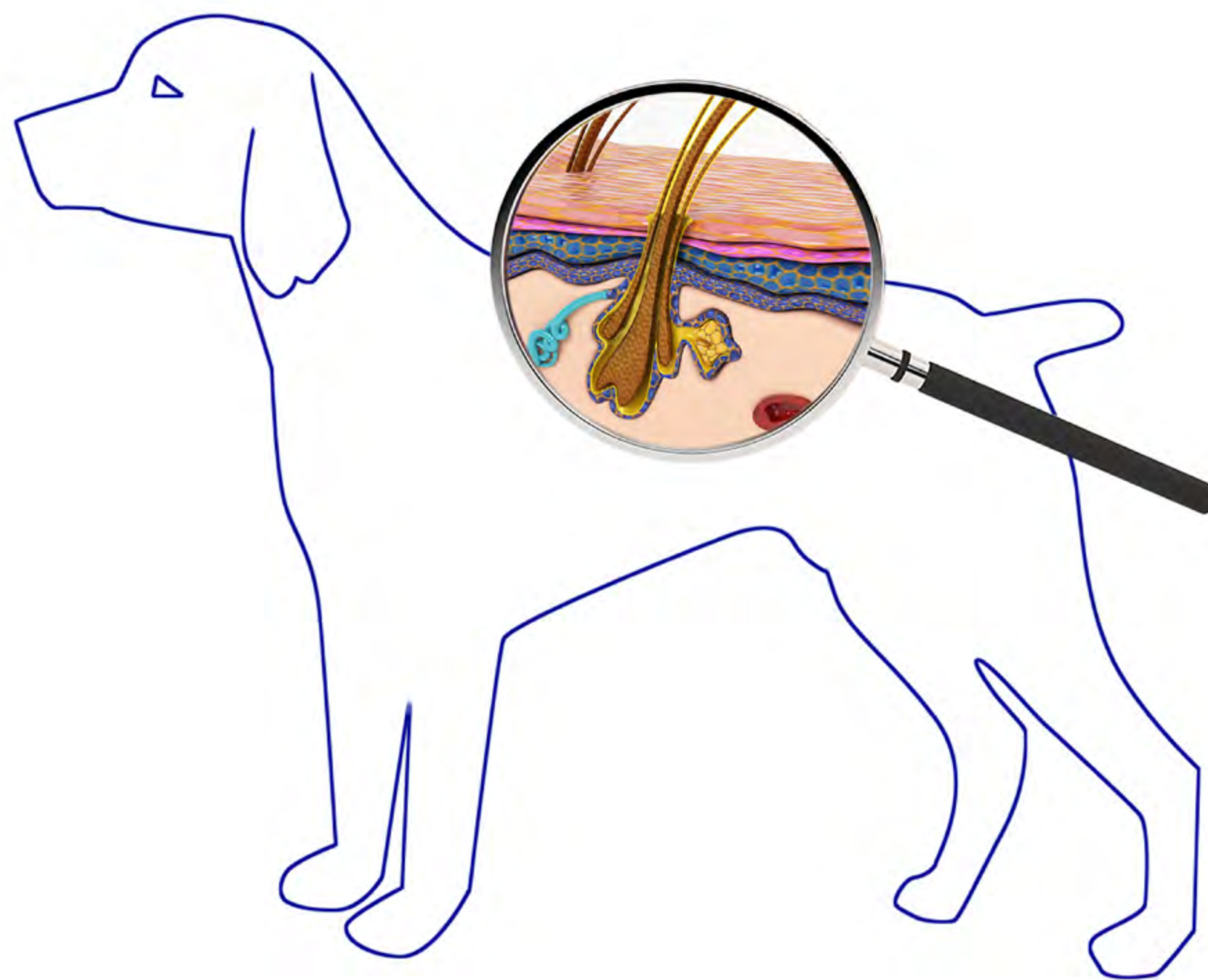
Genodermatoses / Juvenile cellulitis / Cutaneous drug reactions
Leishmaniasis should be considered in group 1 in enzootic areas & many other dermatoses



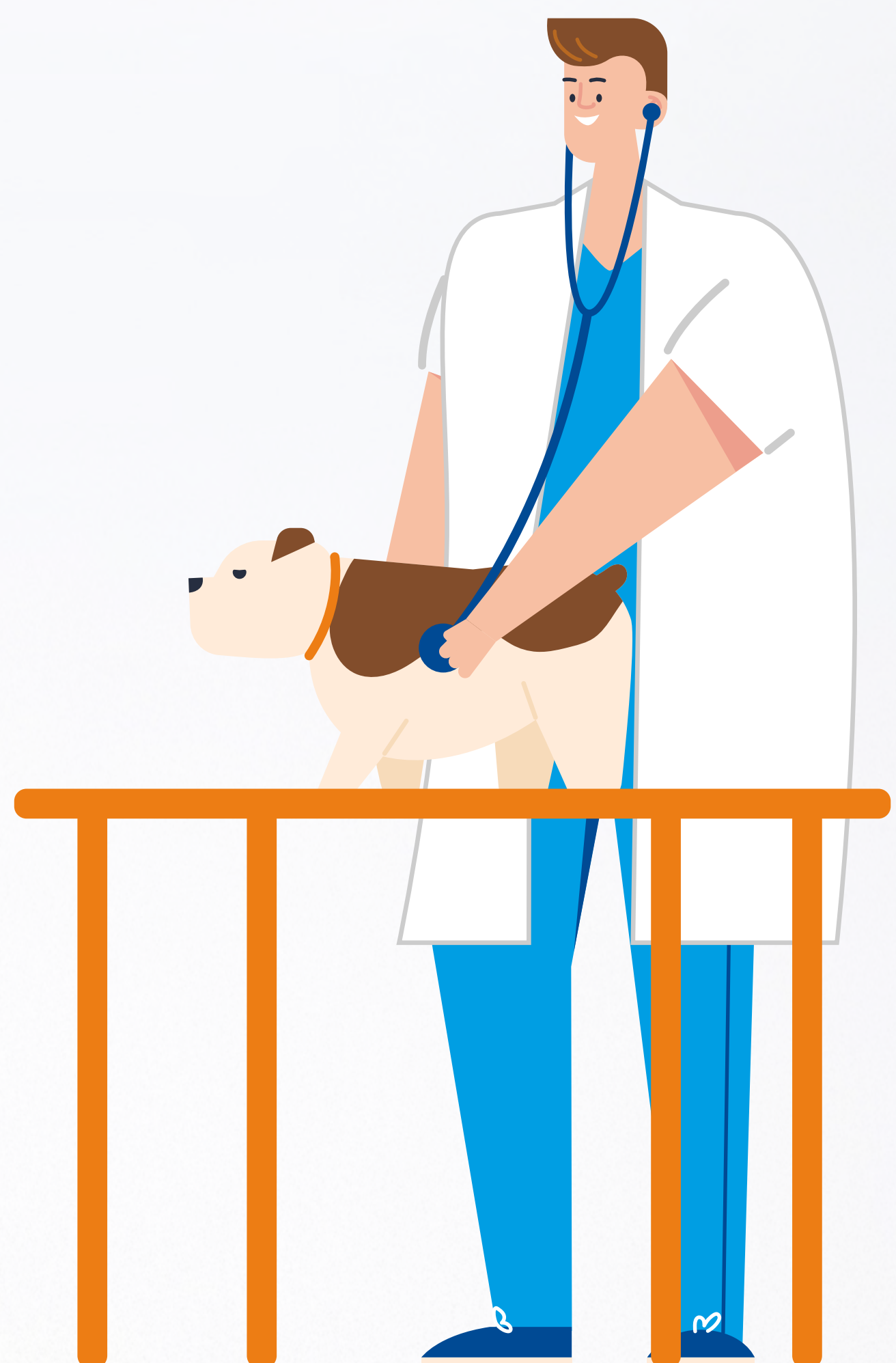
Biopsy

Part. 2

Monographs of the major **canine** **dermatoses**



Clinical Handbook
on **Canine Dermatology**
Fourth Edition



DERMATOPHYTOSIS

INTRODUCTION / DEFINITION

- ▶ **Infection** of the **hair, claw** or **stratum corneum** by **filamentous fungi belonging to the dermatophytes** and normally involving species of the genera ***Microsporum*** and ***Trichophyton***.
- ▶ **Infection almost always affects the hair follicles** leading to **crusting** and **hair loss**. ***Microsporum persicolor*** infects the **stratum corneum** and not the hair shaft. *Trichophyton* species can also infect the SC, for example in pustular dermatophytosis.
- ▶ Affected animals usually recover spontaneously after a period of several weeks but **chronic infection may occur**.
- ▶ The **disease is zoonotic**.
- ▶ **Dermatophytosis in dogs is not very common but clinical signs are highly variable and this disease is one of the major primary infectious dermatoses that have to be investigated as a first step in the diagnostic procedure if clinical signs or the history are suggestive.**



Dog affected by dermatophytosis. *Microsporum canis*. Courtesy of: T. Olivry



Dog affected by dermatophytosis. *Microsporum canis*. Courtesy of: T. Olivry

AETIOLOGY / PATHOGENESIS

- ▶ **Aetiology.**
 - The **dermatophytes** are classified by their **principal habitats** into three groups. **Geophilic** species persist as saprophytes in soil whereas the **zoophilic** species live principally on animals (Table 1). **Anthropophilic** species are those which normally affect man.
 - In dogs, species of the genera *Microsporum* and *Trichophyton* cause nearly all cases of dermatophytosis.

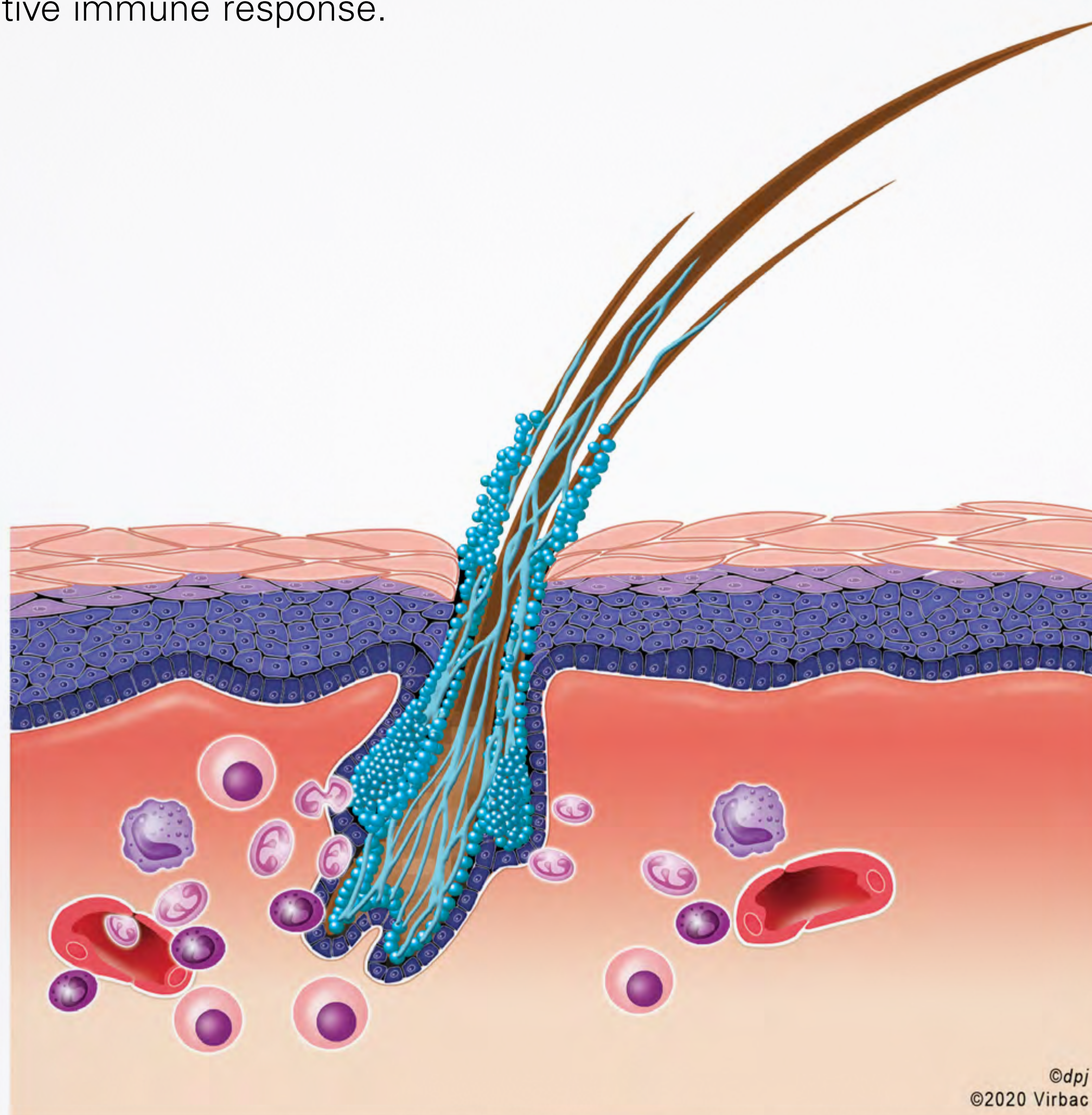
Table 1. Principal Veterinary Dermatophyte Species, their Hosts and Habitat.

GENUS	SPECIES	HOSTS	HABITAT
<i>Microsporum</i>	<i>canis</i>	cat, dog, horse, rodents, man	zoophilic
	<i>equinum</i>	horse, cat, dog	zoophilic
	<i>gypseum</i>	dog, cat, horse, man	geophilic
	<i>nanum</i>	pig, man	zoophilic
<i>Trichophyton</i>	<i>persicolor</i>	dog, cat, rodents	zoophilic
	<i>equinum</i>	horse, dog, cat, man	zoophilic
	<i>erinacei</i>	hedgehog, dog, cat, man	zoophilic
	<i>mentagrophytes</i>	cat, dog, rodents, man	zoophilic
	<i>verrucosum</i>	cattle, sheep, man	zoophilic

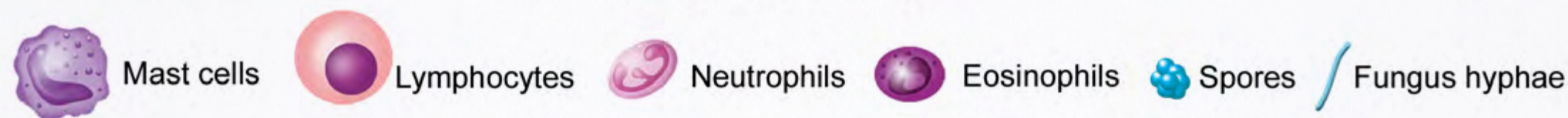
- ***Microsporum*:**
 - ***M. canis*** is responsible for the great majority of canine infections.
 - As a **geophilic species, *M. gypseum***, is influenced by soil conditions and the prevalence of infection with this dermatophyte varies in different regions.
 - ***M. persicolor*** is more **difficult to diagnose** as it **infects the stratum corneum** rather than the hair shaft.
 - Infection with *M. equinum* and *M. nanum* is rarely diagnosed.
- ***Trichophyton*:**
 - About **30% of dermatophyte infections** are caused by ***T. mentagrophytes***.
 - Infection with the other *Trichophyton* species is uncommon to rare in dogs.

► Pathogenesis.

- **Dermatophyte infections** are **acquired by contact with** dermatophyte **arthrospores** derived **from infected animals, soil or fomites**.
- Following **adherence of the arthrospores** to cells of the stratum corneum, **germination** occurs with **production of hyphae**, which **invade the *stratum corneum*** aided by the secretion of multiple enzymes such as keratinases.
- **Penetration of anagen hair shafts** then occurs with invasion extending **through the hair shaft (endothrix invasion)** as far as the new keratin at the base of the hair but not into the mitotically active hair matrix.
- Invasion ceases when hairs enter the telogen growth phase.
- **Following hyphal invasion** of the hair shaft, masses of infective **spherical arthrospores** are **formed** on the **surface of the hairs (ectothrix production)**.
- Invasion provokes an **inflammatory response** and, under normal circumstances, this leads to resolution of the disease within 1-3 months. **Chronic infection** occurs when the host is unable to generate a curative immune response.



Dermatophytosis: ringworm due to *Microsporum canis*
(fungal folliculitis)



Courtesy of: P. Jasmin



Dermatophytosis due to *Microsporum canis*.
Courtesy of: T. Olivry



Dermatophytosis due to *Microsporum canis*. Closer view.
Courtesy of: T. Olivry

EPIDEMIOLOGY

- ▶ **Infective forms** of dermatophytes are **derived** either **from soil** (*M. gypseum* infection) **or from animals**.
- ▶ Potential **animal sources** are **listed in Table 1**.
- ▶ **The commonest source of *M. canis* is infected cats**, whereas ***Trichophyton spp.*** are often acquired from **wild rodent** carriers. Hedgehogs are a source of *T. erinacei*.
- ▶ *M. canis* spores in infected premises can remain viable for over 1 year.
- ▶ In some countries, **hunting dogs** are predisposed to ***M. gypseum*** and ***Trichopyton spp.*** infections.
- ▶ **Terriers**, which like to investigate areas inhabited by wild rodents, are predisposed to ***Trichophyton spp.*** infections.
- ▶ ***M. persicolor*** is most often associated with wood mice and bank voles but canine infection may be acquired from **domestic rabbits**.
- ▶ **The disease is most often diagnosed in young dogs (animals less than one year old)**, presumably because of their less efficient immune system.
- ▶ Older animals are less susceptible and, if previously exposed to dermatophytes, may have developed immunity.
- ▶ **Cats may develop a carrier status in the absence of clinically apparent lesions and represent an insidious source of contamination for dogs.**



Cat affected by dermatophytosis. *Microsporum canis*.
Courtesy of: D.N. Carlotti



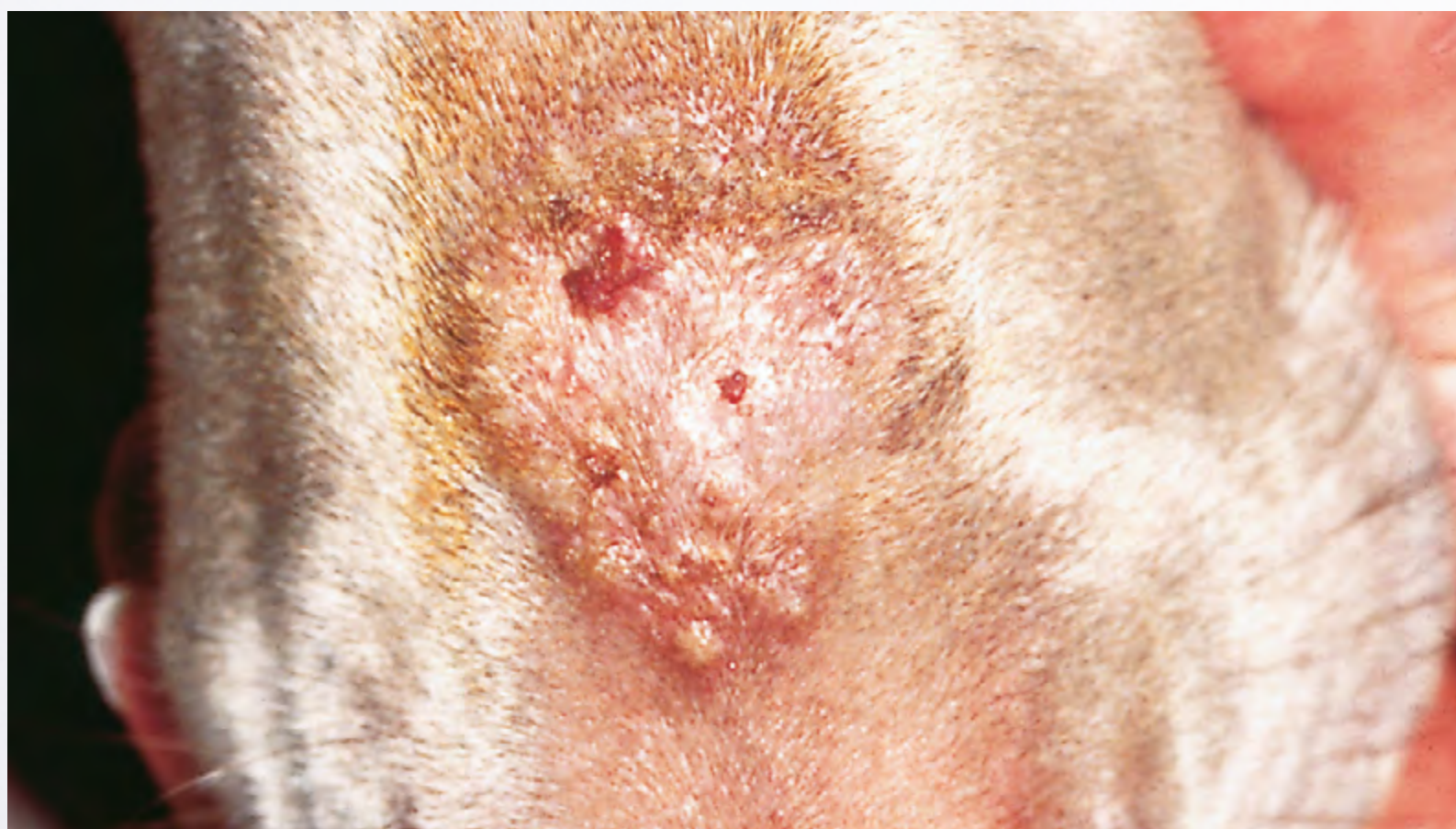
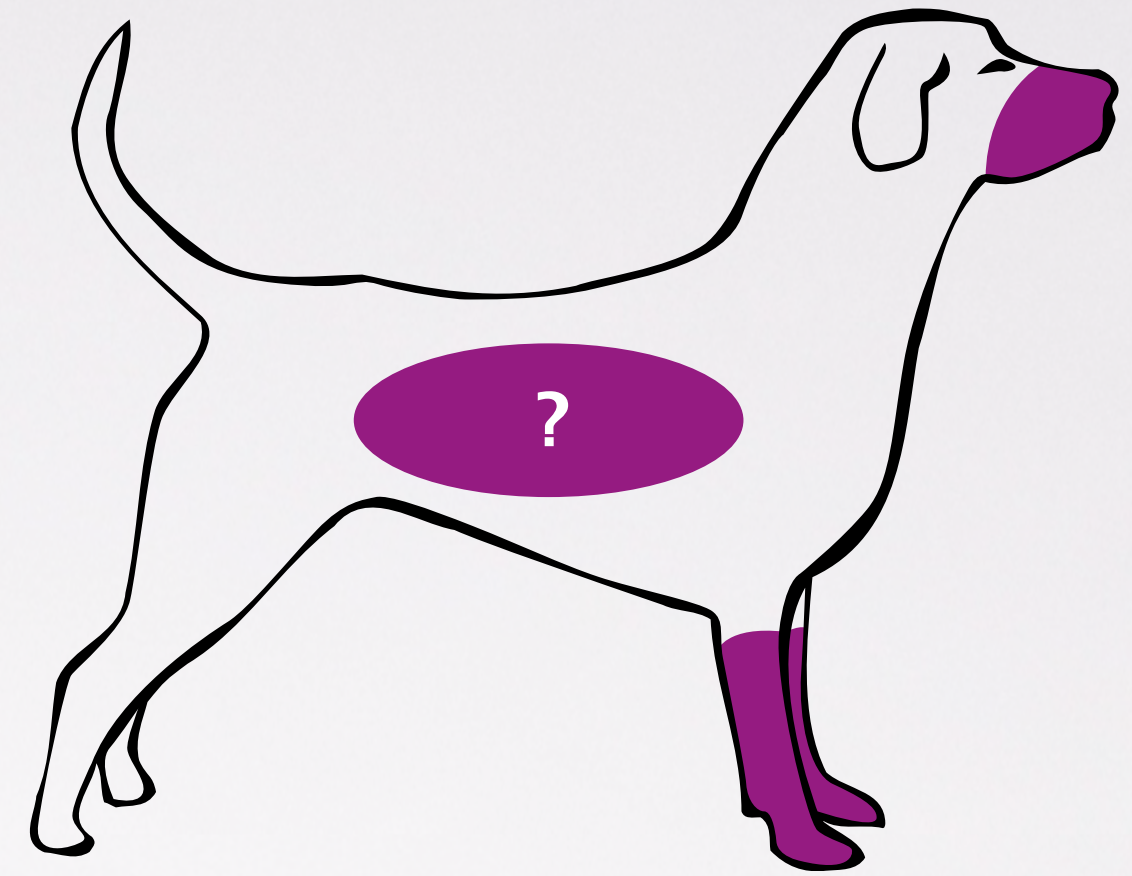
Dog affected by dermatophytosis. *Trichophyton mentagrophytes*.
Courtesy of: D.N. Carlotti



Dog affected by dermatophytosis. *Trichophyton mentagrophytes*.
Courtesy of: D.N. Carlotti

CLINICAL SIGNS

- ▶ Signs can be **very variable and diagnostically misleading**. For example: circular crusting lesions (as in human dermatophytosis) are caused by other common diseases e.g. **exfoliative superficial pyoderma**; in contrast diffuse scaling and crusting with pruritus suggestive of **allergy** may be caused by dermatophytosis.
- ▶ **Typical dermatophytosis.**
 - **Focal or multifocal** areas of **alopecia** including **broken hairs at the periphery**, which **extend centrifugally** and **may heal centrally**.
 - **Take care to differentiate these from the epidermal collarettes of superficial pyoderma.**
 - Pruritus may be variable, typically low to absent.
- ▶ **Other lesions.**
 - **Folliculitis, furunculosis** and crusting, which may be well demarcated.
 - **Scaling** which may be quite **extensive** and may or may not have an erythematous margin.
 - Nodular, deep, inflammatory, suppurating lesions, also known as "**kerion**".
 - In the healing phase, lesions may be smooth and shiny, particularly with *Trichophyton* infections.
- ▶ **Onychomycosis:** infection of the claws may occur with or without evidence of claw bed inflammation (paronychia) and onychodystrophy.
- ▶ **Secondary bacterial infection**, particularly with staphylococci, **may occur very rarely**.



Dog affected by dermatophytosis. *Microsporum persicolor*.
Courtesy of: D.N. Carlotti



Dog affected by dermatophytosis. *Kerion*.
Courtesy of: T. Olivry



Dog affected by dermatophytosis. *Microsporum gypseum*.
Courtesy of: D.N. Carlotti



Dog affected by dermatophytosis. *Microsporum gypseum*.
Courtesy of: D.N. Carlotti

DIAGNOSIS

Clinical signs may not be diagnostic and thus **history**, indicating contact with infected animals or people, and **diagnostic tests** are of **prime importance**.

History.

- The disease is **more common in young dogs (animals less than 1 year old)**. Some dogs are more exposed (see epidemiology).
- There may be a history of **contact with pets**, particularly cats, or with **wild rodents. Humans** in contact may also have characteristic circular, alopecic, erythematous, scaling or crusting lesions.
- The disease is **generally progressive spreading from an initial site to other sites** or extending to form a single confluent lesion (typical of Trichophyton).

Clinical elements.

- **Focal alopecia, scaling lesions** with broken hairs at the periphery and **variable pruritus**.
- With **Trichophyton** lesions may be much more inflammatory with confluent progressive areas of **marked crusting and hair loss**.
- In **M. persicolor** infection, the hair shafts are not invaded and **broken hairs** are **not a feature** unless a consequence of self trauma.
- **Folliculitis, furunculosis, paronychia** and **onychodystrophy** may be present.

Major elements of history and clinical signs.

- History of **contact with infected animals**.
- Ringworm **lesions in humans, especially children**, in contact (typically M. canis infection).
- **Progressive, focal or multifocal alopecia with scaling**.

Major differentials.

- Owing to variable clinical signs, the possible differentials include a wide range of diseases.
- Consider crusting, scaling and alopecic diseases including cases of **bacterial folliculitis** and **furunculosis, hypersensitivities, demodicosis, autoimmune crusting diseases**, follicular dystrophy/dysplasia and sterile eosinophilic pustulosis (Ofugi's disease).

HISTORY SHEET

Date: _____

1/ Age: _____

2/ Name: _____ Sex: _____

Breed: _____ Age: _____ Weight: _____

GENERAL HISTORY

3/ Way of life, environment (exercise, house, garden, flat...) and in-contact pets:

4/ Previous diseases and surgery: _____

7/ Unrelated previous dermatoses: _____

8/ Current non skin-related problems: _____

9/ Behavioural changes: _____

DERMATOLOGICAL HISTORY

1/ Chief complaint: _____

2/ Date of onset: _____

3/ Pruritus, severity and time of onset (before or after lesions): _____

4/ Specific clinical signs and related behaviour:

• Itching of feet (licking, chewing): _____

• Itching of head, face, chin, periorbital area (scratching, rubbing): _____

5/ First cutaneous lesions observed and their development:

• Itching of anogenital area (rubbing, licking and chewing): _____

• Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretion): _____

• Upper respiratory signs, nasal discharge and/or sneezing: _____

• Lower respiratory signs, asthmatic problems: _____

6/ First cutaneous lesions observed and their development: _____

7/ Other affected animals (cohabiting, lineage) or human beings in contact:

8/ Shampoos and grooming: _____

9/ Owner's view (general opinion, remarks on the dermatosis of his dog): _____

10/ Previous treatments (date, products, dosage and duration) and responses: _____



Dog affected by dermatophytosis. *Microsporum canis*.
Courtesy of: D.N. Carlotti



Lesional aspect in a dog affected by dermatophytosis due to *Microsporum canis*. Courtesy of: S. White



Lesional aspect in a dog affected by a superficial pyoderma. Courtesy of: S. White

► **Complementary examinations.**

• **Wood's lamp:**

- ***M. canis* infected hairs** will **fluoresce** with a characteristic **apple green colour** in about **50% of cases**.
- **Only rare other dermatophyte** species **induce** this **fluorescence**.

**WOOD'S LAMP EXAMINATION :
MAXIMISING EFFICACY**

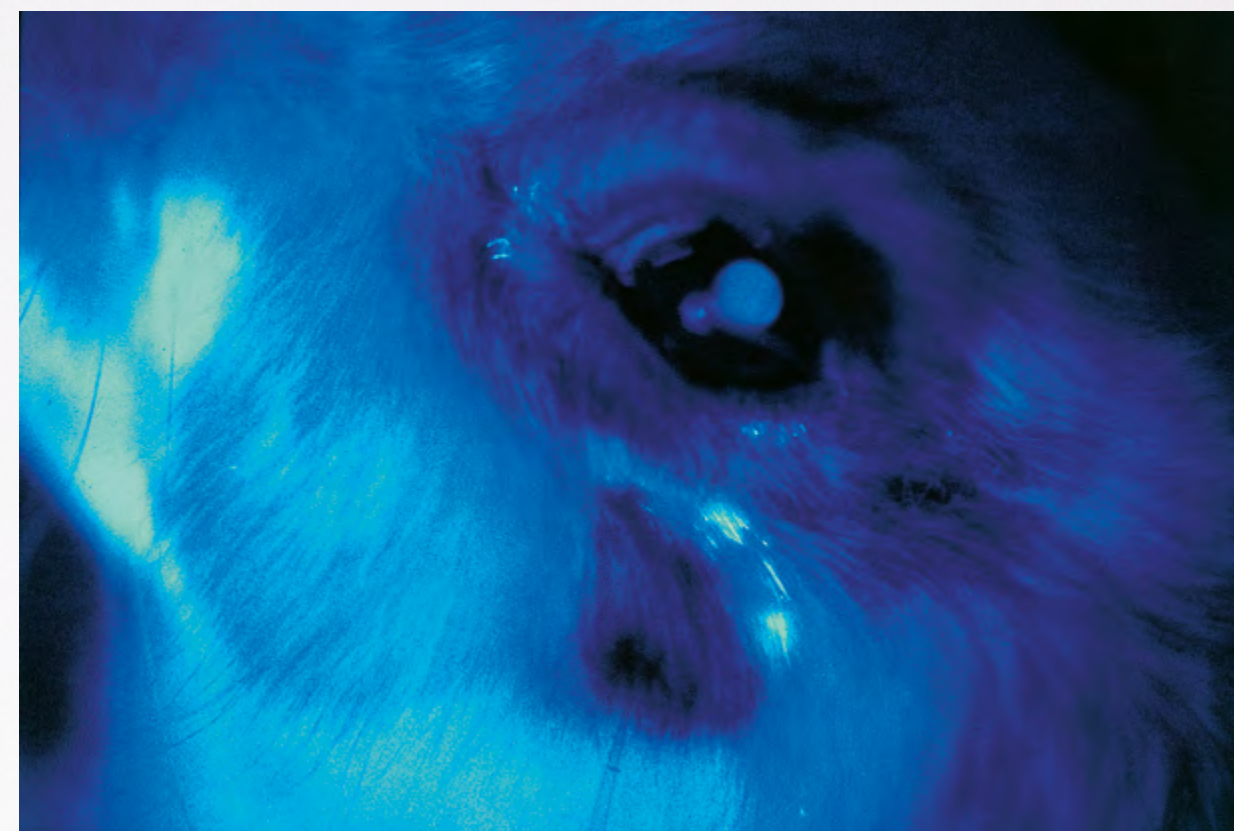
- Lamp should have a built-in lens to enable small broken hairs to be seen.
- Bulbs gradually lose their potency. Check function with known Wood's Lamp positive hair from time to time.
- Allow the lamp to warm up for a few minutes before use.
- Do the examination in a dark room.
- Allow your eyes to become accustomed to the dark if possible.
- Look for apple-green fluorescence associated with the hairs.
- Collect fluorescent hairs for subsequent microscopic or cultural examination.

• **Direct microscopic examination:**

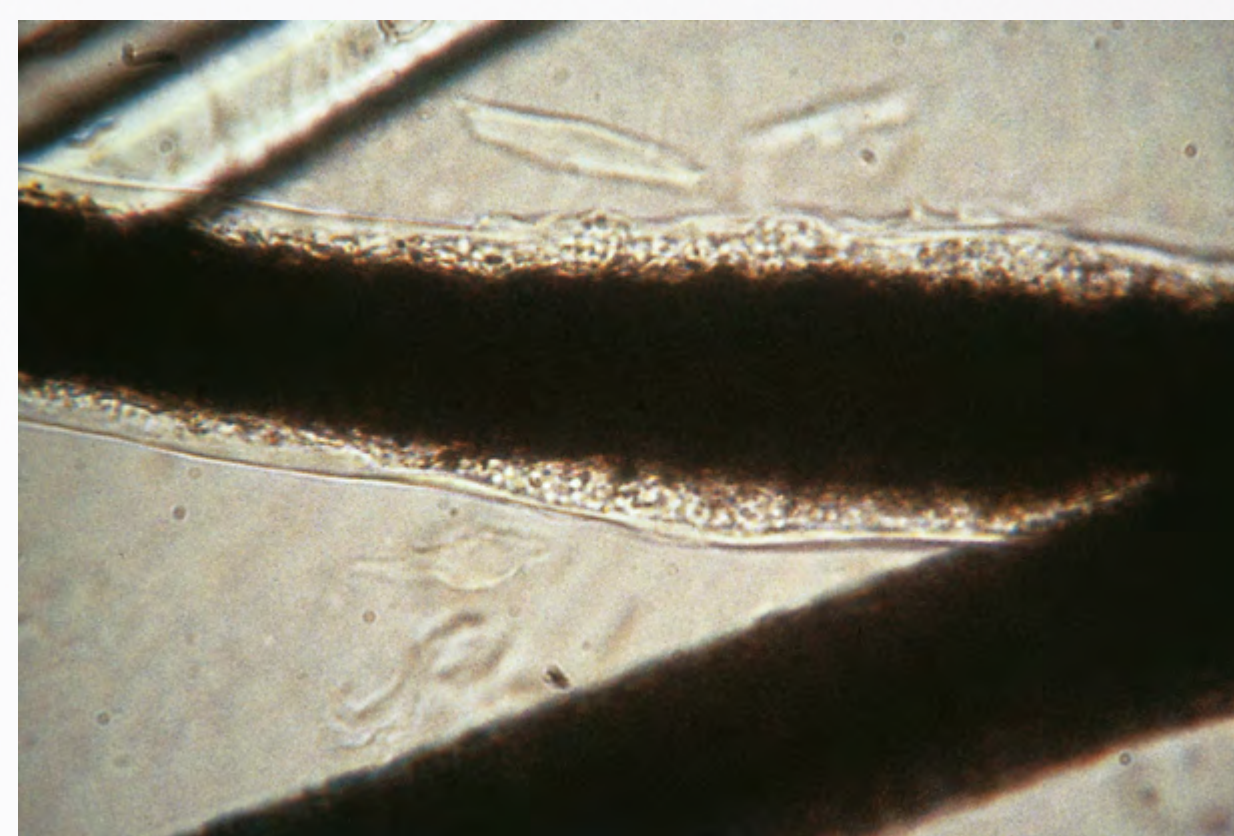
- Collect crusted and **broken hairs** or Wood's lamp positive material by hair plucking or skin scraping and suspend it in 10% KOH or in cotton **blue-lactophenol**, which **stains fungal elements blue**. Breaking up the crusts facilitates examination. Warm the slide gently to speed clearing with KOH. Apply a coverslip.
- Examine at **low power** (total magnification c. X20 – X40) and **look for hairs which are broken** or fragmented, or which appear to have a thin coating of material over the surface.
- Switch to **high power** (total magnification c. **X400-500**) and look for the spherical dermatophyte **arthrospores on the surfaces of the hairs**. You may also see **hyphae within the hairs** and corneocytes.

• **Cytology of smears:**

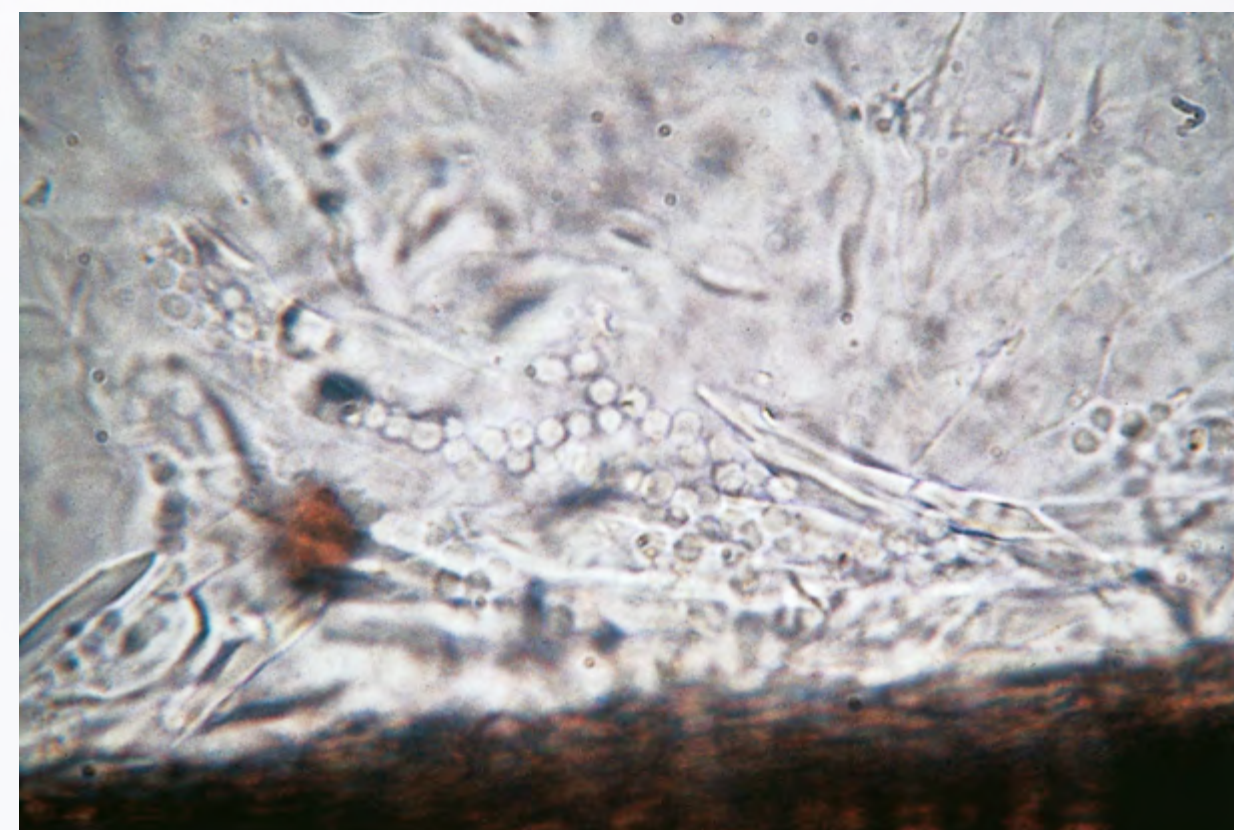
- Sometimes dermatophyte infection is associated with purulent lesions (**furuncles, especially in kerions**). Examination of stained smears (Diff-Quik, immersion: **X1000**) may indicate possible dermatophytosis (to see the procedure, refer to the monographs on pyodermas).
- Microscopic observation shows **non-degenerate neutrophils, macrophages** and sometimes **lymphocytes** and plasma cells, usually **without any bacteria**.



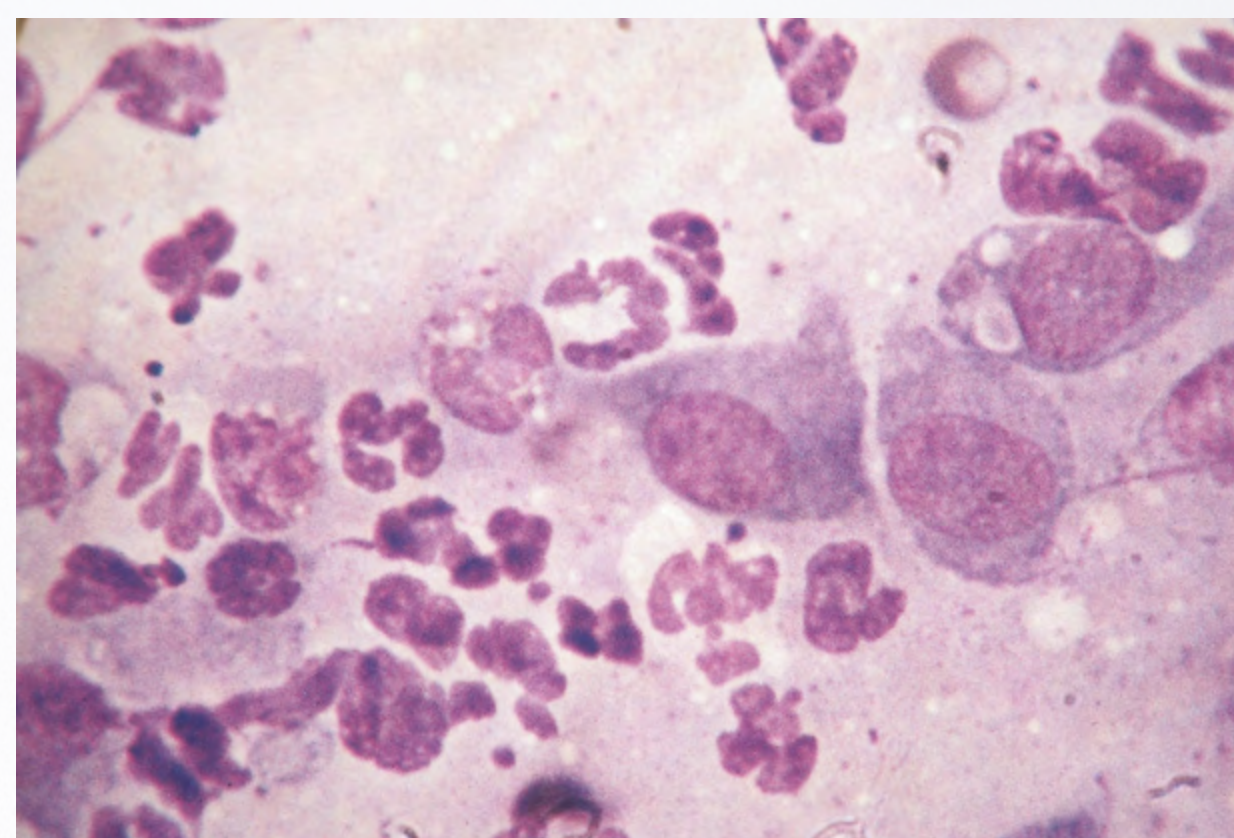
Wood's lamp examination: fluorescence of a hair infected by *Microsporum canis*. Courtesy of: D.N. Carlotti



Direct microscopic examination of a hair infected by *Microsporum canis* (x500). Courtesy of: D.N. Carlotti



Direct microscopic examination of a hair infected by *Microsporum gypseum* (x500). Courtesy of: D.N. Carlotti



Cytology of a smear of a pustule associated with a *Microsporum gypseum* infection: see non degenerate neutrophils, macrophages and lymphocytes. (Diff-Quik stain, x1000). Courtesy of: D.N. Carlotti

► Fungal culture:

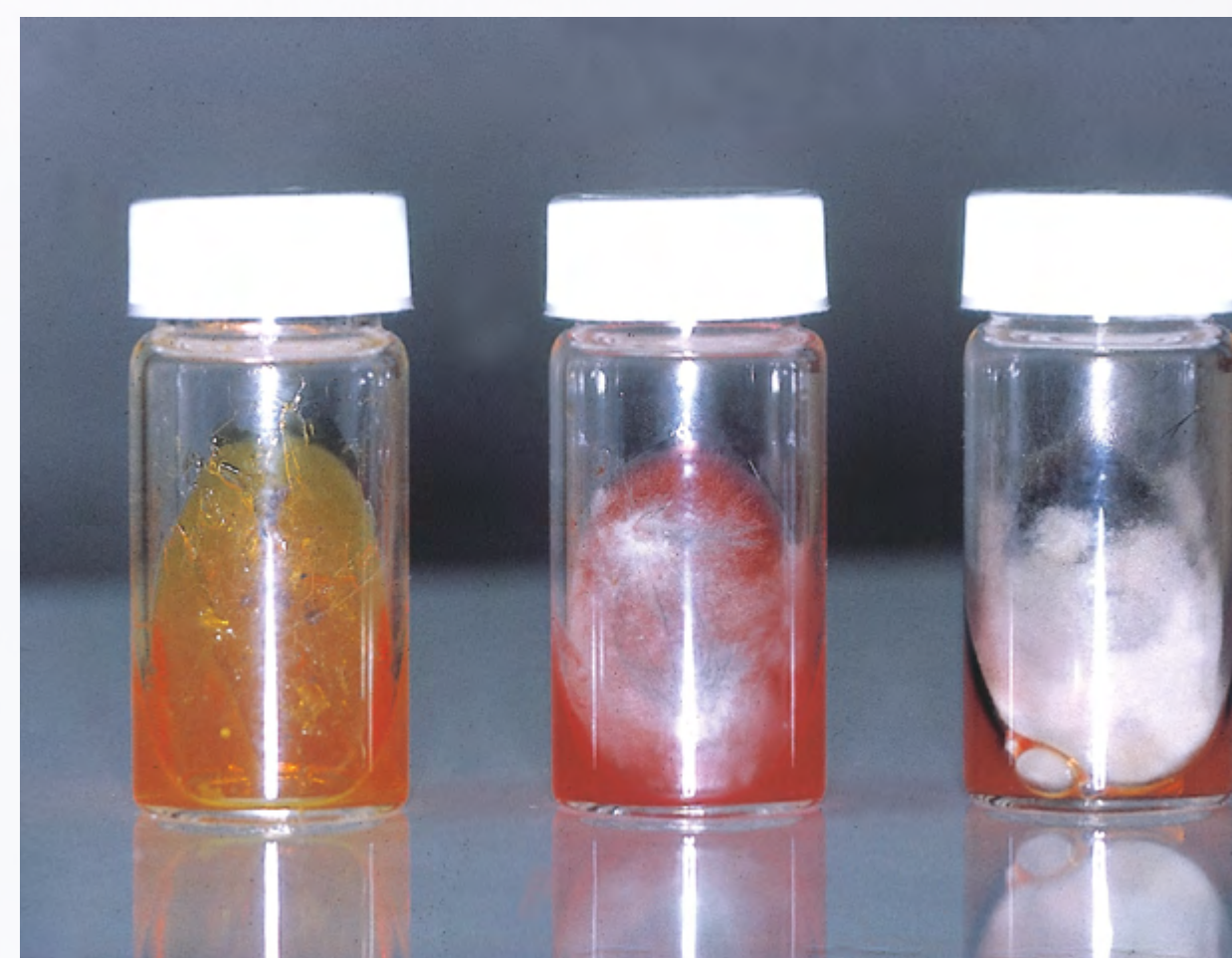
- Isolation of the dermatophyte **confirms the diagnosis** and enables the **species** involved to be **identified**. This may aid **determination of the source** of the infection.
- Note that dermatophytes may sometimes contaminate the coat and thus compatible clinical signs should be present in addition to the presence of the pathogen before dermatophytosis can be confirmed.
- **Prior disinfection of the site to be sampled with 70% alcohol** may be useful in reducing growth of other organisms. Gently spray the sampling area.
- **Collect hairs** and/or crusts as described page 5.
- Send the collected material to a veterinary laboratory or culture the specimens yourself.
- Culture on **dermatophyte test medium (DTM)** is a very convenient method.
 - This medium contains inhibitors which **suppress many but not all contaminants** and the pH indicator, phenol red.
 - **Gently apply the samples on the surface of the medium, in different areas** and in particular **around the periphery**.
 - **The DTM bottle should not be completely closed**, as the growth of dermatophytes is aerobic.
 - **Incubate** at room temperature or, better at **25-30°C** (above a radiator for example).
 - **Cultures** must be **examined regularly**, and saved for at least a month.
 - **Growth of flat white colonies** producing a **red colour** in the surrounding medium **within 10-14 days is suggestive of a dermatophyte**.
 - *Aspergillus* is an example of a contaminant which might grow and cause reddening with 14 days, however, its colonies are blue-green or greyish in colour and unlike those of the dermatophytes.
- **Alternatively**, culture can be done on **Sabouraud's dextrose agar**. However, this method requires a more complete knowledge of the appearance of dermatophyte cultures as there is no indicator to aid identification.
- **Further tests can then be done to identify the species isolated**, either **within your practice**, if you have sufficient expertise, **or the culture can be sent to a laboratory for identification**.



DTM culture of a dermatophyte: method of sampling of hairs. Courtesy of: D. Pin



DTM culture of a dermatophyte: inoculation method of the medium. Courtesy of: D. Pin



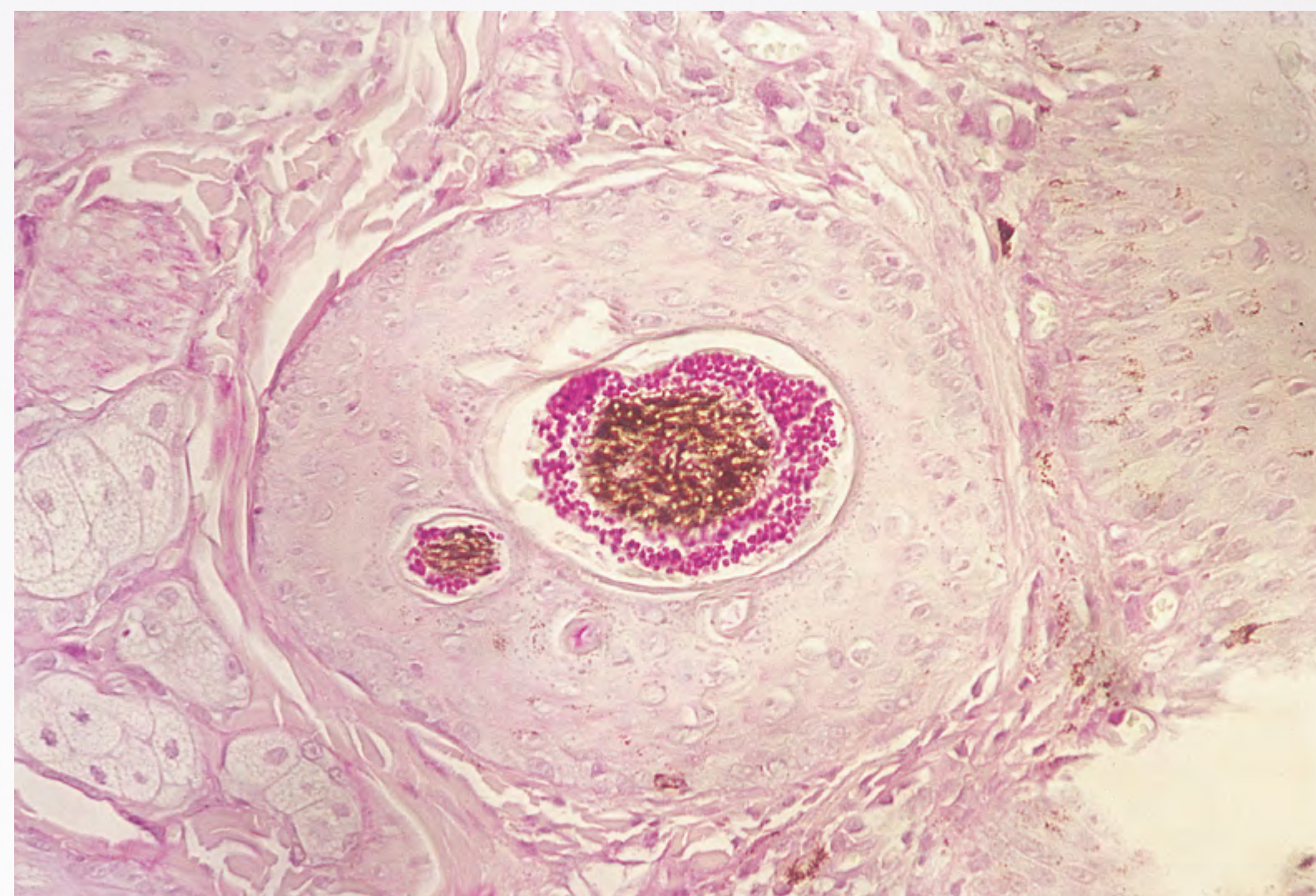
DTM cultures. Negative on the left. Positive to *Microsporum canis* in the middle. Growth of a contaminant on the right. Courtesy of: D.N. Carlotti

- **The Mackenzie Brush Technique for sampling:**

- This is a method which enables **efficient screening of the skin and coat** for the presence of dermatophytes and their arthrospores, especially when characteristic lesions are absent.
- It is a particularly **effective method** in searching for **carriers**, amongst **in-contact cats** for example. **It is also suitable for screening the skin and coat for residual infection whilst monitoring the progress of treatment.**
- The coat of the animal is brushed with a sterile brush and this is then pressed into the surface of the culture medium, which is incubated as above.
- Traditionally, a toothbrush has been used as these can be purchased packaged in an uncontaminated state. However, it is impossible to sample a thick coat efficiently with a toothbrush. Plastic grooming brushes with well-separated teeth are more efficient.

- **Biopsy:**

- Biopsy samples of affected skin are an effective method of diagnosis.
- Samples are taken from the edges of the lesions and fixed in the normal way.
- Sometimes the pathologist will need to use special stains (e.g. PAS: Periodic Acid-Schiff) to demonstrate the dermatophyte elements.



Histopathologic image (x400) of a hair infected by a dermatophyte. PAS stain. Courtesy of: D.N. Carlotti

TREATMENT

- **General remarks.**

- It is important to note that many **dermatophyte infections will resolve spontaneously** within 3 months and thus **recovery may not be directly related to the therapy used. The probability of self-cure depends on the status of the dog's immune system.**
- **Other animals within the home may also be infected at a clinical or subclinical level. These animals should be examined and treated if infection is detected.**
- Infections with *Trichophyton* and cases of **onychomycosis** are often **more difficult to treat** successfully.

- **Topical treatment.**

- Topical therapy is unlikely to be effective on its own in eliminating infection but it **may help to reduce contamination of the environment and spread of infection** to owners and other animals.
- **A combination of topical and systemic therapy is best in most cases.**
- **Clipping:**
 - The coat should be clipped **around focal lesions** for a distance of about 5 cm or, when the **lesions are generalised or extensive**, the **whole coat** should be clipped.
 - Clipping disrupts the skin surface and facilitates penetration by dermatophytes. Thus it is advisable to **clip a few days after starting** topical and systemic **therapy**, when the antifungal agents are established in the skin.
 - **Clippers and premises** must be **disinfected** after use and **the removed hair should be autoclaved or incinerated.**
 - Because the infection of hairs extends below the skin surface, it is wise to **clip the coat again after a growth of about 1-2 cm** has occurred to remove newly appearing hairs bearing arthrospores.
- **Products:**
 - Localised lesions can be treated with **miconazole** or **clotrimazole** creams and lotions applied daily.
 - More extensive infections can be treated with **enilconazole** washes at three-day intervals.

► **Systemic treatment.**

• **Griseofulvin:**

- It is teratogenic and so must not be handled by women of child-bearing age and should not be used on pregnant animals. Side effects including gastrointestinal and haematological changes sometimes occur.
- Doses of **30–50 mg/kg daily** should be effective but can be **doubled if** the lower dose is **not effective**.
- The drug should be **given with a fatty meal**, e.g. add **2.5 – 5.0 ml of vegetable oil or of a veterinary EFA supplement**, to **aid absorption**. **EFA supplements also provides linoleic acid, which aids skin barrier function and improves coat condition.**



Ringworm in human. Courtesy of: D.N. Carlotti

- Treatment will normally be needed **for weeks to months** and should be continued for **at least two weeks after clinical recovery**.

• **Azoles:**

- **Ketoconazole** is employed at **10 mg/kg daily**.
- **Itraconazole** is used at **5 to 10 mg/kg daily**. Itraconazole is registered for use in cats as a palatable liquid given at 5 mg/kg for 7 days on 3 occasions alternating with 7-day treatment free periods.
- Side effects with ketoconazole include hepatotoxicity, adrenal and gonadal hormone suppression, anorexia and vomiting; it is contraindicated in pregnancy.
- **Itraconazole is better tolerated.**
- Terbinafine at 30 mg/kg daily has also been reported to be effective.

► **Additional treatment.**

- **Dermatophytosis should be carefully investigated in all in-contact pets**, especially in **cats** (which can be important asymptomatic carriers), **and treated if necessary**.

• **Environmental decontamination:**

- In view of the **extensive dispersal of infected hairs and squames** from affected animals and the **prolonged survival of arthrospores**, **decontamination** should be attempted.
- Thorough cleaning and the use of **disinfectants** where possible is advisable. Carpets and soft furnishings should be vacuum cleaned.
- This procedure **should be repeated on a number of occasions** as the infection comes under control.

• **Owners' lesions:**

- If the owners have lesions, they should be advised to **consult a dermatologist**.
- They are a **potential source of reinfection** for the animals.

► **Comments.**

- It is important to **involve the owner** and to **gain his/her co-operation**, as **dermatophytosis is sometimes difficult to resolve**, especially where several animals in a household are involved.
- **Concurrent topical therapy is an important aspect of the treatment.**
- In **older animals** and where treatment does **not seem effective**, **check** for **concurrent disease** and possible causes of **immunosuppression**.

PROGNOSIS

- Where only a **single animal** is involved the **prognosis is good**.
- In **groups of animals, particularly** if **cats** are involved, in **older animals** and in **onychomycosis**, the **prognosis** should be **guarded**.

FOLLOW-UP

- **Therapy must be continued after clinical recovery and negative culture results.**
- In Wood's lamp positive cases, the progress of recovery can be followed using the lamp but ultimately should always be checked with cultures.
- Animals may be susceptible to **reinfection**.
- The owner should be warned to look for signs of recurrence.
- In difficult cases monitoring, e.g. with the Mackenzie brush technique during the months following recovery may be warranted.

CONCLUSIONS

- ▶ **Dermatophytosis** is a **very pleomorphic** disease and is easily missed when it appears other than the classical form.
- ▶ The possibility of a dermatophytosis is too frequently ruled out from the differential diagnosis when it appears in other than the classical form.
- ▶ **Fungal cultures should always be done if in doubt.**
- ▶ Treatment failures are often due to non-compliance with good treatment regimens.
- ▶ **Treatment** often needs to be **continued** for many weeks with **regular monitoring** of the progress of **response to therapy**.

WHERE IS THE RINGWORM?



Cushing. Calcinosis cutis.
Courtesy of: T. Olivry



Ringworm. *Microsporum canis*.
Courtesy of: T. Olivry



Exfoliative superficial pyoderma.
Courtesy of: T. Olivry

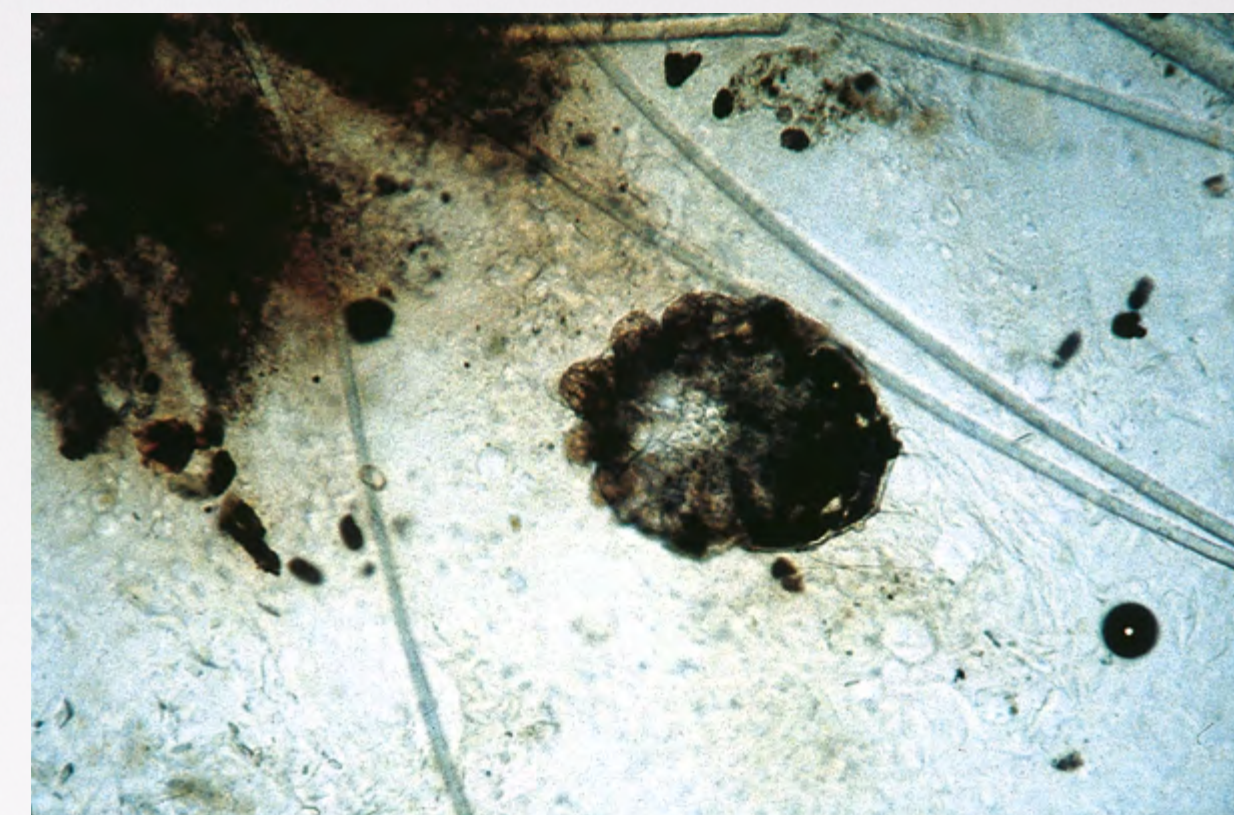
SARCOPTIC MANGE

INTRODUCTION / DEFINITION

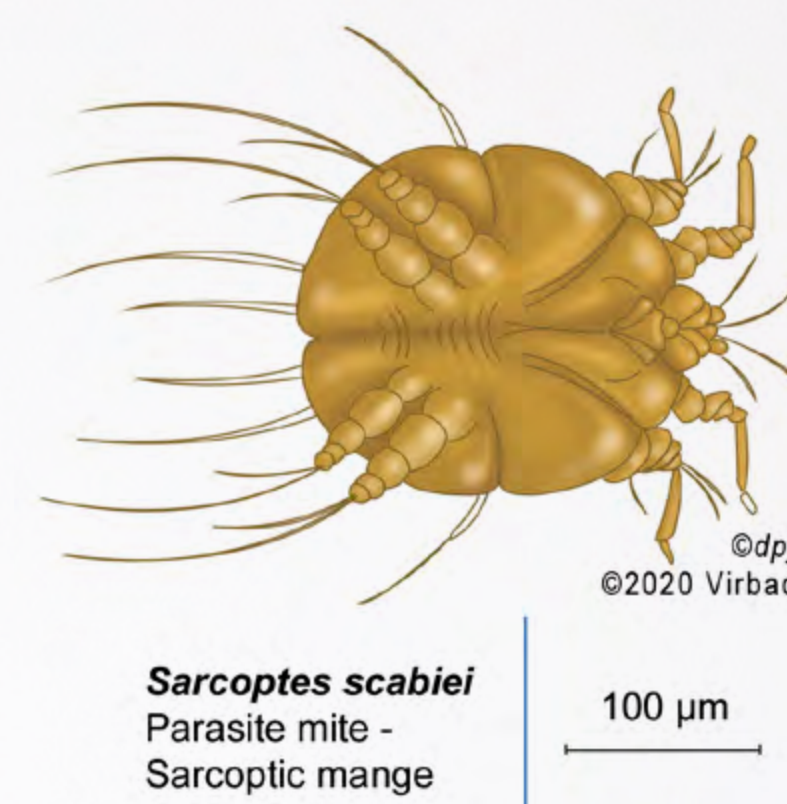
- ▶ **Highly contagious parasitic dermatosis** caused by the multiplication in the epidermis of an acarine mite of the species *Sarcoptes scabiei var. canis* (200 to 400 µm).
- ▶ **Intensely pruritic.**
- ▶ Quite common.

AETIOLOGY / PATHOGENESIS

- ▶ **The parasite: *Sarcoptes scabiei*.**
 - **Mite quite specific to dogs**, although it can infect other species such as cats and humans.
 - **Parasitic life cycle** (egg-larva-nymph-adult): short, **2 to 3 weeks**.
 - The fertilised females on the skin surface move rapidly towards the warmer areas of the skin and **burrow into the epidermis** to lay eggs.
 - Life expectancy of adult mites: 4 to 5 weeks.
 - In the environment (off the host), the different parasitic stages survive for only short periods (2 to 6 days at 25°C). Nevertheless, at lower temperatures and high humidity, nymphs and females can survive for up to 3 weeks and may lead to reinfection.
- ▶ **Pathogenesis.**
 - The clinical signs may appear within one week after infection.
 - They result from mechanical irritation and hypersensitivity.



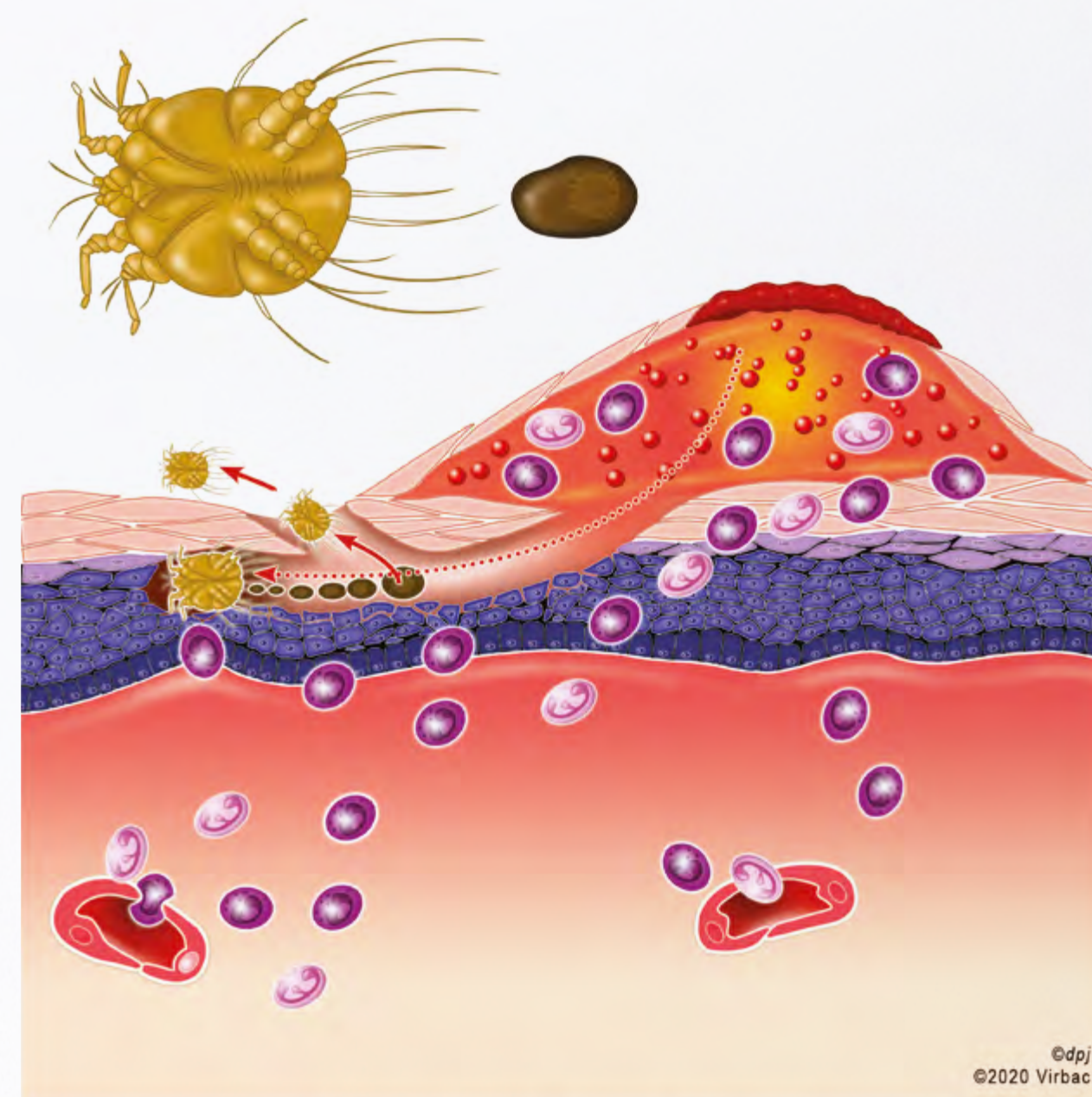
Microscopic view of adult *Sarcoptes* (x125).
Courtesy of: D.N. Carlotti



Courtesy of P. Jasmin

EPIDEMIOLOGY

- ▶ The condition **has remained a consistent problem** over the years occurring with variable frequency.
- ▶ **Major consideration in the differential diagnosis of pruritic dermatoses in dogs.**
- ▶ **Highly contagious infection** but marked individual variation in disease expression with the possibility of asymptomatic carriers. Infection generally results from direct contact but sometimes by indirect contact, with the origin of the disease remaining obscure.
- ▶ **Possible contagion to humans:**
 - Appearance of pruritic papules on the trunk, arms and legs.
- ▶ However, as the parasite is not well adapted to human skin, adults rapidly die and cannot reproduce; **affected individuals normally recover spontaneously once the animal is successfully treated.**
- ▶ **Most commonly found in puppies and young dogs**, especially those coming from pet stores or some breeders. However, **it also occurs in adult dogs.**



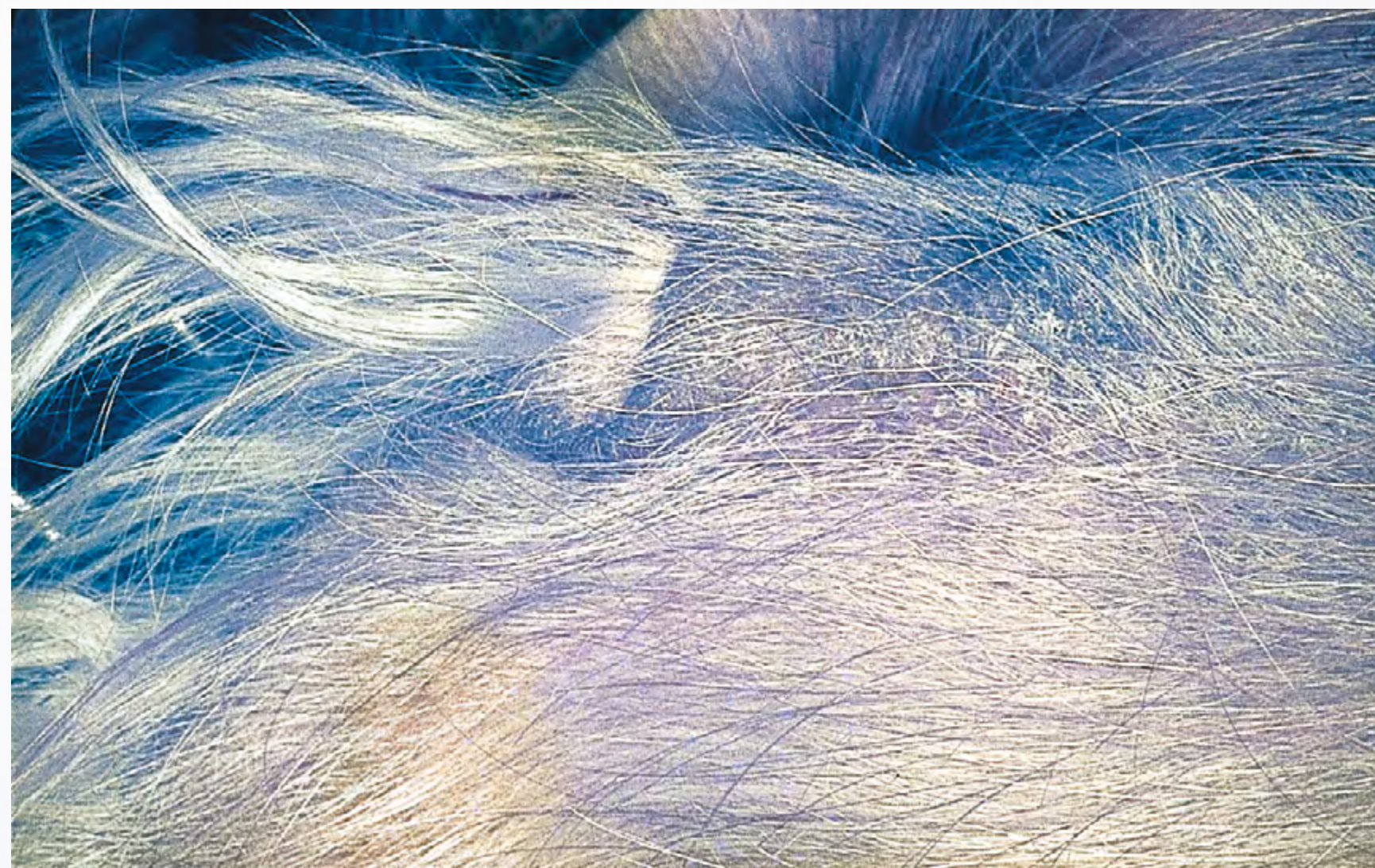
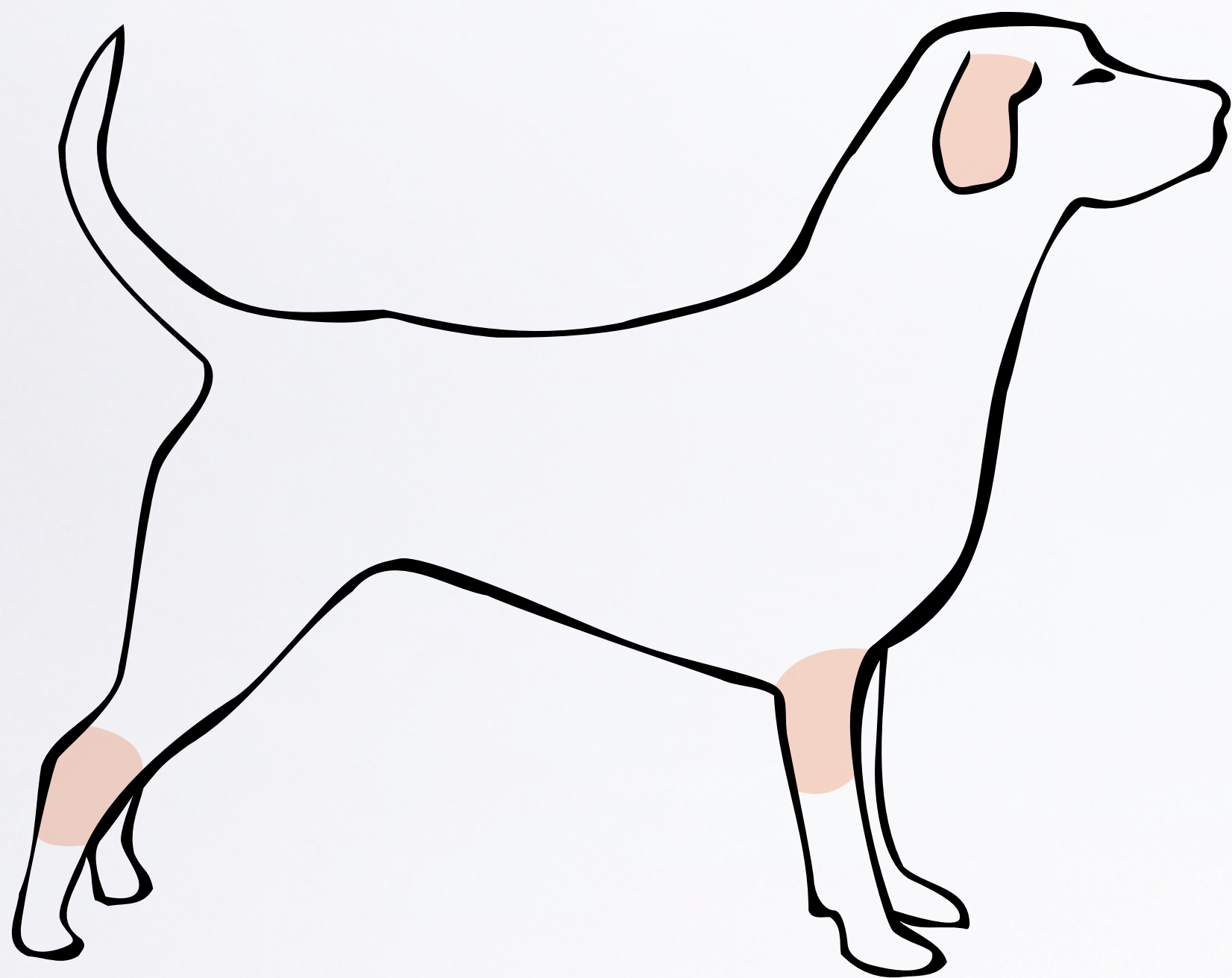
Sarcoptic mange: parasitic dermatitis due to *Sarcoptes scabiei*

Neutrophils Eosinophils *Staphylococcus pseudintermedius*

Courtesy of: P. Jasmin

CLINICAL SIGNS

- ▮ Symptoms and lesions may be more subtle and discreet than portrayed in the literature, particularly in well groomed animals and/or when parasiticides are frequently used, lesions can also be very focal.
- ▮ There is usually **severe pruritus** often leading to a rapid appearance of extensive excoriations. Some forms, presumably when hypersensitivity is absent, have minimal pruritus.
- ▮ Primary lesions: erythematous papules, **crusted papules**. **Typical primary lesions (to be scraped!) are crusted papules** which represent the exact points where the fertilised females entered the epidermis. They appear either just prior to, or simultaneously with the development of increasing pruritus.
- ▮ Secondary lesions: crusts, **excoriations**, hyperpigmentation, lichenification.
- ▮ Associated dermatological findings: scaling and seborrhoeic problems, alopecia, pyotraumatic dermatitis, otitis externa affecting the margins of the ear flaps.
- ▮ Lesion distribution: the favourite habitats of the mites and thus the sites of the lesions are the **margins of the ear** pinnae and the bony prominences, especially **elbows** and **hocks**, and then the ventral portions of the chest and abdomen. When the disease spreads, the entire body may be involved, but the dorsal midline is always spared.



Affected margin of the ear pinnae. Courtesy of: D.N. Carlotti



Crusted papules on an elbow. Courtesy of: D.N. Carlotti

DIAGNOSIS

History.

- **Rapid onset of pruritus.**
- Possible contagion: pet stores, kennels, grooming parlours, veterinarian's office...
- Evidence of spread to other dogs or humans (or rarely cats).
- **Partial previous response to parasitocidal or corticosteroid therapy** (some 40% of cases respond partially to the latter, but there is a rapid reappearance of the pruritus).

HISTORY SHEET

Owner: _____ Date: _____
 Dog's name: _____ Breed: _____ Sex: _____ Age: _____
 Weight: _____

GENERAL HISTORY

1/ Age when acquired and origin (breeder, pet store...):
 2/ Way of life, environment (exercise, house, garden, flat...) and in-contact pets:
 3/ Way of life, environment (exercise, house, garden, flat...) and in-contact pets:

DERMATOLOGICAL HISTORY

3/ Pruritus, severity and time of onset (before or after lesions):
 4/ Specific clinical signs and related behaviour:
 • Itching of feet (licking, chewing):
 • Itching of head, lips, chin, periorbital area (scratching, rubbing):
 • Otitis, itching of ear pinnae (scratching, shaking):
 • Itching of anogenital area (licking, licking and chewing):
 • Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretion):
 • Upper respiratory signs, nasal discharge and/or sneezing:
 • Lower respiratory signs, asthmatic problems:
 • First cutaneous lesions observed and their development:
 5/ Seasonal influences:

7/ Other affected animals (cohabiting, lineage) or human beings in contact:
 8/ Presence of flea and anti-parasitic treatments given:
 9/ Shampoos and grooming:
 10/ Owner's view (general opinion, remarks on the dermatosis of his dog):
 11/ Previous treatments (date, products, dosage and duration) and responses:



Lesions on an affected owner (crusted papules). Courtesy of: D.N. Carlotti

Clinical elements.

- **Pruritus:** the intensity is directly related to the number of parasites only at the onset. Very rapidly (3 to 4 weeks after infestation), **hypersensitivity reactions** lead to very marked pruritus, often with low numbers of parasites that are difficult to demonstrate even with the aid of multiple skin scrapings).
- Lesions and **distribution pattern.**



Very severe pruritus in a dog affected by Sarcoptic mange. Courtesy of: H. Koch

Pinnal-pedal reflex.

- Highly suggestive, positive in more than 80% of cases and rare in other pruritic dermatoses.
- This test should be correctly and consistently performed.



Location at which the pinnal-pedal reflex should be induced. (Henry's area). Courtesy of: D. Pin

- ▶ **Differential diagnosis.**
 - **Atopic dermatitis:** there is the possibility of cross-reactivity between *Sarcoptes* and *Dermatophagoïdes farinae* (Df), and positive skin tests to the latter may be found in cases of sarcoptic mange.
 - **Food allergy.**
 - **Folliculitis, *Malassezia dermatitis*,** bacterial overgrowth and rarely, atypical dermatophytosis.
- ▶ **Scrapings.** (*Scabies with an "S" = Superficial scrapes! Demodicosis with a "D" = Deep scrapes!*).
 - **From crusted papules (elbows and hocks).**
 - **From the ear margins,** preferably in lesional areas.
 - It is vital to note that:
 - This is the only way to obtain absolute confirmation of the diagnosis.
 - It may be quite difficult to diagnose sarcoptic mange by skin scrapings.
 - It is important to emphasise this to the owners and inform them that treatment may be considered even if skin scrapings are negative.
 - **Failure to find any mites does not eliminate the diagnosis!**
 - Following **specific guidelines when looking for *Sarcoptes*** greatly increases the chances of success: **The best lesion to scrape is a crusted papule,** which has resulted from penetration of a female into the epidermis. The mite and/or its eggs may be underneath!
 - **Look for these crusted papules first on the ear margins, elbows and hocks,** with a lens if necessary.
 - **"Much more time has to be spent searching for the area to be scraped than actually scraping"** (contrary to the case in demodicosis).
 - Scrape the ear margins, especially if no crusted papule has been found.
 - Scrape with a blunt scalpel blade. Put a few drops of liquid paraffin, mineral oil or lactophenol on a microscope slide, lubricate the scalpel blade and use that to soften the skin (this facilitates scrapings and the adherence of the scraped material to the blade and its transfer to the slide). Then scrape until capillary bleeding results. With the scalpel blade, macerate and spread the sampled material in the liquid that has been placed on the slide, then crush it under the coverslip.
 - **Microscopic observations:**
 - **Scan** under the 10X objective **the entire sample** present under the coverslip.
 - Every field must be examined carefully.
 - Focus on suspicious areas using the 40X objective, if necessary.
 - If the sample is quite thick, do not forget to focus up and down to ensure that the whole sample is checked. **Note the presence of adults** (200 to 400 µm), **of eggs or of faecal pellets.** Demonstration of any of these is diagnostic.
- ▶ **Serology.**
 - In some countries, tests for circulating IgG antibodies to *Sarcoptes* are available. They indicate recent infestation but may not give positive results until several weeks after infestation.
- ▶ **Skin biopsies.**
 - At best these are only suggestive, with parasites only rarely observed.
 - The disease is characterised by hypersensitivity reactions that result in histopathological changes similar to those encountered in allergic dermatitis.



Scraping of an ear margin. Courtesy of: D.N. Carlotti



Preparation of a sample on a slide. Courtesy of: D.N. Carlotti

► **Therapeutic trial (see treatment).**

- Must be undertaken **rigorously**, as if the diagnosis had been confirmed.
- Sometimes ambiguous as other parasitic dermatoses may respond.
- The evaluation of efficacy is based on the reduction in pruritus (be careful: see next paragraph!) and then of lesions. The response is generally rapid. No final conclusion can be made before the minimum recommended duration of treatment is achieved.
- An **exacerbation of pruritus at the very beginning of treatment** is frequently noted and a **good indication of a positive diagnosis** (this may result from the death of the parasites).
- The diagnosis is excluded with decreasing reliability with the use of a systemic injectable treatment, then a systemic treatment given orally, and finally topical therapy.
- Be sure to use products that are not out of date, and that have been properly stored.

TREATMENT

► **Topical treatment.**

- Selamectin (6mg/kg) and moxidectin (2.5mg/kg) are effective when applied as spot-on preparations at monthly intervals. Treatment for 2 to 3 months is advisable.
- Fipronil spray (0.25%) has been shown to be effective in 5-week old puppies when used on 3 occasions at 3-week intervals. It is useful in very young puppies and pregnant or nursing bitches.
- Acaricidal **dips** can also be used. These are usually given twice a week for a minimum of 6 applications (unless otherwise recommended in the directions for use).
- All parts of the skin must be treated, with particular attention given to the lesions around the ears and eyes.
- Products: organophosphates (phosmet, 0.09%), lime sulfur (2 to 3%), amitraz (0.05%, 3 times at 15 day intervals). Resistance may occur.
- **Clipping** and pre-treatment with keratolytic and antiseborrhoeic shampoos are indicated.

► **Systemic treatment.**

- **Very effective.**
- Isoxazoline family of oral parasiticides: fluralaner, afoxolaner, lotilaner, sarolaner and similar drugs every 1 to 3 months (fluralaner), represents one of the best current choice because of high efficacy and low risk.
- Ivermectin (250 to 400 µg/kg, 2 or 3 times at 10 or 15 day intervals) by subcutaneous injection (may be painful but, can be relieved by the addition of a local anaesthetic in the same syringe).
 - Strictly contra-indicated in Collies, Shetlands, Bobtails, sheepdogs, and their crosses.
 - As this is not an approved drug for this indication, it must be given with the consent of the owner and carefully supervised by the prescribing veterinarian.
- Milbemycin oxime (2 mg/kg, 3 times at 1 week intervals) orally. This is not an approved drug.

► **Additional therapy.**

- Keratolytic, antiseborrhoeic, antipruritic and emollient topical shampoos and lotions.
- Possible systemic corticosteroid treatment for the first week in cases with very intense pruritus (prednisolone, 0.5 to 1 mg/kg/day orally, 2 or 3 days): **only when a definitive diagnosis has been made by scrapings.**
- Occasionally, treatment with an acaricide, presumably because of the killing of the mites with resulting hypersensitivity, causes a marked increase in pruritus. The administration of a corticosteroid would then be indicated.



Microscopic view of eggs and faecal pellets of *Sarcoptes* (x400).
Note: the image has been focused on the eggs. Courtesy of: D.N. Carlotti

► **Important remarks.**

- An **exacerbation of pruritus at the very beginning of the treatment is frequent and suggests the correct diagnosis and efficacy of the treatment (but it is useful to give the owners notice of this fact!)**. Be sure to treat the affected animal long enough after complete clinical recovery (one more systemic administration or two more topical applications).
- Treatment of in-contact dogs is strongly indicated.
- Treatment of the environment using an environmental parasiticide may be necessary.
- Change, or thoroughly cleanse the animals bedding.

PROGNOSIS

- **Excellent response to the correct treatment and a rapid cure.**

FOLLOW-UP

- When relapses occur, it suggests that either the therapy was too short, or that there has been reinfection from the environment or another infected animal.
- Repeated recurrences will necessitate a complete and thorough epidemiological investigation.

CONCLUSIONS

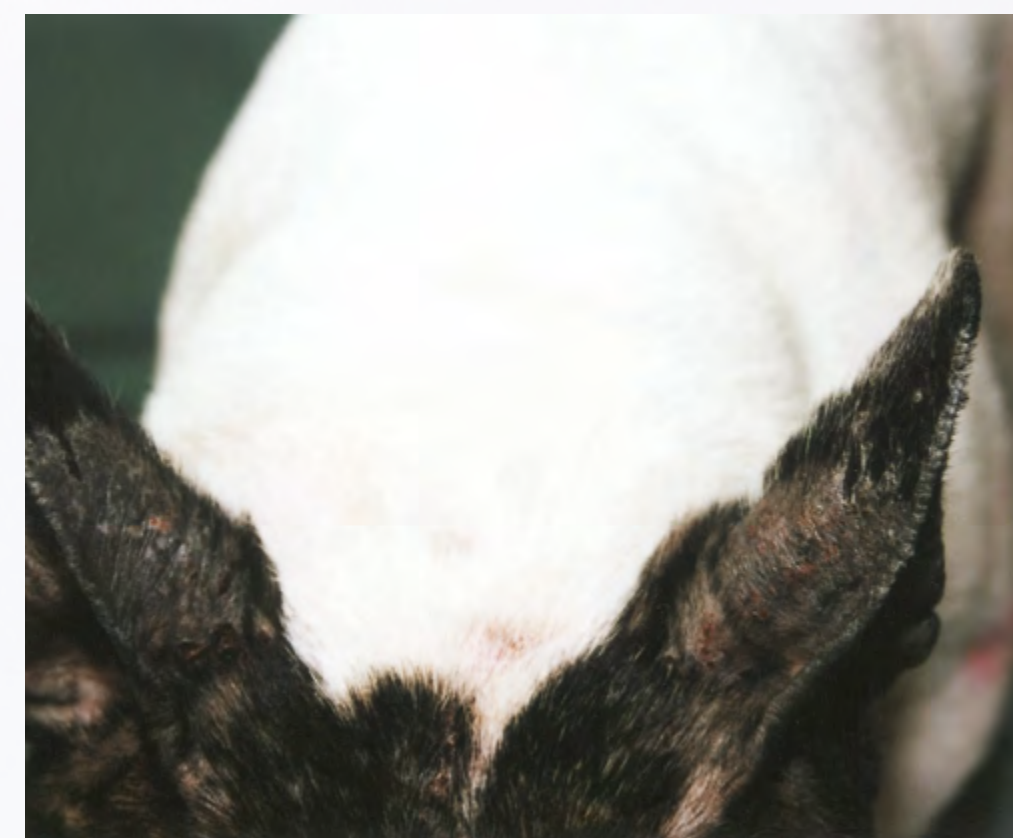
- The **possible confusion with allergic dermatitis**, together with the difficulty and the time sometimes needed for the differential diagnosis of allergies, make it vital to exclude this condition prior to the work up for the other pruritic dermatoses.
- **"When in doubt, treat!"**



Sarcoptic mange. Courtesy of: P. Jasmin



Sarcoptic mange. Courtesy of: P. Jasmin



Sarcoptic mange. Courtesy of: P. Jasmin



Sarcoptic mange. Courtesy of: P. Jasmin



Sarcoptic mange. Courtesy of: P. Jasmin



Sarcoptic mange. Courtesy of: P. Jasmin

DERMATOSES ASSOCIATED WITH INFESTATIONS BY OTHER PARASITES

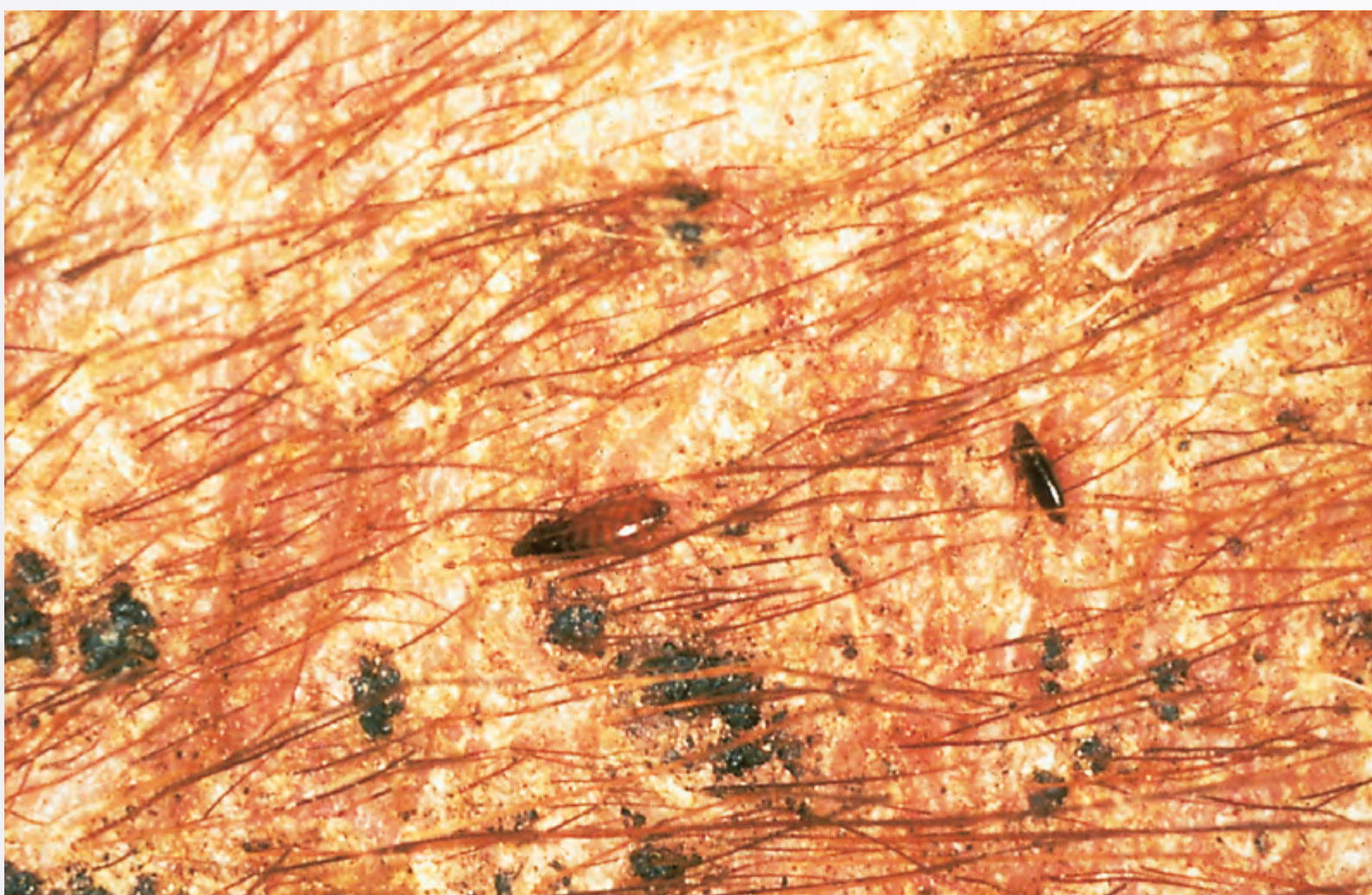
Fleas, Lice, Cheyletiella, Neotrombicula and Straelensia

INTRODUCTION / DEFINITION

- ▶ **Infestations with ectoparasites other than *Sarcoptes***, including insects (fleas, lice) and mites (*Cheyletiella*, *Neotrombicula* and *Straelensia*) are described.
- ▶ Infestation may be subclinical for all of these except *Neotrombicula* and *Straelensia*.
- ▶ Clinical disease is associated with **variable degrees of pruritus**.
- ▶ Frequency of occurrence of ectoparasitic infestations by decreasing order: fleas, *Sarcoptes*, *Neotrombicula*, *Cheyletiella* and lice. Infestation with *Straelensia* is rare but is reported in France and the Iberian Peninsula.

AETIOLOGY / PATHOGENESIS

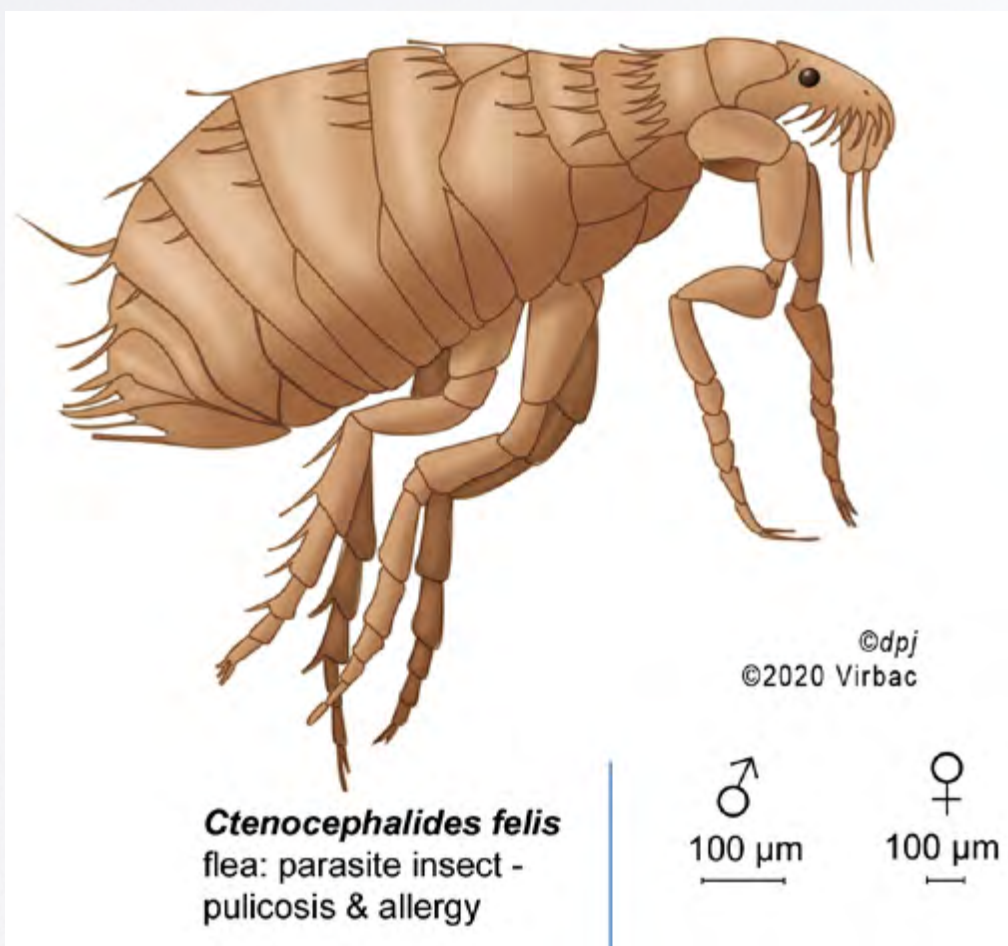
- ▶ **Aetiology.**
 - **Flea infestation.** Normally caused by *Ctenocephalides felis* but *Ctenocephalides canis* also infests dogs in certain areas and is more common in southern Europe. Infestation with species from man (*Pulex irritans*, *P. simulans*) and wildlife (e.g. *Archeopsylla erinacei* from hedgehogs and *Spilopsyllus cuniculi* from rabbits) also occurs. Only the adults live on the dog. Eggs are laid after the female has fed on blood and fall into the environment where they develop through larval and pupal stages to give rise to new adults, which seek a new mammalian host. Most of the life cycle is spent off the host. Typically it lasts 3-4 weeks but can take up to 6 months.



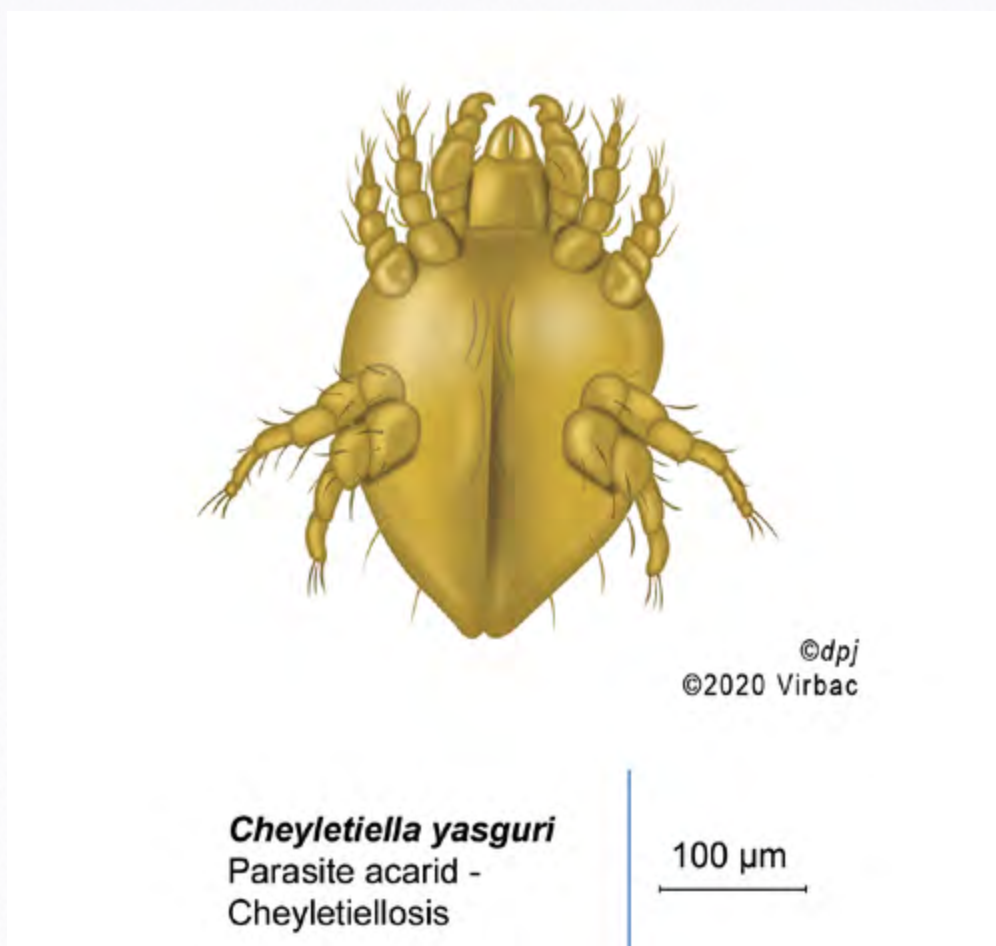
Flea infestation. *Ctenocephalides felis*. Courtesy of: D.N. Carlotti



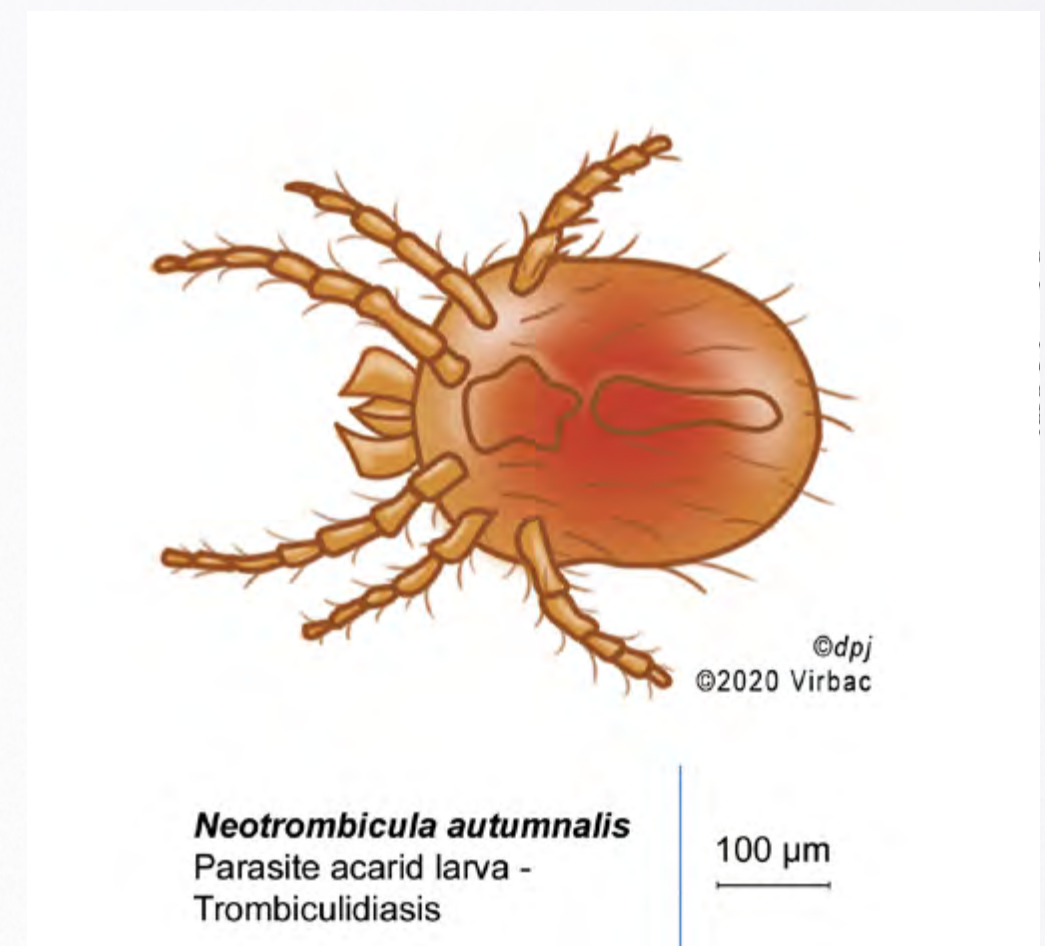
Linognathus setosus (x400). Courtesy of: P. Bourdeau



Courtesy of: P. Jasmin



Courtesy of: P. Jasmin



Courtesy of: P. Jasmin

- **Louse infestation (pediculosis).** Dogs may be infested with the sucking louse, *Linognathus setosus*, which ingests blood via its piercing mouthparts. It is found particularly on the long ears of breeds such as the spaniel, basset and Afghan hounds. The biting louse of dogs, *Trichodectes canis*, which feeds on epidermal debris and is more active, generally causes more irritation. It is chiefly found on the head, neck and tail and tends to cause problems particularly in puppies. It can act as an intermediate host for the tapeworm, *Dipylidium caninum*. Lice spend their entire life cycle on their host. Eggs laid by the female are cemented to the hairs at one end and give rise to nymphal stages and then adults. Louse life cycles take 20-40 days.
- **Cheyletiella infestation (cheyletiellosis).** Normally caused by *Cheyletiella yasguri*. Other species may also infest the dog, particularly *C. parasitivorax* and *C. blakei*, typically found in rabbits and cats respectively. Owners may also develop transient infestation. The mites live in "pseudotunnels" within cellular debris at the skin surface and feed on tissue fluid with their piercing mouthparts. Eggs are attached to the hairs with fine filaments and are smaller than those of lice. Nymphs emerge from the eggs and eventually develop into adults. The life cycle entirely spent on the host, takes about 21 days.
- **Neotrombicula infestation (trombiculidosis).** Infestation by the larval stage of the free-living mite, *Neotrombicula autumnalis* which emerges from eggs laid in damp soil by the female in late summer and autumn and climbs upwards, typically on grass stems, and awaits the arrival of a host to which it attaches. The larva feeds on host fluids via piercing mouthparts for 3 days or more and then falls off to continue its life cycle in the environment.
- **Straelensia cynotis infestation (trombiculidosis).** As with *Neotrombicula* infestation is by free living larvae in later summer and autumn in dogs in rural environments. The larvae invade the hair follicles and after a prolonged feeding cycle may emerge and return to the environment.



Cheyletiella yasguri (x400).
Courtesy of: Royal Veterinary College, London



Neotrombicula (x400).
Courtesy of: Royal Veterinary College, London

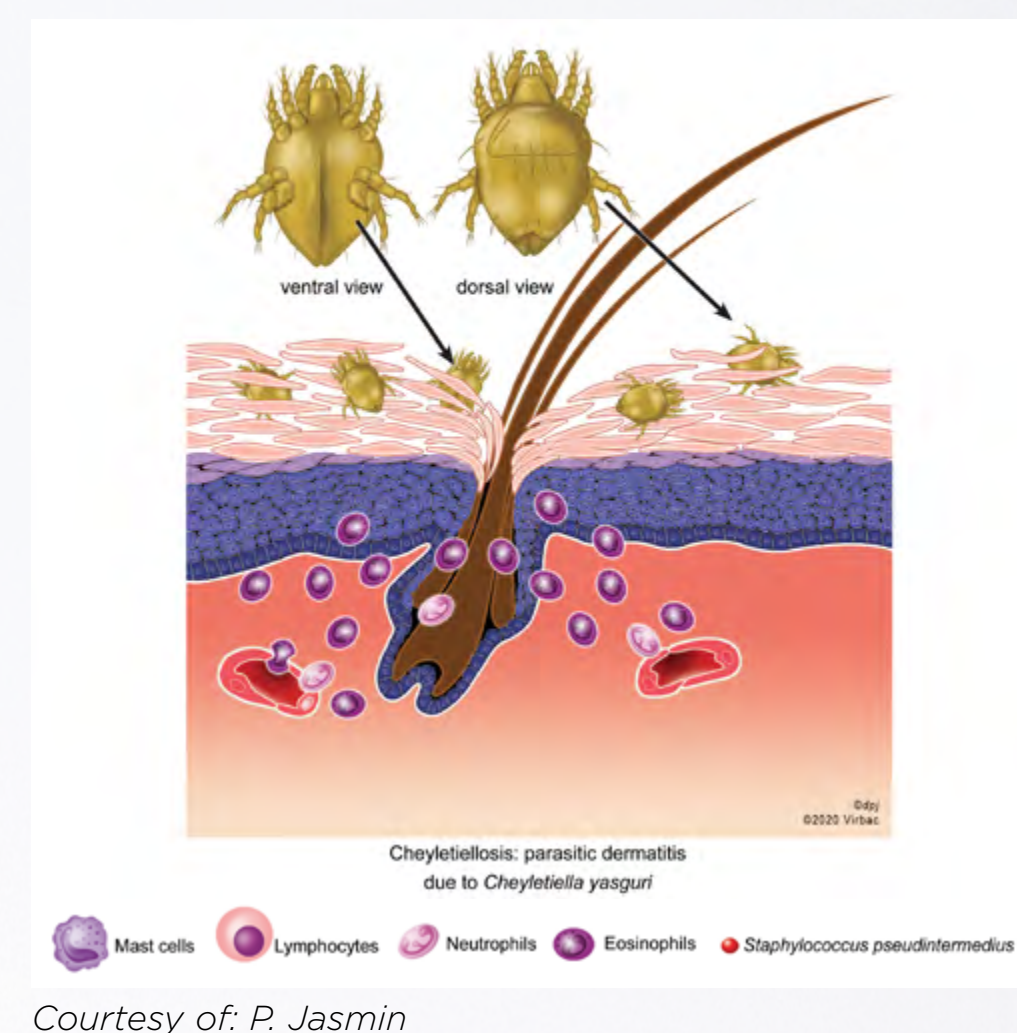
Pathogenesis.

These infestations **commonly affect young dogs** (especially from breeding colonies) but also occur in adult dogs.

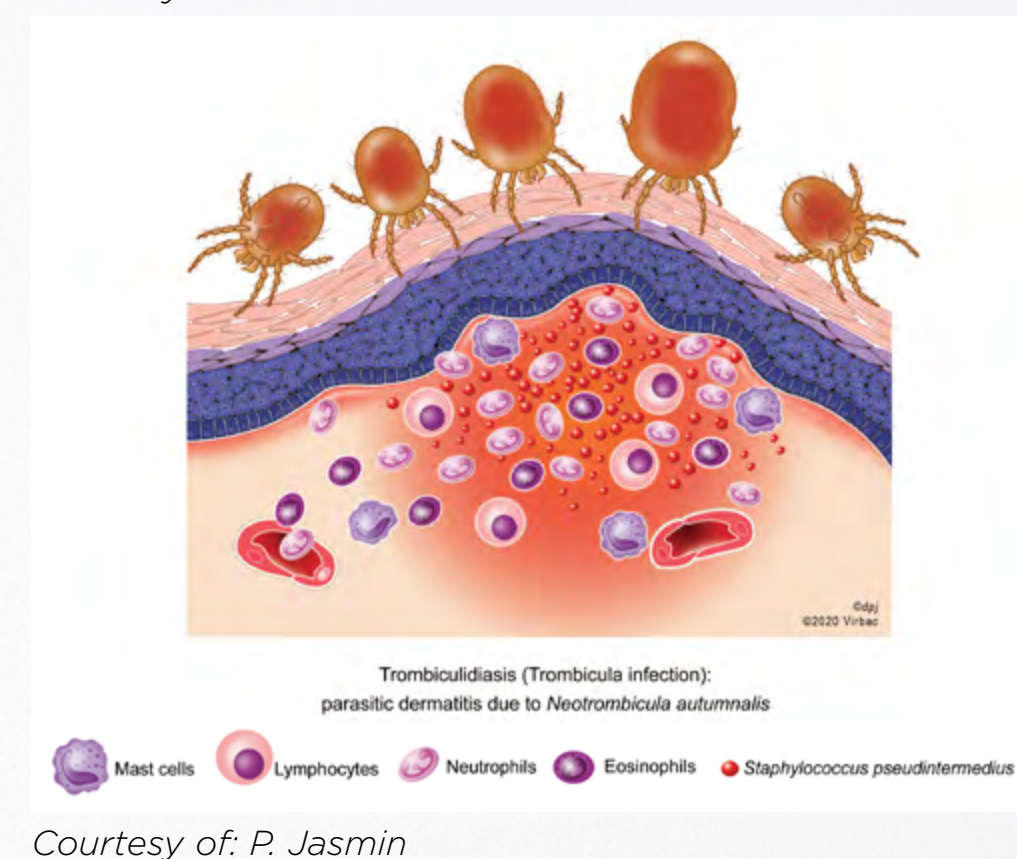
- Cutaneous irritation is generally associated with hypersensitivity reactions to the bites of these parasites (see monograph on flea allergy dermatitis). Where there is a state of anergy or low-grade sensitivity, infestation may be subclinical.
- In flea, louse and *Neotrombicula* infestations, crusted papules and excoriations associated with self-trauma may occur. Infestation with *Neotrombicula* normally causes intense irritation.

In cheyletiellosis, abundant scaling is usually present. *Straelensia* infestation is associated with development of nodular lesions, often with a purulent dermatitis, folliculitis, furunculosis and crusts ; pruritus is uncommon but can be intense.

- Anaemia may be caused by heavy infestations of fleas or lice, particularly in young or small dogs.



Courtesy of: P. Jasmin



Courtesy of: P. Jasmin

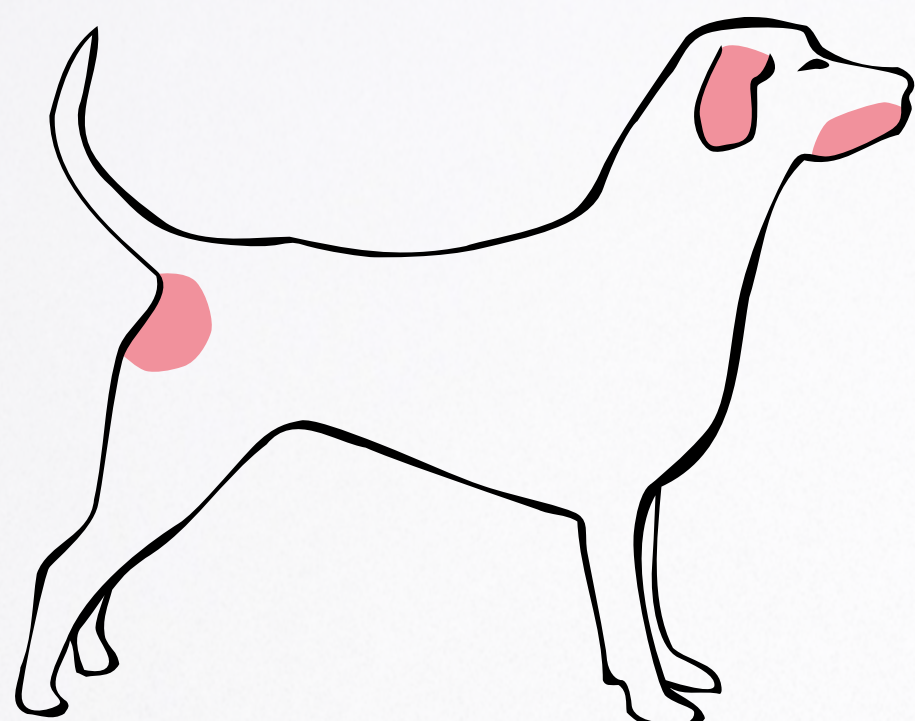
EPIDEMIOLOGY

- Fleas.** See monograph on flea allergy dermatitis.
- Lice.** These insects are unable to tolerate high temperatures at the skin surface and populations generally fall in the summer. Infestations tend to be greater in winter. Transfer between animals occurs with close contact and infestation is promoted by poor management, crowding and debility. Lice are quite host specific and so transmission does not occur to dogs from other mammalian species. The entire life cycle is spent on the host.
- Cheyletiella.** Transfer between animals may occur via contact or from the environment. Adults can survive off the host for up to 10 days in a cool environment but the nymphal stages survive no longer than 48 hours. The entire life cycle is spent on the host. Sequestration of the mites in the nasal cavity has been reported and may enable survival and continuing infestation despite use of topical parasiticides.
- Neotrombicula.** Larvae are picked up from vegetation growing in moist, cool environments in the late summer and autumn and feed for a few days before falling off. The remainder of the life cycle occurs in the environment.
- Straelensia.** Larvae are acquired in rural environments, especially woodlands, by hunting dogs when looking for preys in burrows. Spontaneous remission can occur but may take up to 12 months.

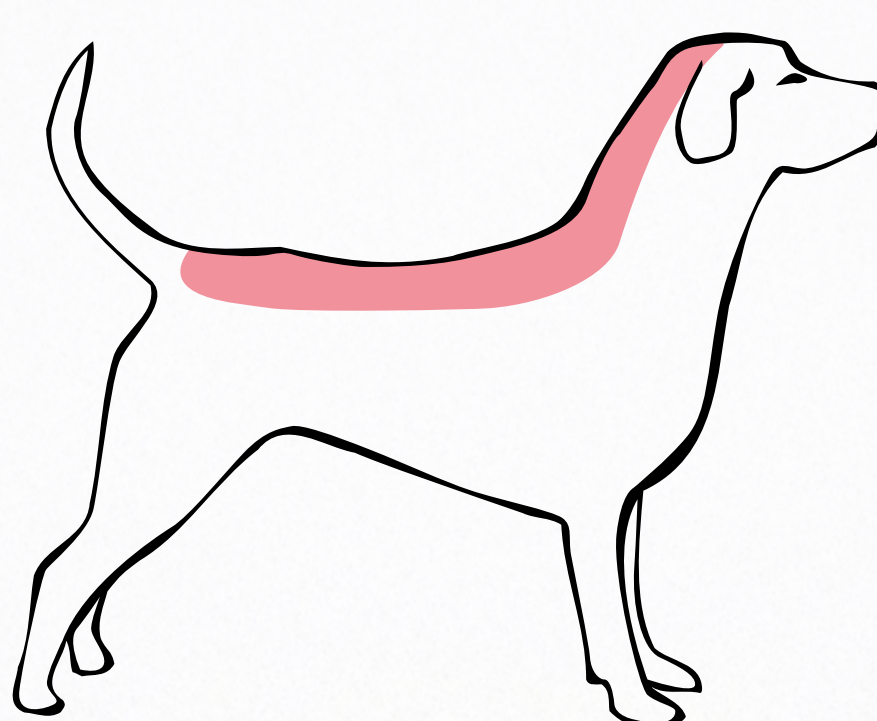
CLINICAL SIGNS

- Fleas.** In the absence of flea allergy, minor irritation but anaemia and accumulation of flea dirt in the coat in heavy infestations. See also monograph on flea allergy dermatitis.
- Lice.** In some animals there is intense pruritus and crusted papules may be seen. In such cases, hair loss associated with self-trauma is likely. Infestation may also be sub-clinical or cause only scaling or signs of "seborrhoea sicca". Higher populations of lice tend to be found on the **head**, especially the ears, and adjacent to **body openings**. The coat is commonly matted, hiding the lice.
- Cheyletiella.** Signs vary from intense pruritus that may even simulate neurological disease, with much scaling, to mild or sub-clinical infestation with minimal scurf. Scaling usually commences on the dorsal trunk but can become **very extensive**.
- Neotrombicula.** The mites attach close to the points of contact with infested soil or vegetation where they accumulate and may be seen as orange-red spots. They are commonly found on the feet, the head and particularly the ears, and the ventrum. Erythema, papules and crusts, together with scaling, excoriation and alopecia associated with self-trauma are found in and around the infested areas.
- Straelensia.** The mites invade hair follicles particularly dorsally, including the head, causing erythematous, alopecic nodules and papules sometimes with marked purulent exudation, folliculitis, furunculosis and crusting. Limbs; ventral abdomen and chest tend to be spared but lesions can be generalised. Pruritus is uncommon and may be associated with secondary infection.

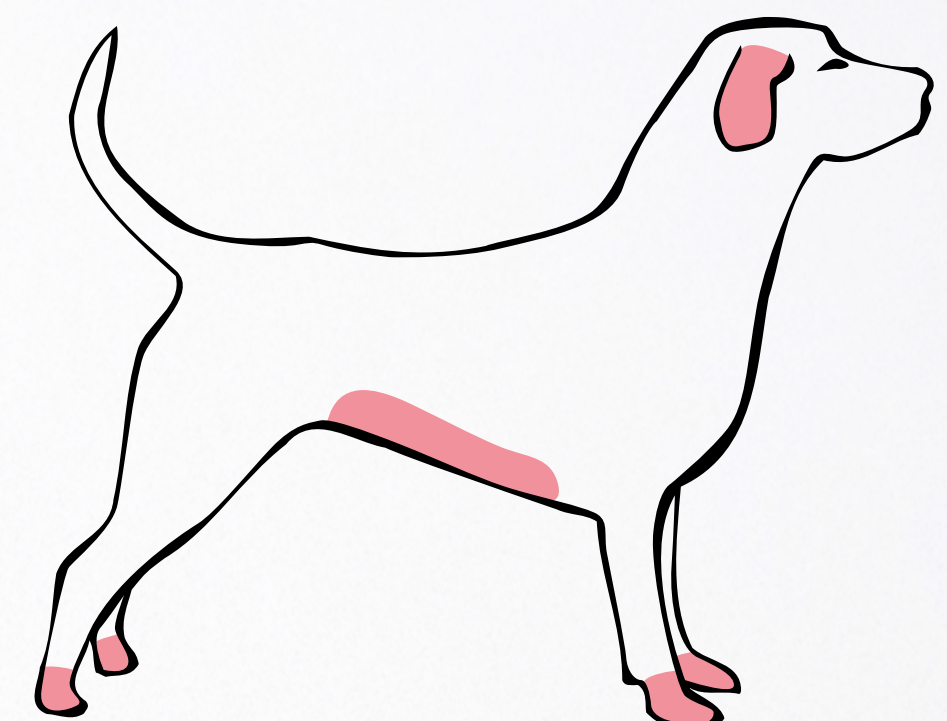
Louse infestation



Cheyletiella & Straelensia infestations



Neotrombicula infestation



DIAGNOSIS

History.

- **Fleas.** See monograph on flea allergy dermatitis.
- **Lice.** Crowding and poor management, including malnutrition, are usually important factors. Dogs may have been bought from **breeding establishments** with endemic infestation or may have visited infested premises.
- **Cheyletiella.** Direct or indirect contact with infested dogs, **cats** or **rabbits**. Papular lesions may be present on the owners, particularly the arms, around the waist and on the thighs. These normally resolve when the infestation in the dog has been cleared.
- **Neotrombicula.** Occurrence of marked, focal pruritus of the head, ears, feet or ventrum occurring in the late **summer** or **autumn** in dogs that have visited infested areas of ground. Infestation may extend into the winter in warmer climates. Often there is local knowledge of such areas and owners may have had a similar problem in previous years.
- **Straelensia.** Appearance of alopecic nodules and papules in late summer and autumn in dogs living in rural and wooded environments, particularly hunting dogs, in **Southern France** and the **Iberian Peninsula**.

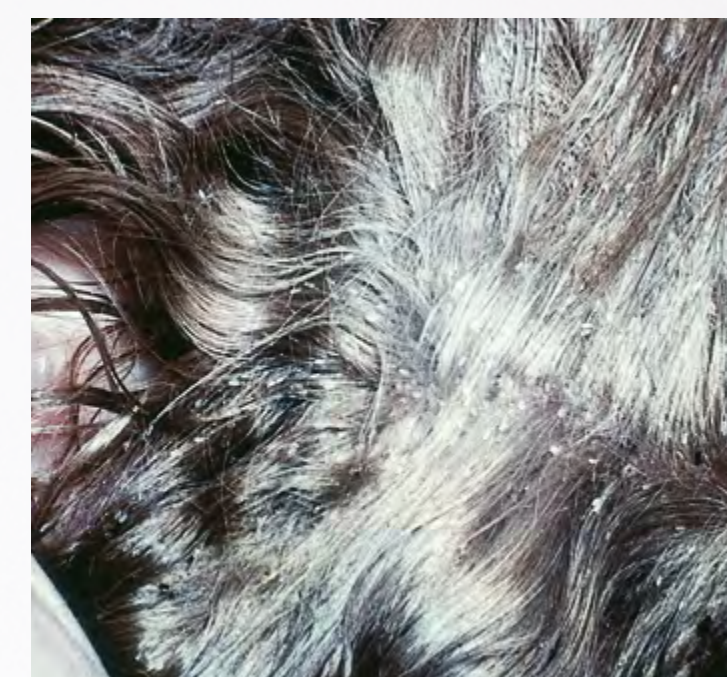
Clinical elements.

- **Fleas.** See monograph on flea allergy dermatitis.
- **Lice.** Anaemia and **debilitation** with sucking lice. **Poor coat condition** with matting, particularly on the **head** and **ears**, and around **body openings**. **Pruritus** varying from marked to mild. Self-inflicted wounds and secondary infection may be significant. Occasionally signs **may mimic** those of **flea allergy dermatitis**. Infestation may be subclinical or associated only with mild scaling. Lice are visible as dark ovoid objects. Good lighting and a lens aids detection. Trichodectes canis is about 1-1.5 mm in length. It moves rapidly and may be difficult to catch. Linognathus setosus is up to 2 mm in length and is less mobile.
- **Cheyletiella.** **Scaling** which may be **severe**, particularly of the trunk. **Pruritus** varying from **severe** (scratch reflex causes dog to collapse) to mild. Occasionally scaling, crusting and erythema **mimicking sarcoptic mange** may occur. Some cases show only slight scaling and no pruritus. Inapparent infestation also occurs.
- **Neotrombicula.** Usually marked **pruritus** of the **head**, particularly the **ears, feet** and/or the **ventrum** with accumulations of orange-red mites, visible singly with a hand lens. Papules, pustules and crusts may be present. Self-inflicted excoriations, with **hair loss** and **scaling** may occur. Some cases are non-pruritic.
- **Straelensia.** Erythematous **alopecic nodules and papules** particularly affecting **dorsal parts of the body**. Commonly non-pruritic.

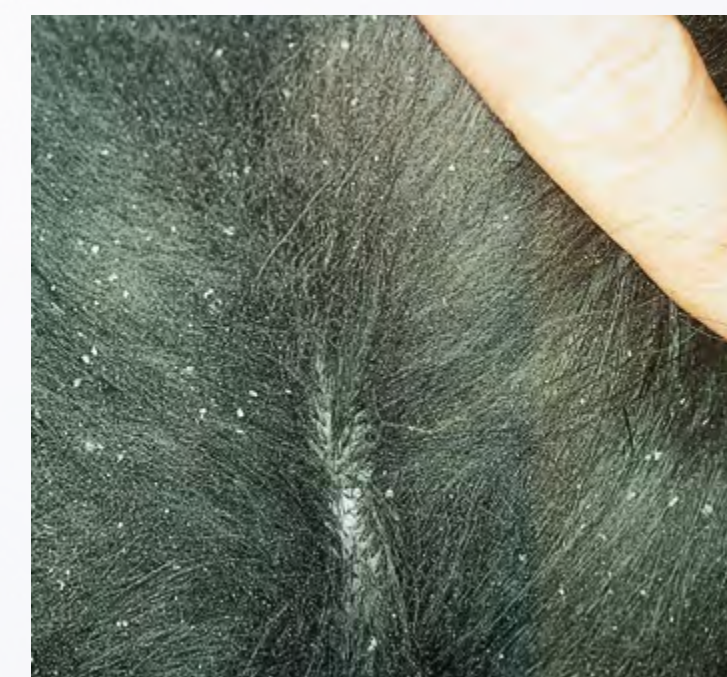
Major elements of history and clinical signs.

- **Fleas.** Flea allergy. Anaemia in heavy infestations.
- **Lice.** Matting of the coat, poor management. Lice and or eggs visible in the coat.
- **Cheyletiella.** Scaling and pruritus. Papular lesions on owners.
- **Neotrombicula.** Late summer and autumn. Pruritus of head and feet. Accumulations of orange-red mites.
- **Straelensia.** Late summer and autumn. Dorsal parts of body. Commonly non-pruritic. Rural dogs.

HISTORY SHEET	
Owner: _____	Date: _____
Dog's name: _____	Breed: _____
Sex: _____	Age: _____
Weight: _____	
1/ Age when acquired and origin (breeder, pet store...): <small>At: Year of the, environment (enclosed, house, garden, flat...), and in-contact pets:</small>	
2/ Geographical area of home, present and past (trips, kennels...):	
3/ Way of life, environment (exercise, house, garden, flat...) and in-contact pets:	
4/ Specific clinical signs and related behaviour: • History of flea infestation, chewing: • Itching of head, face, ears, respiratory area (sneezing, coughing):	
3/ Pruritus, severity and time of onset (before or after lesions): • Upper respiratory signs, conjunctivitis and/or epiphora (ocular secretions): • Lower respiratory signs, nasal discharge and/or sneezing: • Lower respiratory signs, asthmatic problems:	
6/ Seasonal influences:	
7/ Other affected animals (cohabiting, lineage) or human beings in contact: • Owner's view (personal opinion, remarks) on the dermatosis of his dog: • Previous treatments (drugs, products, dosage and duration) and responses:	



Louse infestation in a dog.
Courtesy of: P. Bourdeau



Cheyletiella infestation in a dog.
Courtesy of: H. Koch



Neotrombicula infestation in a dog.
Courtesy of: Royal Veterinary College, London



Straelensia infestation in a dog.
Courtesy of: A. Olivry

► **Differential diagnosis.**

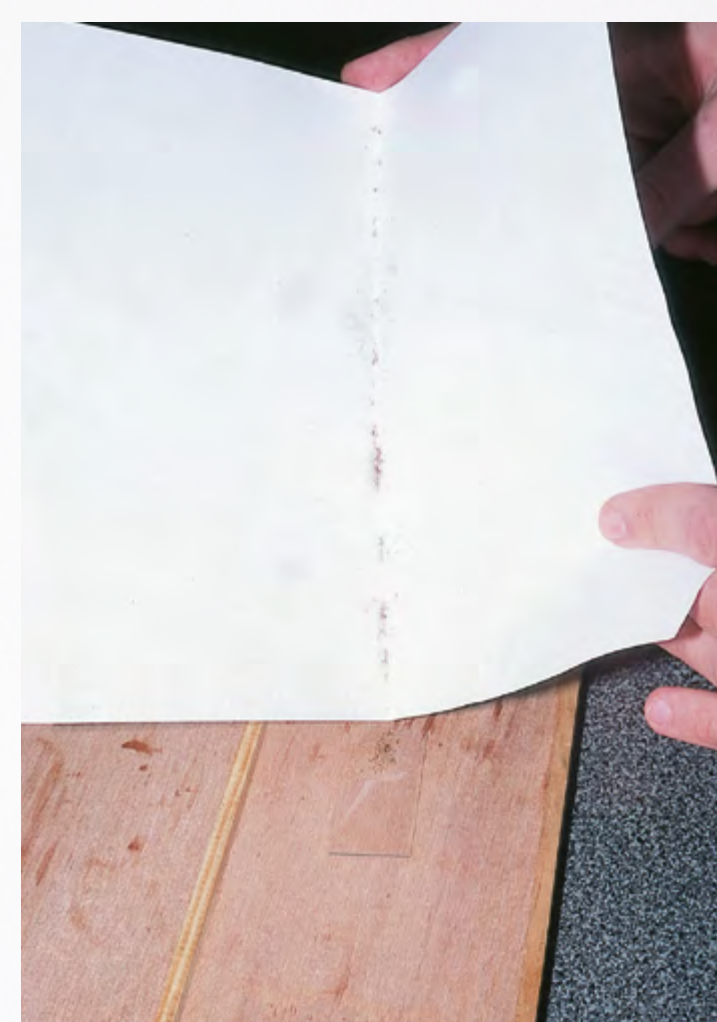
- **Fleas.** See monograph on flea allergy. Where there is no allergy, causes of anaemia (including lice).
- **Lice.** Ectoparasitic infestations including fleas, *Cheyletiella*, *Neotrombicula*, *Otodectes* and *Sarcoptes*, and other causes of debility and anaemia.
- ***Cheyletiella*.** Ectoparasitic infestations including fleas, *Neotrombicula*, *Otodectes* and *Sarcoptes*, and keratinisation disorders.
- ***Neotrombicula*.** Ectoparasitic infestations including fleas, *Cheyletiella*, *Otodectes* and *Sarcoptes*.
- ***Straelensia*.** Superficial and deep pyoderma; demodicosis.

► **Complementary examinations.**

- **Coat brushings.** This method is very efficient. The objective is to have a maximum of cutaneous debris (hairs, scales...) fall down onto a piece of paper, by brushing vigorously the back of the animal. Collected debris is first observed by eye (it is then possible to see some scales "moving") and then dropped onto a slide with lactophenol or liquid paraffin and examined under a coverslip at low magnification. This technique is effective for searching for *Cheyletiella* present on the skin surface, but also allows the detection of flea faeces (wet paper test), or lice and their eggs attached to the hairs (lice are more mobile and are about 1-2 mm in length).
- **Hair plucks.** Mount in paraffin and examine as above for eggs and lice or mites.
- **Skin scrapings.** Remove hair (scissors), apply paraffin to the skin and scrape in areas with scaling or crusting and adjacent skin. Mount scrapings and examine as above.
- **Tape strips.** Use transparent adhesive tape. Apply to the affected area. Useful for trapping lice and collecting hair to check for the presence of eggs and lice or mites. Also useful for *Neotrombicula*. After sampling, press the adhesive side of the tape onto a glass slide and examine in the microscope as above.
- **Biopsy.** *Straelensia* infestation is best diagnosed by histopathology; deep skin scrapings can show the "tubes" in which the larvae live, they might be however negative.



Coat brushing technique in a dog affected by *Cheyletiella* infestation. Courtesy of: D. Pin



Coat brushings from a dog affected by *Cheyletiella* infestation. Courtesy of: D. Pin

TREATMENT

► **Topical treatment.**

- **Fleas.** See monograph on flea allergy dermatitis.
- **Lice.** Shampoo the dog with a good cleansing shampoo and then apply an insecticide of your choice. Lice are readily killed by insecticides. Selamectin is effective against biting lice.
- ***Cheyletiella*.** Four weekly treatments with a parasiticide effective against *Cheyletiella* will usually be curative. Most insecticides and acaricides are effective. Selamectin is reported to be effective as a spot-on. All dogs and cats in contact should be treated. Heavy-coated dogs should be closely clipped to ensure effective penetration of the parasitocidal agent. An antiseborrhoeic shampoo can also be useful. Environmental treatment is advisable (see below). Where topical treatment is unsuccessful or cannot be effectively applied (aggressive animals, large numbers affected, owners cannot cope, sequestration of the mites within the nose suspected) systemic therapy may be necessary.
- ***Neotrombicula*.** One or two applications of an insecticidal shampoo are normally effective. Animals should be kept away from the infested area until the *Neotrombicula* larval season has ended. Combined permethrin and pyriproxyfen is reported to be effective as a spray or a spot-on.
- ***Straelensia*.** Topical therapy alone is not effective but fipronil spray every 15 days combined with systemic therapy may be useful. Antimicrobial shampoos may help to control crusting and secondary infection.

Systemic treatment.

- **Most of these parasites are killed by the isoxazolines.** In case of failure, we can then move to the topical or systemic avermectins; 200-400 µg/kg subcutaneously on two or three occasions at two week intervals may be used. **See monograph on sarcoptic mange**, and especially contra-indications..
- **Anti-inflammatory therapy.** In all these diseases use of glucocorticoids at anti-inflammatory doses may be useful to control pruritus and reduce inflammation initially. To be avoided if possible.
- **Antibiotic therapy.** Where there is secondary pyoderma, treatment with an antibiotic effective against *Staphylococcus pseudintermedius* should be instituted. See monographs on pyoderma.

Additional treatment.

- **Treatment of the environment.** Environmental cleaning, particularly the use of a powerful vacuum cleaner, followed by the use of a parasiticide which persists in the environment for two weeks or more is advisable in cheyletiellosis and may be useful in infestation with lice where many animals are affected. See monograph on flea allergy for anti-flea measures.
- **Better management.** Parasitic infestation, particularly with lice, is likely to be more severe in animals that are not well groomed, are malnourished or in poor bodily condition. Management may need to be improved to aid recovery and reduce the likelihood of recurrence, especially in louse infestation.

Comments.

- Lack of success is likely to occur most often because of failure of owners to properly and fully prescribed treatments. Clear explanation of what is required and maintenance of good communication with owners until the parasites have been eliminated is very important.

PROGNOSIS

- Provided that treatments are properly applied, the prognosis is good. In trombiculidiasis, owners should be warned to avoid infested areas in late summer and autumn.
- Flea allergy is much more difficult to treat successfully (see monograph on flea allergy dermatitis).

FOLLOW-UP

- It is important to re-check the animals to ensure that the parasites have been eliminated. If in doubt, extend the period of treatment.
- Occasionally, lack of response may be due to resistance to the agent used and a new course of treatment with a different product may be necessary.

CONCLUSIONS

- These parasitic infestations require careful evaluation and treatment. Good communication with the owners and careful application of the treatments are the keys to success.
- **Their frequency should not be underestimated.**
- **Flea infestation** of course is **frequent** and **must be vigorously treated** (even in absence of allergic signs).
- **Cheyletiellosis is underestimated and must be investigated.**
- Trombiculidosis due to *Neotrombicula* is more often recognised, because of its seasonal influence, and also because it is more easily detected and often recognised by the owners, but it is rarer than cheyletiellosis.
- Lice infestation is quite rare in many countries but it may be commoner in others.

DEMODICOSIS AND PYODEMOCOSIS

(juvenile onset and adult onset)

INTRODUCTION / DEFINITION

- ▶ **Demodicosis** is a **relatively common** disease, there is a hereditary basis that is very likely, thus predisposing dogs of some breeds.
- ▶ It is associated with **proliferation of the mites *Demodex canis***, which are **normal inhabitants** of the hair follicle, and sometimes of the sebaceous glands.
- ▶ **Secondary bacterial infection** of the hair follicles **often occurs**, and rupture of the hair follicle wall may lead to the presence of free mites in the dermis, and a severe pyogenic infection.
- ▶ Classically, **two forms** of demodicosis are described, namely **localised** and **generalised**. Cases of **the former usually self-cure**, whereas **generalised demodicosis** is a **severe disease** requiring aggressive therapy. However, the distinction frequently made that they are completely different diseases is an oversimplification, as overlapping spectra occur. Also, it should be remembered that every case of generalised demodicosis was once localised.
- ▶ **In addition** to localised and generalised demodicosis, **the following forms are recognised:**



Microscopic view of *Demodex canis* adults (x64).
Courtesy of: D. Pin

- **Juvenile onset demodicosis** (onset prior to puberty) and **adult onset demodicosis:**

- **Juvenile onset** is by far **the most common**, and **although a serious disease, offers a better prognosis than does adult onset.**
- **Adult onset** is usually **associated with severe internal** disease and is often **very difficult to control.**

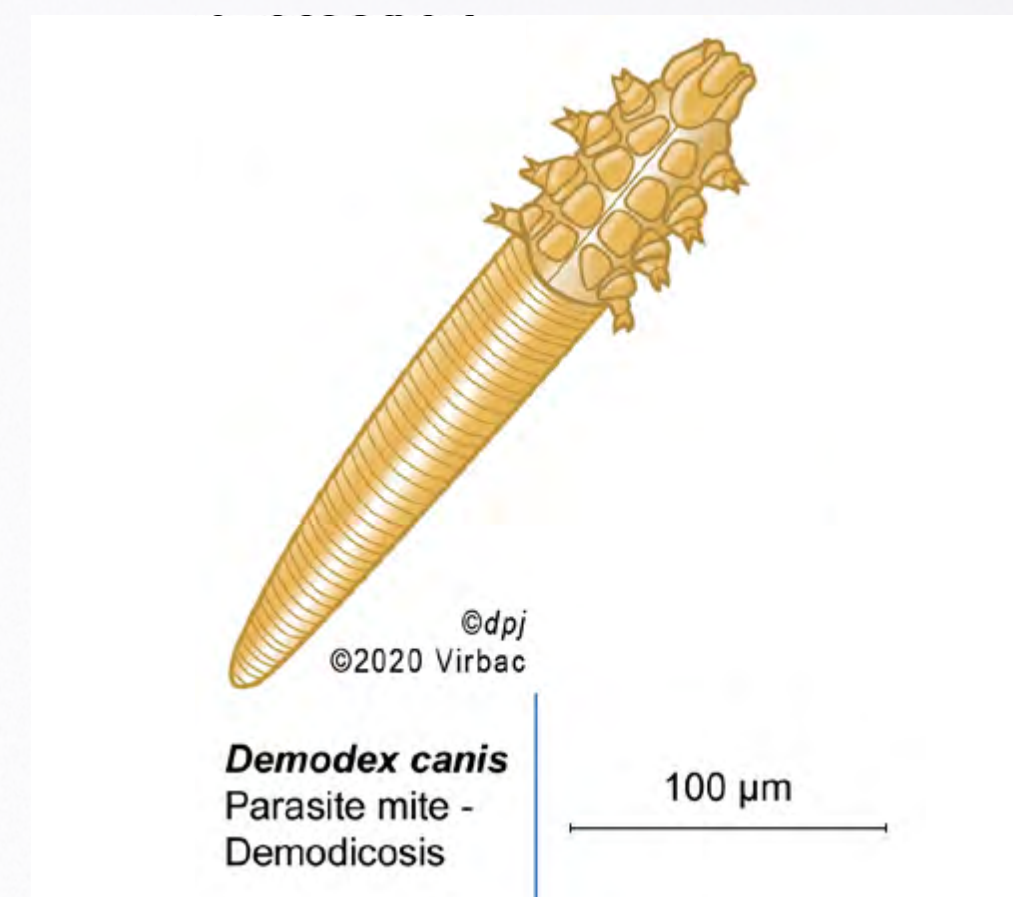
- **Squamous demodicosis** (with no secondary infection) and **pustular demodicosis (pyodemodocosis)** where there is an associated pyoderma. Treatment of the latter involves appropriate antibiotics in addition to parasitocidal therapy.
- **Pododemodocosis** is a demodicosis affecting the feet, generally pustular and often very refractory to treatment.

AETIOLOGY / PATHOGENESIS

- ▶ **The parasite.**
 - The condition is associated with the mite ***Demodex canis***.
 - These mites **reside in the hair follicles** and sometimes the sebaceous glands where they live on sebum and cellular debris.
 - Four stages are seen, the diamond shaped egg, the 6-legged larvae, and the 8-legged nymphal form which develops into the adult.
 - Their **habitat is restricted to the skin**, but may be found in the ear canal. In severe demodicosis all stages may be found in the lymphoid tissues and in many other internal organs. It is assumed that they reach these sites by simple drainage via the lymphatics.



Generalised demodicosis in 5 dogs of the same litter.
Courtesy of: R.E.W. Halliwell.



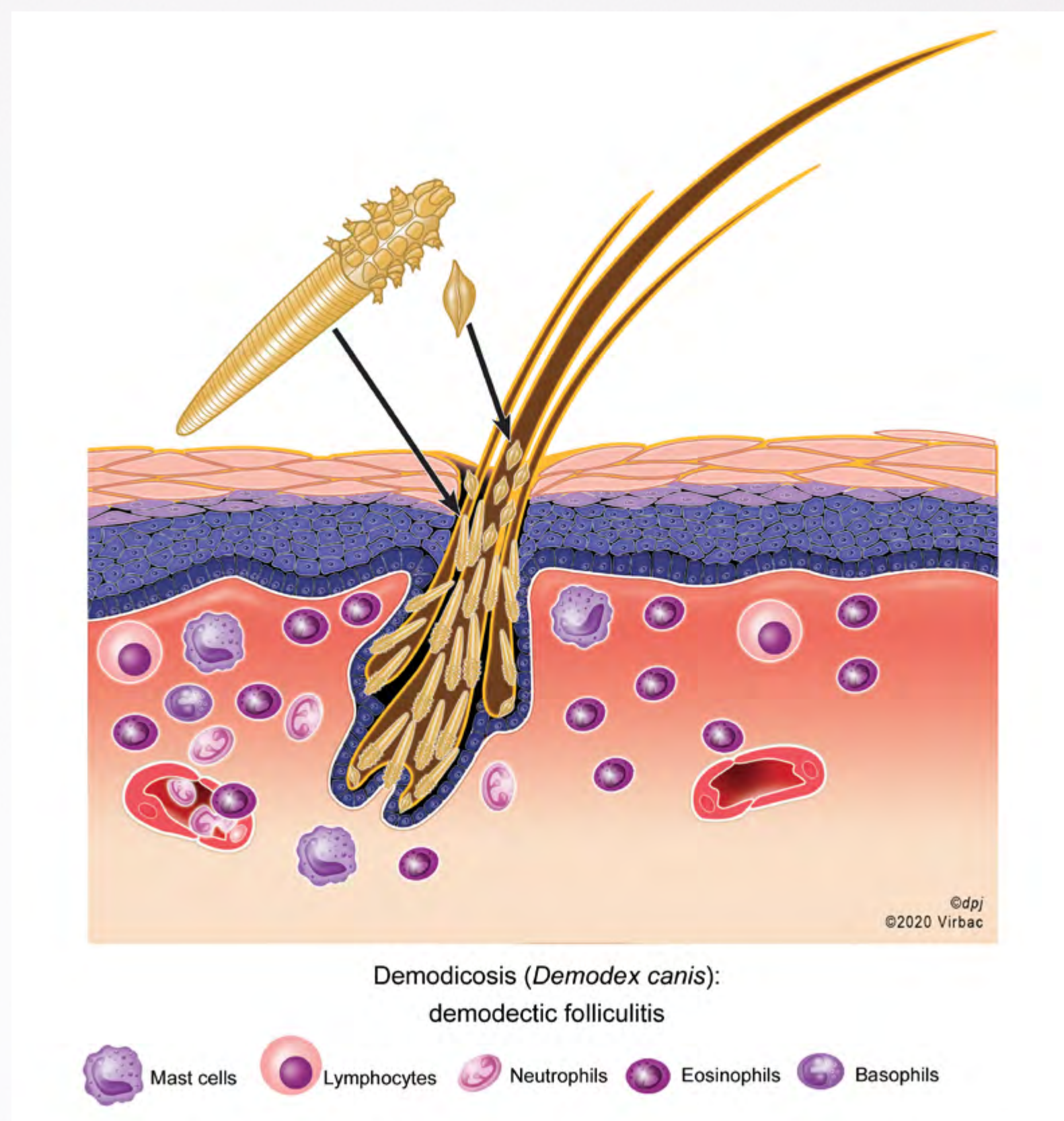
Courtesy of: P. Jasmin.

► **Heredity.**

- There is absolutely no doubt that **the tendency to develop generalised demodicosis is inherited.** Although the precise mode has yet to be elucidated, it is clear that the condition can be transmitted both by the dam and the sire.
- Thus at this point, the recommendation is that **neither the sire nor the dam of litters that have resulted in generalised demodicosis should be used again for breeding.**
- **It is difficult to be as certain in the case of localised demodicosis,** although lines have certainly been encountered within breeding kennels that have a higher than expected incidence.

► **Proliferation of the mites.**

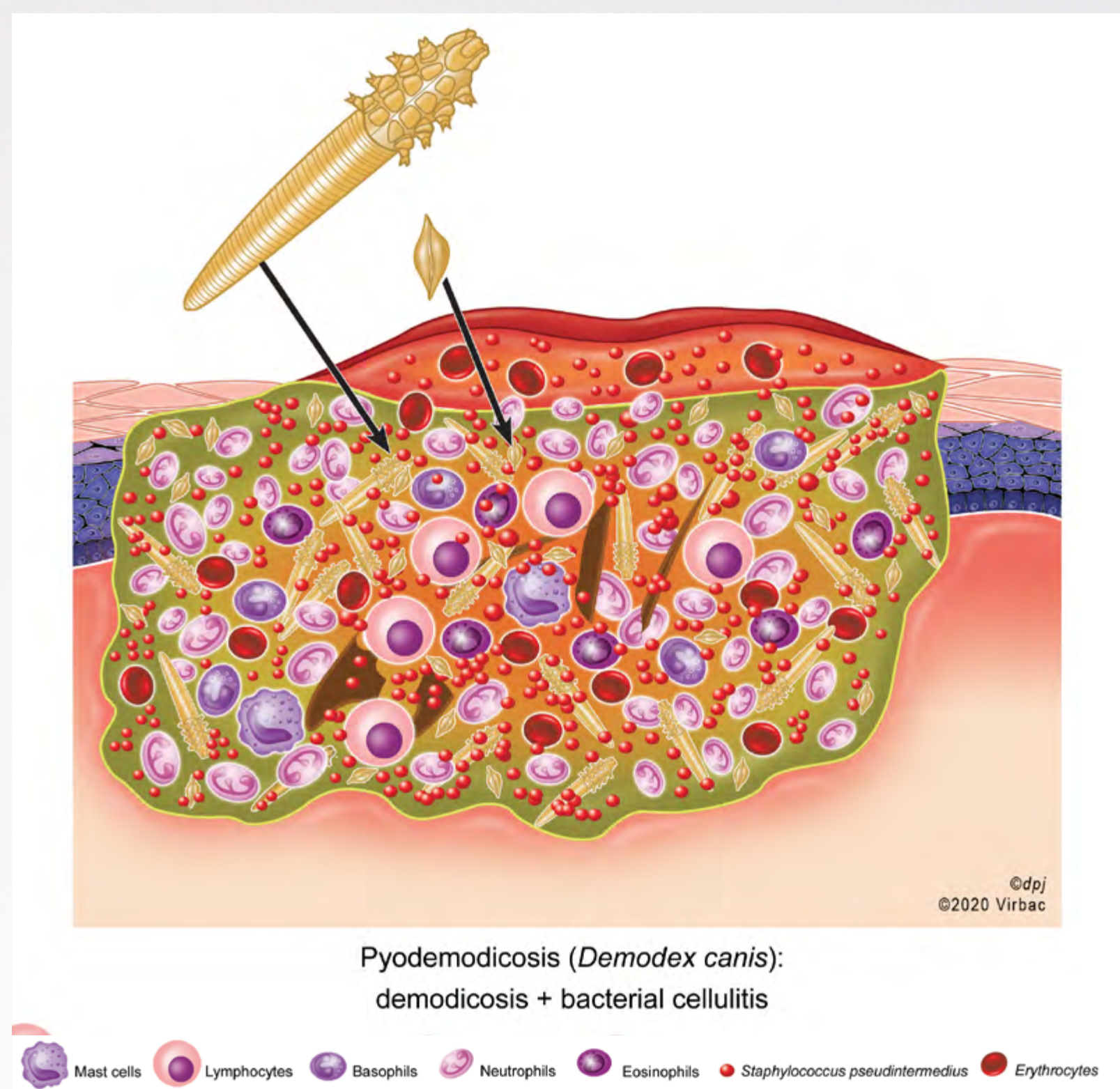
- As already indicated, *Demodex canis* is a **normal inhabitant of canine skin.**
- The puppy acquires the mites within the first few hours of suckling, and only animals reared artificially are free of mites.
- The **factors that cause proliferation** are probably **multiple and complex.** However, much **interest** has **focused on the immunological factors.**
 - There appears to be a **high incidence** of demodicosis in **malnourished puppies,** and also in **association with severe internal parasitism.**
 - **Adult onset generalised demodicosis** is usually **associated with a serious internal disease** and is not infrequently seen with multicentric lymphoma, **hyperadrenocorticism** and hypothyroidism. It may also develop secondarily to **chronic corticosteroid or immunosuppressive therapy.**
 - However, in some cases, no underlying disease can be identified.
- Data from several studies are certainly consistent with **demodicosis** being **associated with a T cell immunodeficiency.**
 - But it is **not always clear** as to whether this defect is **the cause or the result** of the disease.
 - In particular, it fails to explain what triggers the initial mite proliferation.
 - It has been hypothesised that this results from an antigen-specific T cell defect.
 - In support of this, it has been shown that normal dogs show positive delayed intradermal skin tests to crude *Demodex* antigen, whereas animals with demodicosis react negatively.
 - Clearly, such tests must be repeated with purified antigens before conclusive deductions are made.
- In addition, there is some evidence in favour of **hormonal involvement.**
- Although **many dog with Demodex suffer from a "euthyroid sick syndrome",** with low T_4 levels, but a normal TSH response, occasional cases are truly hypothyroid, and will not respond to parasitocidal therapy unless supplemented with thyroid hormone.
- Intact bitches with generalised demodicosis that have been successfully treated, will frequently relapse when they come into oestrus.
- In conclusion, although immunological factors are certainly relevant, there are probably a number of different and interrelated factors that can lead to proliferation of the mites.



Courtesy of: P. Jasmin

- **Development of pustular demodicosis (pyodermatitis).**

 - The following sequence of events occurs:
 - **Proliferation of mites** within the hair follicle **interferes with the normal clearing mechanisms** of the follicle and **predisposes to infection with *Staphylococcus pseudintermedius***.
 - Subsequent **rupture of the hair follicle leads to a bacterial furunculosis** and free mites in the dermis initiate a foreign body reaction.
 - Free keratin from the hair shaft represents further foreign body material.
 - **In long-standing cases the infection can go deeper and cellulitis develops.** This is particularly serious when it involves the interdigital area, leading to severe **pododemodosis**.



Courtesy of: P. Jasmin



Generalised pyodermatitis. Courtesy of: R.E.W. Halliwell.

EPIDEMIOLOGY

The epidemiology can be considered in terms of three differing types:

- **Juvenile onset of localised demodicosis.**

 - Peak age of onset is 3-6 months.
 - Although some lines of differing breeds may be predisposed, localised demodicosis is generally thought of as being a relatively **common disease**, but **without any inherited predisposition**.
- **Juvenile onset of generalised demodicosis.**

 - Again, onset is usually from 3-6 months and it is rare for this to commence after puberty.
 - Fortunately, this disease is **less common**.
 - It usually **commences as localised demodicosis**, of which **some 10% of cases may progress to the generalised form**.
 - Here, there is a **clear inherited predisposition**. Breeds commonly quoted as being **predisposed** include: Old English Sheepdog, German shepherd, Great Dane, Chinese shar pei, Collie, Doberman pinscher, English bulldog, Boxer, Afghan hound, Dalmatian, Dachshund, Beagle...
 - This predisposition can be transmitted both by the dam and the sire.



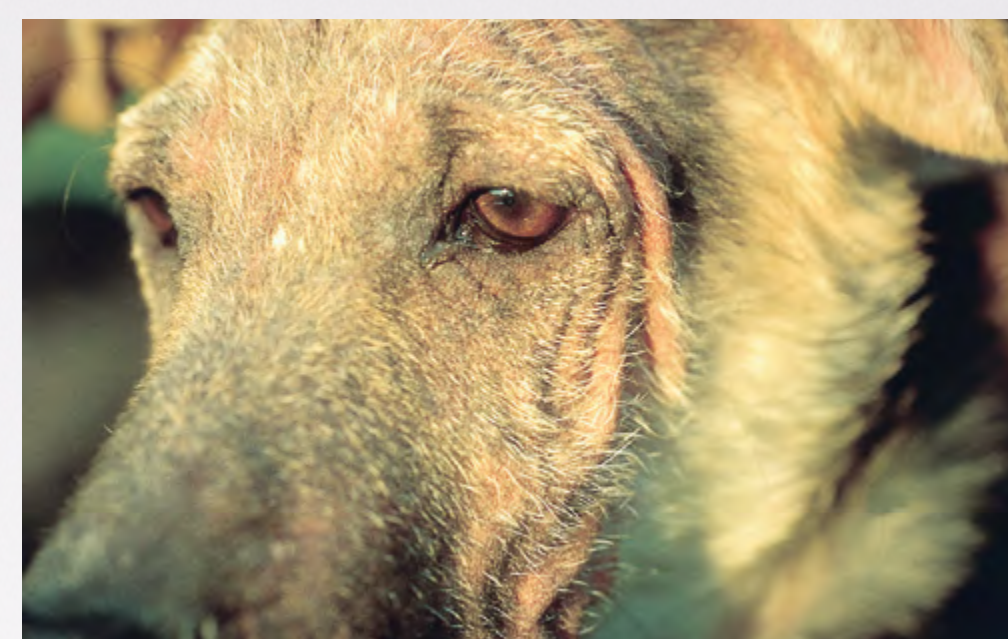
Juvenile onset of localised demodicosis.
Courtesy of: H. Koch

► **Adult onset of generalised demodicosis.**

- This is far less common, and is usually associated **with a severe internal disease** (e.g. **endocrine disorders**, or the **use of corticosteroids** or immunosuppressive drugs).
- Sometimes, demodicosis appears prior to overt signs of internal disease, and so a **continuing search must be made for such diseases during the course of treatment.**
- In some cases, there is **no obvious cause**, and it could be due to **unknown immunologic** or **genetic factors.**



Squamous demodicosis (with no secondary bacterial infection) in a Saluki. Close view of the lower back. Courtesy of: D. Pin



Adult onset of generalised demodicosis. Courtesy of: H. Koch

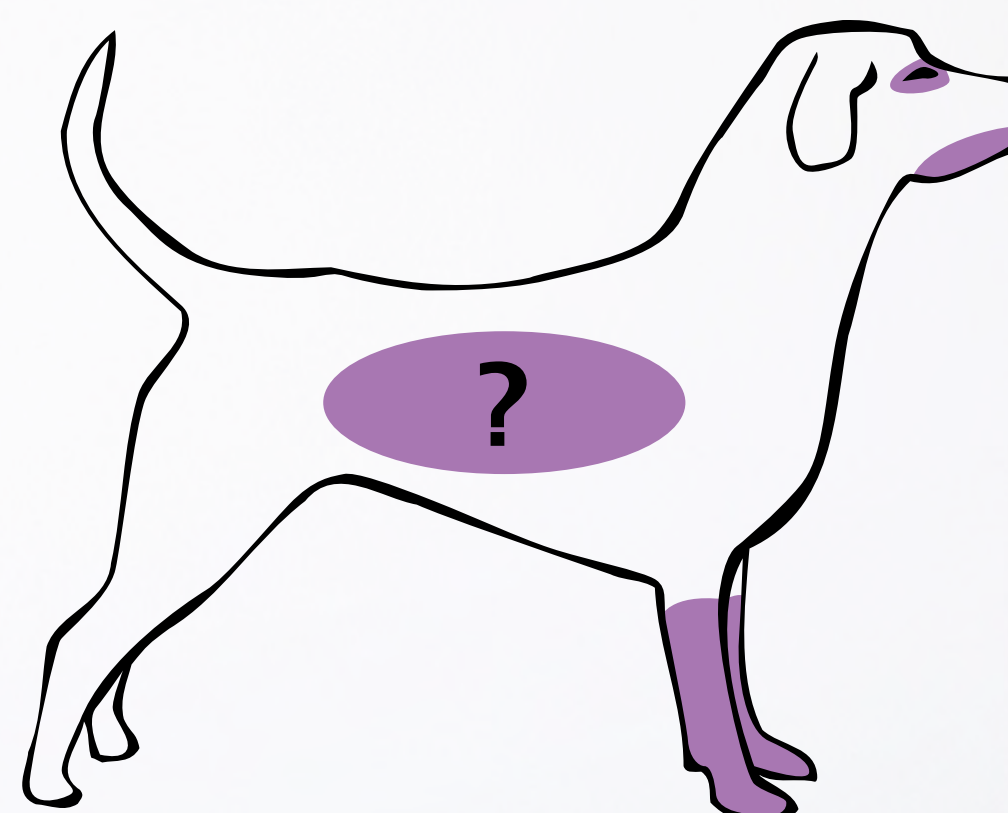


Squamous demodicosis (with no secondary bacterial infection) in a Saluki. Close view of a foot (pododemodicosis). Courtesy of: D. Pin

CLINICAL SIGNS

► **Demodicosis may have any of the following appearances:**

- Areas of predilection are **the face**, particularly the **periocular area** and **commissures of the lips**, and the **forelegs**.
- **Focal, demarcated areas of alopecia accompanied by a fine scale.** There might be a **unique "blue-grey"** color of the lesional patches.
- **Such areas may be erythematous.**
- Areas of **follicular plugging** are **often seen** and may be the only sign when the disease involves the hairless areas.
- **Focal, or generalised** areas with **comedones** and of **seborrhoea** manifested by **excessive scale** and a **waxy surface** lipid film.
- **Most cases of demodicosis are non-pruritic unless there is a secondary pyoderma.** However, rarely, some localised and some more generalised cases may be quite pruritic, markedly erythematous and **occasionally appear clinically compatible with atopic dermatitis.**
- **Some cases**, usually those with marked follicular plugging, **develop a bacterial folliculitis and show pustules.**
- **Deep pyoderma**, either **furunculosis** or **cellulitis** is **often a sequel and indeed this may be the only presenting sign.**
- Very rarely, **ulceration may develop**, especially on the face and mucocutaneous areas which **may mimic autoimmune diseases.**
- Caution: all cases of deep pyoderma, especially if present in an unusual site or in an unusual breed, must be carefully evaluated for demodicosis (**deep pyoderma = scrapings!**).



Cellulitis lesions in a dog affected by pyodemodicosis. Courtesy of: D.Pin

When does localised demodicosis become generalised demodicosis?

- This is debatable.
- However, in general the presence of **more than 5 patches of localised demodicosis, or the development of confluent patches should alert the clinician** to the possibility that generalised disease exists and that **aggressive therapy is indicated.**



Generalised pyodermatitis in a dog. Close view of the lower back. Courtesy of: D. Pin



Generalised pyodermatitis in a dog. Close view of a foot (pododemodectosis). Courtesy of: D. Pin

DIAGNOSIS

History.

- **Juvenile onset localised demodicosis is the most common.**
- Although *Demodex canis* is acquired by puppies within the first few hours of suckling it is a **normal inhabitant of canine skin** and **demodicosis is not a contagious disease.**
- **Adult onset generalised demodicosis is far less common** and is usually (but not always) **associated with an identifiable internal disease, which may be of a serious nature.** In some cases the onset of demodicosis precedes the overt development of the underlying disease.

Clinical elements.

- Major lesions are **focal to generalised** areas of **alopecia** and **seborrhoea.**
- With a predilection of development on the **face** and **forelegs.**
- Areas of **follicular plugging** are often seen.
- Demodicosis is usually **non-pruritic except when there is a secondary pyoderma.**
- **Secondary pyoderma** (folliculitis, furunculosis or cellulitis) is not infrequent.

Skin scrapings.

- The **diagnosis** is most often made by **demonstration of the mites by skin scraping.**
- As *Demodex* mites are part of the normal microfauna, one mite identified on several deep skin scrapings could be a normal but uncommon finding.
- If only one mite is found in a dog with compatible clinical signs, further skin scrapings should be performed to confirm the diagnosis.
- **More than one mite is strongly suggestive of clinical demodicosis.**
- **Different life stages** (eggs, larvae, nymphs and adults) and their numbers **should be recorded** and compared from the same sites at each visit to objectively measure the treatment success.
- The performance of the skin scraping:
 1. Some **3-5 sites** are selected for skin scraping.
 2. The hair, if present, is clipped.
 3. The **skin** is gently **squeezed between thumb and forefinger to force the mites more superficially** in the hair follicle.
 4. The **skin** is **moistened** with **liquid paraffin** or **mineral oil.**
 5. Some is **also placed on the slide.**
 6. The **skin** is then **scraped using a blunted scalpel blade until capillary bleeding** is observed.
 7. the **material** is then **transferred to the slide.**
 8. **The entire slide is scanned using the 10X objective.**
 9. **Focus on suspicious areas using the 40X objective if necessary.**
 10. The proportion of **live and dead mites, of adult and young forms** and of eggs should be **recorded.**

HISTORY SHEET

Breed: _____ Date: _____
 Name: _____ Sex: _____ Age: _____
 Weight: _____

GENERAL HISTORY

1/ Age when acquired (e.g. breeder, pet store, ...)
 2/ Geographical area of home, present and past (trip, travels, ...)
 3/ Way of life, environment (pasture, forest, garden, field, ...), and in contact with:
 4/ Diet (source and previous):
 5/ Reproduction (frequency of oestrus, pregnancy, behaviour of males, ...)

8/ Current non skin-related problems:

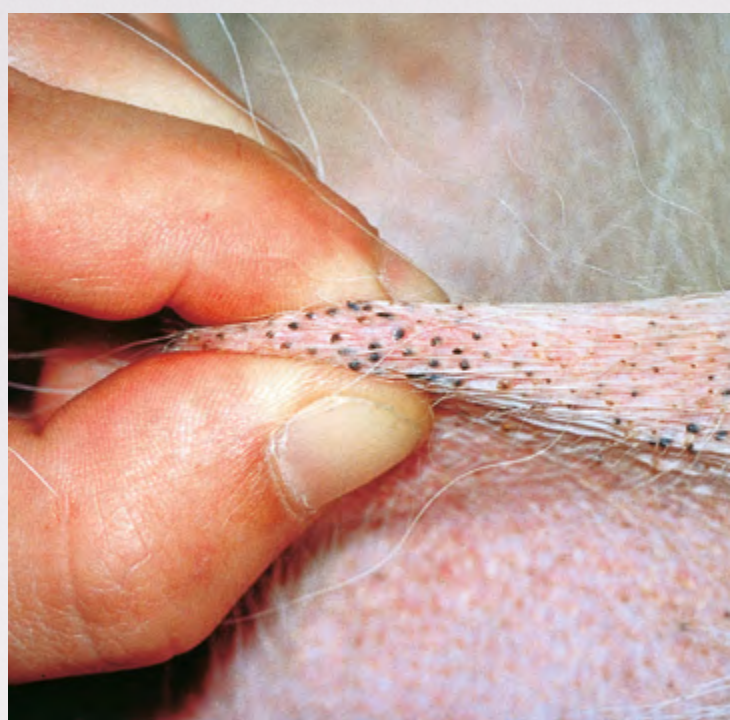
1/ Behavioural changes
DERMATOLOGICAL HISTORY
 1/ Chief complaint:
 2/ Date of onset:
 3/ Onset, severity and time of onset (before or after season):
 4/ Specific clinical signs and related behaviour:
 • Itching of feet (licking, chewing):
 • Itching of head, lips, chin, periorbital area (scratching, rubbing):
 • Otitis, itching of ear pinnae (scratching, shaking):

5/ First cutaneous lesions observed and their development:

1/ Seasonal influences:
 2/ Other affected animals (collaborating, inseparator or human beings in contact):
 3/ Presence of flea and ectoparasitic treatments (date):

11/ Previous treatments (date, products, dosage, duration) and responses:

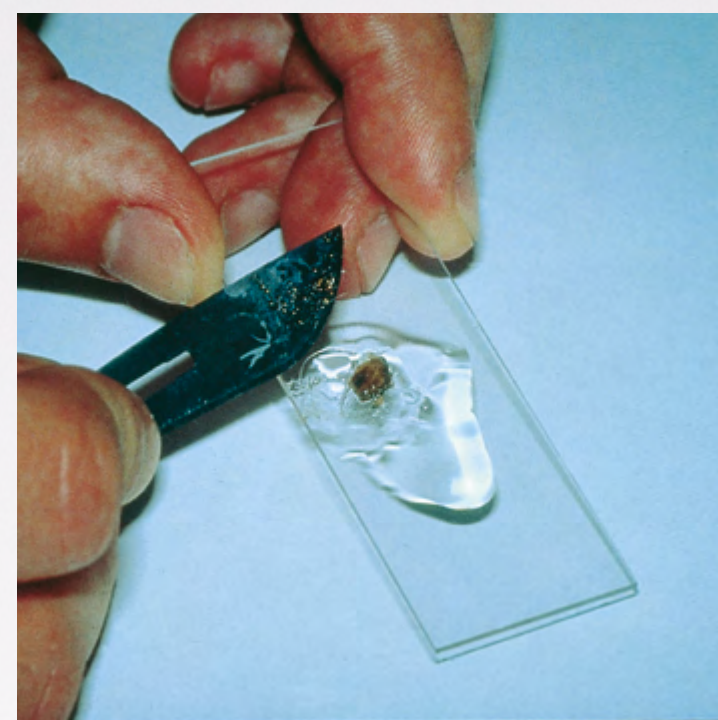
Note that mites are more readily demonstrated in demodicosis than in Sarcoptic mange and failure to demonstrate mites by skin scraping nearly always eliminates the diagnosis, as skin scrapings have a high sensitivity for *Demodex*. The only exception to this is in cases of pododemodectosis, when the mites may be very hard to find.



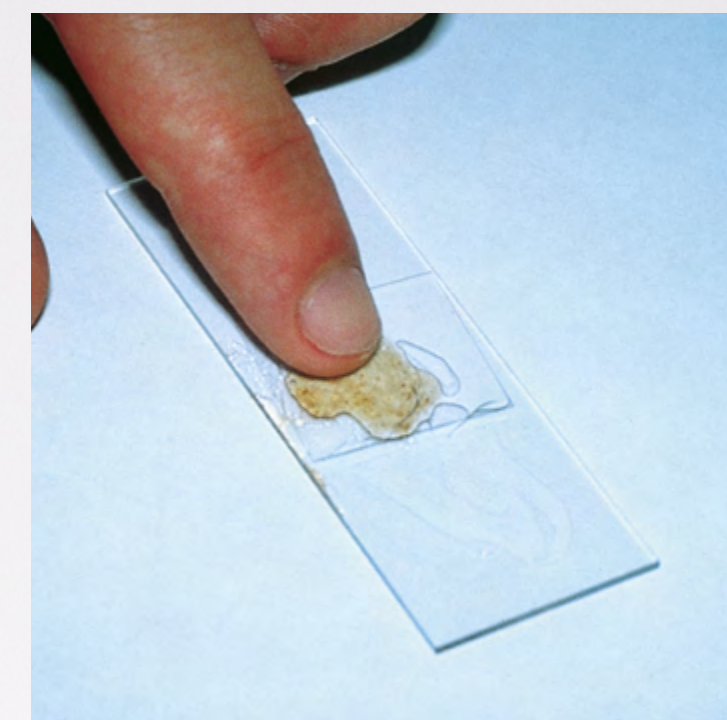
Skin scraping. Courtesy of: D.N. Carlotti



Skin scraping. Courtesy of: D.N. Carlotti



Skin scraping. Courtesy of: D.N. Carlotti



Skin scraping. Courtesy of: D.N. Carlotti

Other diagnostic aids.

- **Examination of hair "pluckings"**: as the mites are deep in the hair follicle, they are often readily observed around the hair bulb of hairs plucked from the periphery of lesions. However this method is less sensitive than is skin scraping, so a negative trichogram should be followed by deep scrapes.
- **Examination of pustular exudate**: material squeezed from areas of deep pyoderma frequently reveal many mites free in the exudate.
- **Skin biopsies**:
 - Biopsy samples of affected skin are an **effective method** of diagnosis, but are unnecessary for routine cases.
 - Sometimes the mites may be very deep, especially when associated with a deep pyoderma such as in pododemodicosis and not readily demonstrated by skin scrapings.
 - In some breeds, such as Chinese shar pei, the skin is sometimes difficult to scrape.
 - **If the clinical index of suspicion is high such cases should be biopsied if negative skin scrapings result.**
 - In demodicosis, contrary to the case in Sarcoptic mange, mites are easily seen during histopathological examination of skin biopsies.
 - **Tape strips** have also been reported as an excellent diagnostic method. While squeezing the skin, the cellophane tape is pressed onto the skin with the sticky surface down. A negative test may be followed by deep scrapes.

Major differentials.

- The **localised form** is readily confused clinically with **dermatophytosis**.
- Lesions of demodicosis also resemble those of **leishmaniasis** and occasionally, the two diseases may coexist.
- The **pustular form** resembles any other form of **deep pyoderma**.
- Other deep, exudative diseases that may be confused with demodicosis are nodular panniculitis and (in areas of the world where they exist) the intermediate and deep mycoses such as sporotrichosis.

TREATMENT

Localised demodicosis.

- **This is usually a self-limiting disease that cures spontaneously.**
- Treatment with parasiticides is usually not warranted.
- In general it can be stated that:
 - **Cases that have very few mites** are probably curing themselves and **treatment is not warranted.**
 - **Where many mites are seen** and especially young forms and eggs **treatment should be given.**
 - In juvenile dogs, the treatment of the demodicosis and possible bacterial infection is generally sufficient without the need for further diagnostics.
- **However, always remember that some 10% of cases of localised demodicosis go on to become generalised. Therefore, whether or not treatment is given a careful follow-up is necessary.**

Generalised demodicosis.

- **Aggressive acaricidal therapy is necessary for this is a potentially fatal disease.**



Localised demodicosis.
Courtesy of: R.E.W. Halliwell.



Lesional aspect in a dog affected by dermatophytosis due to *Microsporum canis*. Courtesy of: S. White

• **Amitraz**

- Amitraz is used at 250 parts per million (ppm) applied every 2 weeks in the USA, but **at 500 ppm weekly** in most other countries.
- It should not be used in **Chihuahuas and other smaller breeds due to concern with toxicity, and is used at lower concentrations in debilitated animals.**
- Other considerations in the use of amitraz are:
 - » long and medium coated dogs should be clipped and the hair kept short during treatment,
 - » any crusts should be removed by warm water soaks,
 - » prior shampooing with a sulphur/salicylic acid or benzoyl peroxide shampoo is helpful,
 - » skin scrapings should be taken every 2-3 weeks to monitor the response in terms of the live/dead mite ratio, and the number of eggs and juvenile forms,
 - » therapy should be continued for at least 2 weeks or 2 dips after mites were last demonstrated.

• **Macrocytic lactones**

- Oral ivermectin at 0.3-0.6 mg/kg daily, not licensed.
- Moxidectin at 0.3-0.5 mg/kg daily, not licensed.
- Milbemycin oxime at 1.0-2.0 mg/kg daily, licensed in some countries.
- Doramectin injected subcutaneously every week at 0.6 mg/kg, not licensed.
- Initial gradual dose increase is recommended for systemic moxidectin and ivermectin to identify dogs potentially sensitive to toxicoses.
- A combination of 10% imidacloprid and 2.5% moxidectin spot-on could be used for less severe cases.
- **Collies of all types, old English sheepdogs, other herding dogs and their crosses, and any other dogs with the MDR 1 gene mutation should never receive ivermectin,** which is not licensed for this use in any country of the world. **Toxicity has been recorded even in dogs lacking this mutation.**

• **Isoxazolines**

- **Isoxazoline family of oral parasiticides:** fluralaner, afoxolaner, lotilaner, sarolaner and similar drugs every 1 to 3 months (fluralaner), **represents one of the best current choice** because of high efficacy and low risk.

• **Antibiotic therapy.**

- Concomitant antibiotics should be used in cases of pustular demodicosis.
- Generally, **an antibiotic** that is **appropriate for *Staphylococcus pseudintermedius*** is used, irrespective of whether gram-negative organisms are also isolated.
- In cases with severe secondary infections, culture and sensitivity are mandatory, and if the animal is severely debilitated, an antibiotic that will encompass both Gram-positives and Gram-negatives may be necessary and indeed life-saving.
- **Antibiotic therapy should be continued until the mite population is well-controlled.**

• **Further supportive therapy.**

- **Antiseptic shampoo adjunctive therapy** may be sufficient in mild to moderate bacterial infection, or associated with systemic antibiotic therapy in more severe infections.
- Remember that cases of **adult-onset demodicosis** are likely to be **associated with an underlying disease process or with drug administration.**
- **Any contributing disease must, therefore, be treated.**
- All intact bitches must be subjected to ovariohysterectomy, or recurrence will be very likely.

FOLLOW-UP

General remarks.

- **Treatment efficacy** for generalised demodicosis has to be **evaluated microscopically every month until the second negative skin scrapings**, therapy should be **continued 4 to 8 weeks beyond** to limit the risk of recurrence.
- Follow up involves a **full clinical examination and multiple skin scrapings from affected areas**.
- Live mites are readily identified by their movement, even under oil.
- The **proportion of live/dead mites**, and the different life stages (eggs, larvae, nymphs and adults) and their numbers, should be recorded and compared from the same sites at each visit to objectively measure the treatment success.
- **All cases**, both localised and generalised, **should be re-checked initially at intervals of 2 to 4 weeks** and assessed as above.
- Cases of localised demodicosis in which it was elected not to give treatment initially, should be immediately subjected to parasitocidal therapy if they show signs of spreading, or if a greater proportion of live mites, eggs and young forms are found.
- **Cases under long term treatment can be checked monthly**, and if the proportion of live/dead mites is not diminishing, then consideration should be given to the use of an alternative therapy.

The approach to recurrent and/or resistant cases.

- Be sure that the treatment has been correctly administered.
- Be sure that the entire mite population has, as far as can be ascertained, been eliminated.
- **Be sure that any underlying disease has been appropriately and successfully treated.**
- Long-term use of safer drugs such as isoxazolines may limit recurrent or resistant cases.

PROGNOSIS

The cure is defined as 2 negative skin scrapings at one month interval.

The prognosis for juvenile onset localised demodicosis is very good.

The prognosis for juvenile onset generalised demodicosis is always guarded.

- Recurrence even over one year after apparently successful therapy may occur.
- Essentially, the case of severe, generalised demodicosis can never be considered as cured.
- In particular, pododemodicosis has an especially guarded prognosis.
- However, upon recurrence, reinstatement of therapy may still be successful.

The prognosis for adult onset generalised demodicosis is especially guarded.

- In that it is often associated with serious underlying disease.
- However, if the underlying disease is successfully controlled, then the demodicosis should also be controlled.

CONCLUSIONS

- Demodicosis is **often a frustrating disease to manage** and one where the precise aetiological factors are poorly understood.
- **Owner education is vital** in obtaining co-operation **in the therapeutic approaches** which may be **expensive** and are often **long-term**.
- **In adult dogs, generalised demodicosis is a very serious disease** and is usually **secondary to an underlying disease process. Both the demodicosis and the underlying disease must be treated.**
- **In young dogs generalised demodicosis is still a very serious disease** with a guarded prognosis, but there is **usually an absence of underlying disease.**
- **Juvenile localised demodicosis is usually a benign** and self-limiting **disease**, although all such cases should be carefully monitored for any tendency to develop generalised disease.

PYODERMA - GENERAL PRESENTATION

INTRODUCTION / DEFINITION

- ▶ Canine pyoderma is a **pyogenic bacterial infection** of the dog's skin.
- ▶ Pyodermas are **very frequent, often pruritic** dermatoses of dogs.
- ▶ They **should always be considered as a possible differential diagnosis at primary presentation** of canine dermatoses.
- ▶ Correct **diagnosis** is of **major importance**, especially in the case of pruritic skin diseases, as pyoderma can **mimic a great number of dermatoses and above all be secondary to them**.

KEY POINTS AND CLASSIFICATION

- ▶ According to the origin and/or immune status of the dog, they can be **superficial or deep, localised or generalised**. Superficial proliferation of bacteriae (Staphylococci mainly) might be considered as a "surface pyoderma".
A recurrent pyoderma is a pyoderma that responds well to appropriate therapy (topical and systemic antibiotic) but that relapses soon after treatment discontinuation, and/or regularly, which implies repeated treatments.
A resistant pyoderma is a pyoderma that does not respond to a number of usually effective therapies, particularly classical antibiotic treatments and thus necessitates aggressive treatment, including with particular antibiotics.
- ▶ **Pyoderma** has **different causes and/or characteristics** depending upon whether it is found in **young or adult dogs**. Even though the first fundamental division of the general dermatological approach proposed is done according to the age of the animal, for practicality and the purposes of clarity, **pyodermas will be differently but closely classified as "simple approach pyodermas" and as "complex approach pyodermas"**.
- ▶ **Terminology.**
 - **Simple approach pyodermas** may be **primary** or **idiopathic**, or **related** to causes that need to be investigated simultaneously in the first instance. There can be evident causes (folded skin in intertrigo) or other dermatoses, mostly ectoparasitic infestations (demodicosis and Sarcoptic mange in particular).
 - **Complex approach pyodermas** are **secondary** to underlying causes (mostly allergies and endocrine disorders) that need to be explored in the second instance, after treating the pyoderma when it interferes with any further diagnosis.
- ▶ It is important to highlight that **many forms of pyoderma** may just depend upon the combination of **virulence factors of the *Staphylococci*** and **host responses**.
- ▶ **In the young dog.**
 - **Only simple approach pyodermas are present**; they are **superficial: intertrigo, folliculitis** and **impetigo** (exceptionally a juvenile pyodemodiosis may be deep).
- ▶ **In the adult dog.**
 - **Simple approach pyodermas are rarely present**. In **most cases, complex approach pyoderma** is present **secondary** to allergic dermatitis or endocrine disorders.

- **Simple approach pyodermas** are **superficial: intertrigo, idiopathic folliculitis** (in the so-called short-haired breeds or due to so-called bacterial hypersensitivity) and **folliculitis related to ectoparasitic infestation** (except for demodicosis that is secondary in adult dogs; pyodermoidosis then has a complex approach).
 - **The so-called short-haired breeds pyoderma likely represents and exfoliative superficial pyoderma (ESP)** in which the *Staphylococci* proteases digest the bonds between the hair shaft and the inner root sheath. If we look at the edges of the circular alopecia, we will typically find the collarettes typical of ESP.
 - **The so-called bacterial hypersensitivity might not exist. It might just be an ESP or a *Staphylococcus* that produces specific virulence factors.**
 - **Complex approach pyodermas** are **secondary** and chiefly **very frequent** (directly related to the frequency of the underlying cause). They can be:
 - superficial (**folliculitis**): usually secondary to allergic dermatitis, very frequent.
 - deep (**furunculosis** and **cellulitis** including pyodermoidosis): generally secondary to endocrine disorders, much lower frequency.
 - "pseudo-pyodermas" or "surface pyoderma" (**pyotraumatic dermatitis** or "**hot spots**") which has a "semi-complex approach" as they are generally secondary to a flea allergy dermatitis - relatively frequent.
 - NB: some rare cases of localised deep pyoderma (e.g., pododermatitis) are idiopathic and then of simple approach.
- **Simple approach pyodermas** therefore represent **the majority of pyodermas found in young dogs** and in **some rare cases, adults**. They are chiefly **superficial**.
 - **Complex approach pyodermas** follow the occurrence of underlying dermatoses and **concern only adult dogs**. They are more frequently **superficial** and **secondary to allergic dermatitis**.
 - **Table summarising the different classifications:**

AGE CATEGORY	YOUNG DOG		ADULT DOG		
	SUPERFICIAL PYODERMAS	DEEP PYODERMAS	SUPERFICIAL PYODERMAS	DEEP PYODERMAS	SURFACE PYODERMAS
Simple approach pyodermas	Intertrigo Folliculitis Impetigo	≈ 0* (<i>Pyodermoidosis</i>) (<i>Canine acne</i>)	Intertrigo, Idiopathic folliculitis	≈ 0 (<i>Idiopathic interdigital pyoderma***</i>) (<i>Nasal pyoderma</i>) (<i>Localised cellulitis</i>)	≈ 0
Complex approach pyodermas	≈ 0	≈ 0	Folliculitis Impetigo**	Furunculosis Cellulitis (including <i>Pyodermoidosis</i>) Interdigital pyoderma***	Pyotraumatic dermatitis ("Hot spot")

Typography indicating the relative importance of these pyodermas: **very frequent, frequent**, not frequent, rare.

Because of their specific nature, some pyodermas are classified in the third group of the diagnostic approach:

* Beware juvenile cellulitis which looks like cellulitis, affecting puppies of only few months old, which must however be thoroughly investigated.

** Impetigo is rarely seen in adults but it is usually severe and secondary to trauma or debilitating underlying diseases (Cushing's syndrome...).

*** Interdigital pyoderma might represent the rupture of follicular cysts on the bottom of the feet.

AETIOLOGY, PATHOGENESIS AND EPIDEMIOLOGY

- Canine pyoderma is due to the **multiplication of bacteria** in the epidermis and its appendages (hair follicles in folliculitis, or sweat glands in hidradenitis) in the case of superficial pyoderma, and with invasion of the dermis in the case of deep pyoderma.

- The bacteria.**

- In most cases**, the sole agent involved is a coagulase-positive **staphylococcus specific to the dog** – ***Staphylococcus pseudintermedius***.
- In other rare cases, other species of pathogenic staphylococci can be found - *Staphylococcus aureus* or *Staphylococcus hyicus* or *Staphylococcus schleiferi* (var *schleiferi* or *coagulans*).
- Other bacteria can be involved, particularly gram-negative bacteria (*Pseudomonas aeruginosa*, *Proteus mirabilis*, *Escherichia coli*...), but their development is usually secondary to the outgrowth of *Staphylococcus pseudintermedius*.
- Therefore, the latter will always have to be the **principle target** of the treatment, whatever the results of bacterial culture.

- Pathogenesis.**

In the dog, the *stratum corneum* is far thinner and more compact than that of any other species, and there is a paucity of intercellular emulsion. Furthermore, the hair follicle infundibulum of the dog is open, lacking a sebum plug.

- Staphylococcus pseudintermedius* belongs to the resident flora of the dog's skin and mucosa.**

- It becomes pathogenic** when the equilibrium of the cutaneous ecosystem is disturbed by modifications in the surface micro-environment. Pathogenic staphylococci can easily colonize an inflamed and excoriated, seborrhoeic skin. In fact, inflamed skin has accelerated epidermal proliferation and desquamation and is more humid and warmer. These alterations of the skin surface micro-environment promote the multiplication of bacteria. Furthermore, self-trauma and excoriations due to pruritus further degrade the epidermal defences and allow inoculation of bacteria into the skin.

- This explains why **pyodermas are essentially secondary to underlying dermatoses.**

- They are therefore **very frequent in adult dogs**, which group is more susceptible to skin diseases and in particular, allergies. Allergic skin disease, notably atopic dermatitis, is thus probably one of the most common causes of canine pyoderma and particularly of recurrent pyoderma.

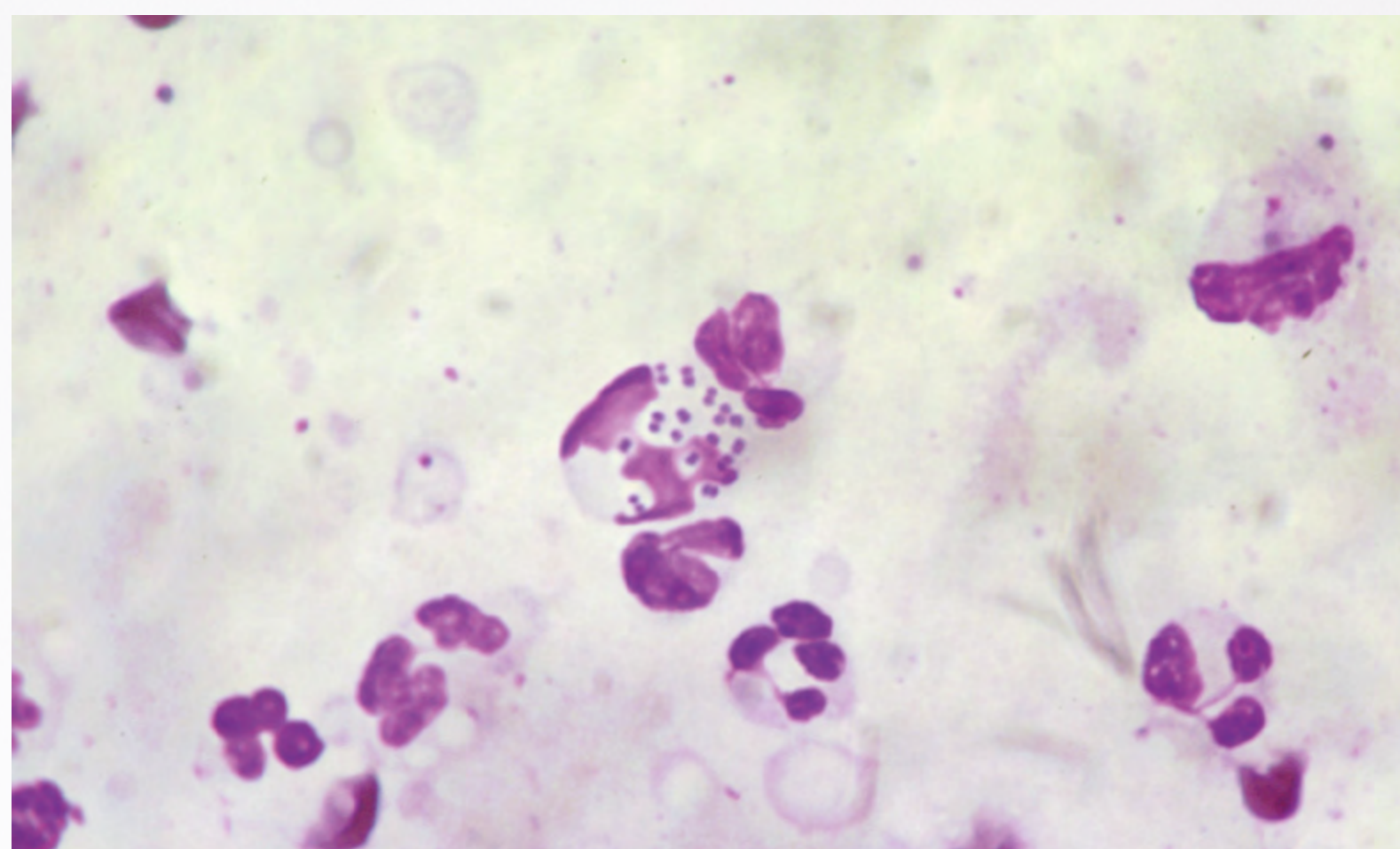
In addition, it has been demonstrated that dogs affected with primary seborrhoea have markedly higher cutaneous bacterial counts than normal dogs, with a flora composed primarily of coagulase-positive staphylococci. Any seborrhoeic skin disease (including allergic skin disease and endocrinopathies) is therefore a possible cause of canine pyoderma. If the keratoseborrhoeic condition is not controlled, the pyoderma can become recurrent.

- A vicious circle can then take place, staphylococci secreting virulent factors aggravating the cutaneous lesions and therefore the bacterial overgrowth. Antibacterial therapy is hence the key component in general therapy.
- Another likely explanation, especially for the "primary" pyodermas, are **deficits in the skin immune system**, or innate defences.

- Pyodermas are generally not contagious** neither to animals nor to humans. Nevertheless, routine hygienic rules must be respected when the animal presents with suppurative lesions.

- The aetiology of recurrent pyoderma includes:**

- Anatomic defect i.e. excessive folds that cause intertrigo.
- Allergic skin disease, generating skin inflammation and consequently skin infection, mostly superficial (folliculitis) but also deep in severe and poorly treated cases.



Staphylococcus intermedius in a neutrophil (phagocytosis).
Courtesy of: D. Pin

- Cornification disorders.
- Immunological deficiencies.
- Inappropriate treatments:
 - Poor selection of antibiotics.
 - Lack of complementary anti-microbial topical treatment.
 - Too short antibiotic therapy.
 - Too low dosage of antibiotic therapy.
 - Simultaneous use of contra-indicated drugs, particularly glucocorticoids that are never indicated in pyoderma, even in case of severe pruritus, because of their rebound effect; in addition, the pruritus due to pyoderma disappears very quickly after the initiation of specific therapy.

The main cause of resistant pyoderma is infection with resistant strains, including MRSP (and eventually Methicillin Resistant *Staphylococcus aureus* – MRSA – or Methicillin Resistant *Staphylococcus schleiferei* – MRSS) or *Pseudomonas spp.*

DIAGNOSTIC METHODS

- ▶ **Clinical suspicion is fundamental** and may justify by itself the initiation of systemic antibacterial therapy, especially where there are pustules.
- ▶ **Cytology.**
 - **An excellent method to support the clinical diagnosis**, providing there are good data indicating the presence of pyoderma or other possible causes. It is also **reliable** and allows **rapid** performance and interpretation (at the patient's side) and relatively inexpensive.
 - **The cellular types observed in pyodermas are the following:**
 - Microscopic **observation of pus** is **substantiated by the presence of neutrophils** which can be **degenerate** (also called "impaired") **or non-degenerate**. The degenerate neutrophils indicate an active immune status. They do not stain much and appear bulky, with hypersegmented and pyknotic nuclei while the non-degenerate neutrophils appear healthy and well stained (dark purple).
 - **Presence of bacteria**, generally **cocci** (and more rarely rods).
 - **Bacteria** may be **extracellular** (next to the neutrophils) or **intracellular**. In the latter case a few bacteria are gathered in vacuoles in a neutrophil appearing degenerate: this a **sign of engulfment** (phagocytosis) which indicates an immune response by the host and is suggestive of an active disease status, mainly if that phagocytosis is seen inside a lesion (pustule) and not on the surface of the skin; the engulfed bacteria can be considered as pathogens and therefore a diagnosis of a **pyoderma can be made**.
 - Macrophages and/or lymphocytes or plasma cells may be present, supporting a more specific immune response which indicates a more chronic and/or severe condition.
 - Red blood cells may be present, indicating capillary lesions and therefore a deeper involvement.
 - Most cellular elements are easily observed, however, **signs of phagocytosis**, which represent a fundamental diagnostic feature, **must be explored**. They are easily found, observation should be focused on accumulations of cocci.
 - In superficial pyodermas, there are more neutrophils with intracellular cocci. In deep pyoderma, there are more neutrophils and macrophages that come due to the ruptured hair follicles, so fewer neutrophils have bacteria in them.
 - **Cytologic findings may also allow consideration of other dermatoses, for example:**
 - The lack of bacteria in the presence of many non-degenerate neutrophils may suggest a sterile pustulosis. When occurring with acantholytic epidermal cells (large cells with a single, polygonal aspect) and especially with healthy neutrophils, an auto-immune dermatosis may be suspected - most commonly pemphigus foliaceus).
 - The presence of macrophages and/or lymphoplasmocytes combined with the absence of bacteria may indicate a dermatophytosis.
 - Eosinophils are found in pustular reactions to arthropod stings, etc.

- **Practical guidelines to sampling and taking direct impression smears:**

- In the cases of **fold pyodermas** (or even "hot spots"), perform an **impression smear** by pressing the slide against the lesion, the edge (or a corner) is sufficient for sampling small areas. An easier way is to **swab the fold**.
- In the cases of **impetigo, folliculitis** and **furunculosis**, look for an **intact purulent lesion** (pustule or furuncle), **open it gently** with the corner of the slide or a needle pinching the skin between two fingers in order to express the fluid, and **apply the slide** on to several areas of the pus.
- In cases of **cellulitis**, take samples **under the crust**, selecting crust revealing pus and apply the slide to several areas.

- **Slide preparation and fast-acting dye (Diff-Quik type):**

- Note on the slide where the sample has been placed (write the nature and the location of the sample). This will be the examination side.
- Let the samples dry for 1 to 2 minutes in open air.
- Immerse the slides in the three different dyes, following the advised contact times (generally 30 seconds each).
- Rinse the slides thoroughly with clear water and blot them carefully with a **paper towel**, examination side upwards, until the water is completely absorbed.
- A hair-dryer may be used (gently) for final drying.

- **Microscopic examination:**

- First locate evenly spread and fully stained areas and place them under the microscope, examination side upwards!
 - **Under low (10X objective) magnification look for the areas with most cells** particularly the neutrophils whose nuclei appear as "omegas" (Ω).
 - Then change to the **40X objective**.
 - **Without modifying the depth setting**, place the slide between two objective lenses to **apply** a few drops of immersion oil on the chosen area. **Turn to the high power objective (100X immersion)** adjusting the focus.
 - If the image stays blurred, the slide may have been accidentally turned upside down, and the reading side may be on the other side!
 - **Scan the sample over a large area** for a few minutes and look for characteristic images, such as cocci phagocytosis, eventually looking in other areas of the sample (adding some immersion oil if necessary).
- **The images commonly found for each type of pyoderma are described in the chapter concerning the specific diagnosis.**



Method to open a pustule with the edge of a microscopic slide.
Courtesy of: D. Pin
Gloves should be weared for sampling.



Method to spread on a microscopic slide the material contained in a pustule.
Courtesy of: D. Pin
Gloves should be weared for sampling.

► **Skin biopsies.**

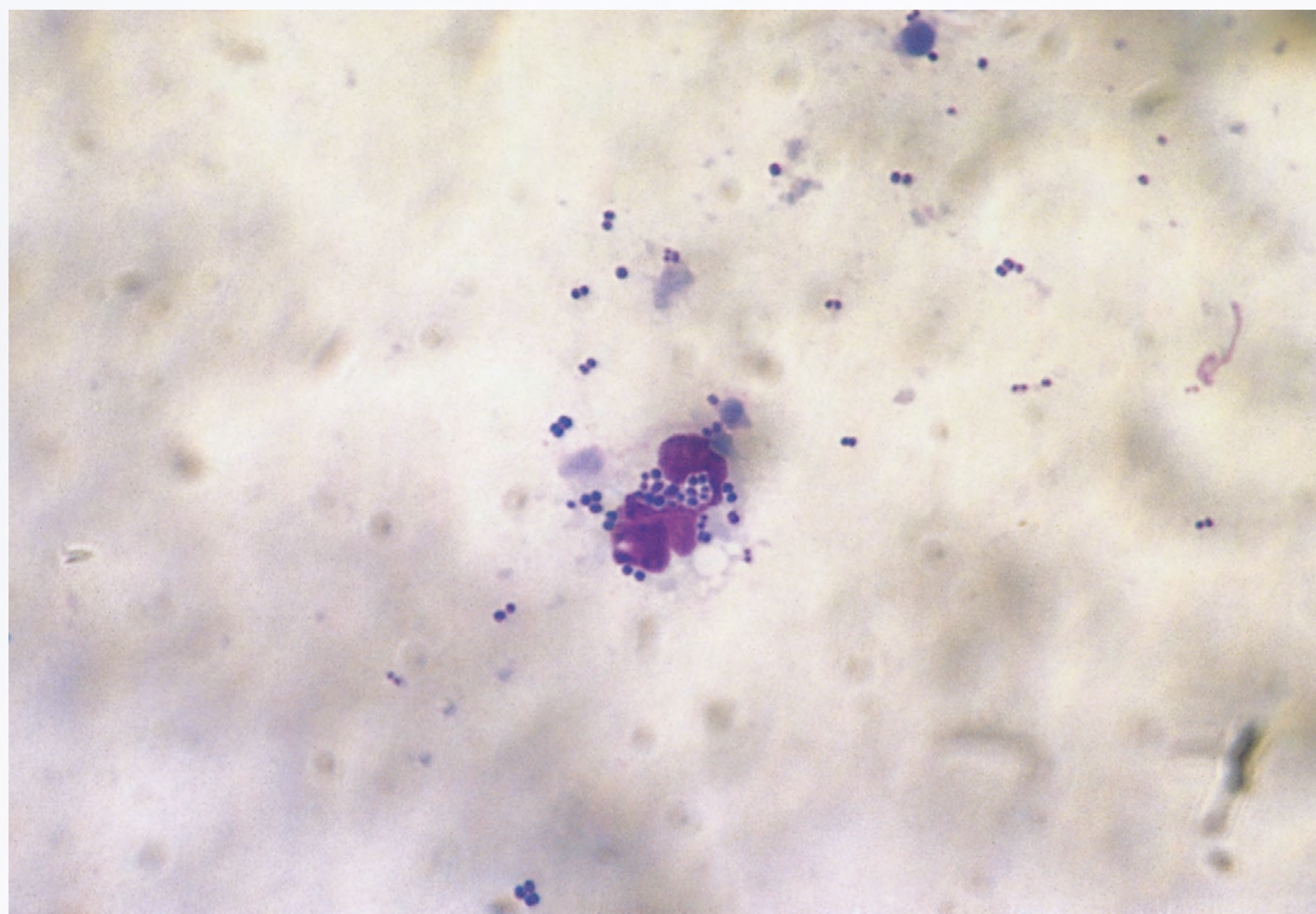
- May reveal characteristic images of pyoderma.
- Skin biopsies are required when support of the clinical diagnosis is needed, particularly if therapy has failed in spite of a strong suspicion (histopathology will then either confirm the diagnosis and support the continuation of an antibacterial therapy, or give proof or suggestion of another disease).

► **Culture and Sensitivity testing.**

- **This test is not a diagnostic procedure by itself in dermatology**, but it can confirm the presumption, revealing the presence of one (or several) pathogen(s) inside a lesion.
- It should above all be considered as a **guide to treatment**.
- It normally allows the identification of the bacteria present in the pus, and the testing of their sensitivity:
 - » with the conditions that the causal bacteria has been sampled (and not a normal skin resident species), that it survived during transportation (use the appropriate medium), that it is not inhibited by contaminating species and there is agreement with a laboratory that routinely isolates *Staphylococcus pseudintermedius*.
- Choose antibiotics that need to be included in the sensitivity test and be sure that the laboratory employs adapted discs/systems and refers to validated critical concentrations, especially for *Staphylococcus pseudintermedius*.
- These tests must be kept for difficult cases, e.g. therapy failure, cases refractory to treatment (resistant pyoderma), multiple relapses on animal treated several times (recurrent pyoderma), severe deep pyoderma...

Obviously, the identification of a MRSP (Methicillin Resistant *Staphylococcus pseudintermedius*) or *Pseudomonas spp.* is mandatory since these bacteria can be considered as a cause of pyoderma resistant to a well conducted antibiotic treatment.

It is likely that the increase of number of resistant strains will lead to a more frequent use of bacterial culturing and sensitivity testing.



Microscopic picture of a direct smear of a follicular pustule.
Phagocytosis of cocci by neutrophils (Diff-Quik stain, x1000).
Courtesy of: D. Pin

GENERAL THERAPY

- ▶ Classically, pyoderma therapy requires **antiseptic topical therapy** combined with **systemic antibiotics**. This association **hastens** the healing process and allows a **faster recovery**, compared with systemictreatment alone.
- ▶ **Antibiotics.**
 - **Systemic antibiotics** are necessary in most pyoderma cases.
 - The initial prescription must be for a **minimum of two weeks plus one to two additional weeks after clinical recovery**.
 - The antibiotic can be **renewed for courses of two to three weeks if necessary**.
 - **The deeper the lesions, the longer the treatment.**
 - Appropriate antibiotics for skin infections:
 - must be active on staphylococci and resistant to their enzymatic inactivators (e.g. *Staphylococcus pseudintermedius* secretes penicillinases),
 - must have an appropriate kinetics and good cutaneous penetration,
 - must be active in pus and reactive tissues (particularly in deep pyoderma),
 - must be easily taken orally to facilitate long term treatment by the owner,
 - because of duration of the treatment it must be well tolerated, particularly in young dogs,
 - its clinical efficacy must have been proven in recent trials.
 - Useful antibiotics in dermatology are the following:
 - **Macrolides**, but resistance is increasing.
 - **Diaminopyrimidines potentiated sulfonamides**. Possibilities of development of polyarthritis (principally in Dobermans) and keratoconjunctivitis sicca in long term treatments.
 - **Penicillins resistant to penicillinases: Amoxicillin + clavulanic acid** (clavulanic acid is an essential inhibitor of penicillinases, **amoxicillin alone is not efficacious** in pyoderma treatments).
 - **Cephalosporins (cephalexin, cefovecin, cefpodoxime and cefadroxil)**. **Cephalexin** is a molecule that has been used for many years in veterinary medicine. Thanks to its excellent clinical efficacy, it remains a **first choice antibiotic** in veterinary dermatology.
 - **Fluoroquinolones**, should not be used in young dogs (especially in big breeds) because of their toxic effect on cartilage. As resistances increase quickly, they should not be used as first intention antibiotics, particularly in superficial pyoderma.

The best recent clinical results have been obtained with clindamycin, fluoroquinolones and cephalosporins, such as cephalexin. Always choose veterinary specialities for which efficacy has been proven in practice.

► **Corticosteroid therapy.**

- Inadequate and indiscriminate use of corticosteroids can produce **difficulties in diagnosis and treatment**, except for special cases (such as juvenile cellulitis).
- As a factor of immunodeficiency it favours the outbreak of pyoderma, in particular deep pyoderma (with a possible development of iatrogenic Cushing's syndrome in the worst cases).
- Furthermore, diminishing the pruritus in a symptomatic manner does not allow evaluating the component due to the pyoderma itself (which will disappear with the healing of the lesions) and the component due to an eventual underlying pruritic dermatosis.
- The pruritus due to a pyoderma disappears rapidly (in a few days) following successful antibacterial treatment.
- However, the dogma that corticosteroids are contraindicated, may be revised. It might be true for deep pyoderma, however, the use of corticosteroids in atopic dogs may help to normalise the skin barrier thus reducing the risk of pyoderma recurrence.

► **Topical therapy.**

- Antiseptic topical products include shampoos, ointments and lotions (used as adjuncts to antibiotics or for symptomatic relief). In case of resistant pyoderma, they become a major part of the treatment.
- Shampoos (especially antiseptic) are very useful, at least at the beginning of the treatment. They allow the mechanical removal of debris, pus, crusts and bacteria (also eliminated by the antiseptic action).

They contain various antiseptics: chlorhexidine, benzoyl peroxide, ethyl lactate or piroctone olamine. Products containing sugars (glycotechnology) can decrease the adherence of staphylococci and pseudomonas.

Ointments, creams and gels containing fucidic acid or benzoyl peroxide are useful for treating localized lesions of pyoderma. Chlorhexidine can be used in lotions and sprays, as an antibacterial agent.

- The use of **topical therapy** (in particular antiseptic shampoos) is **of benefit in all pyodermas**.

► **Therapy duration and follow-up.**

- **Antibiotic therapy in dermatology is protracted!** The recovery time for canine pyoderma is totally different from almost all other bacterial infections. **The owner must be made aware of this peculiarity** of canine dermatology.
- Whatever the case, a **minimum of three weeks** of treatment must be prescribed.
- The first re-visit should be planned after this time; the owner must of course be aware of the need to come back before if the condition deteriorates (e.g. non-effective treatment, or worse, a cutaneous drug reaction due to the molecule prescribed).
- **At that visit, prescribe a further two weeks** of treatment **if it has not completely recovered for at least one week.**
- In case of **resistance or recurrence**, several cultures and **sensitivity testings** may be done during the follow-up.



Cellulitis. After clipping, before shampoo. Courtesy of: P. Jasmin



Cellulitis. After clipping, after shampoo. Courtesy of: P. Jasmin

SIMPLE APPROACH PYODERMA

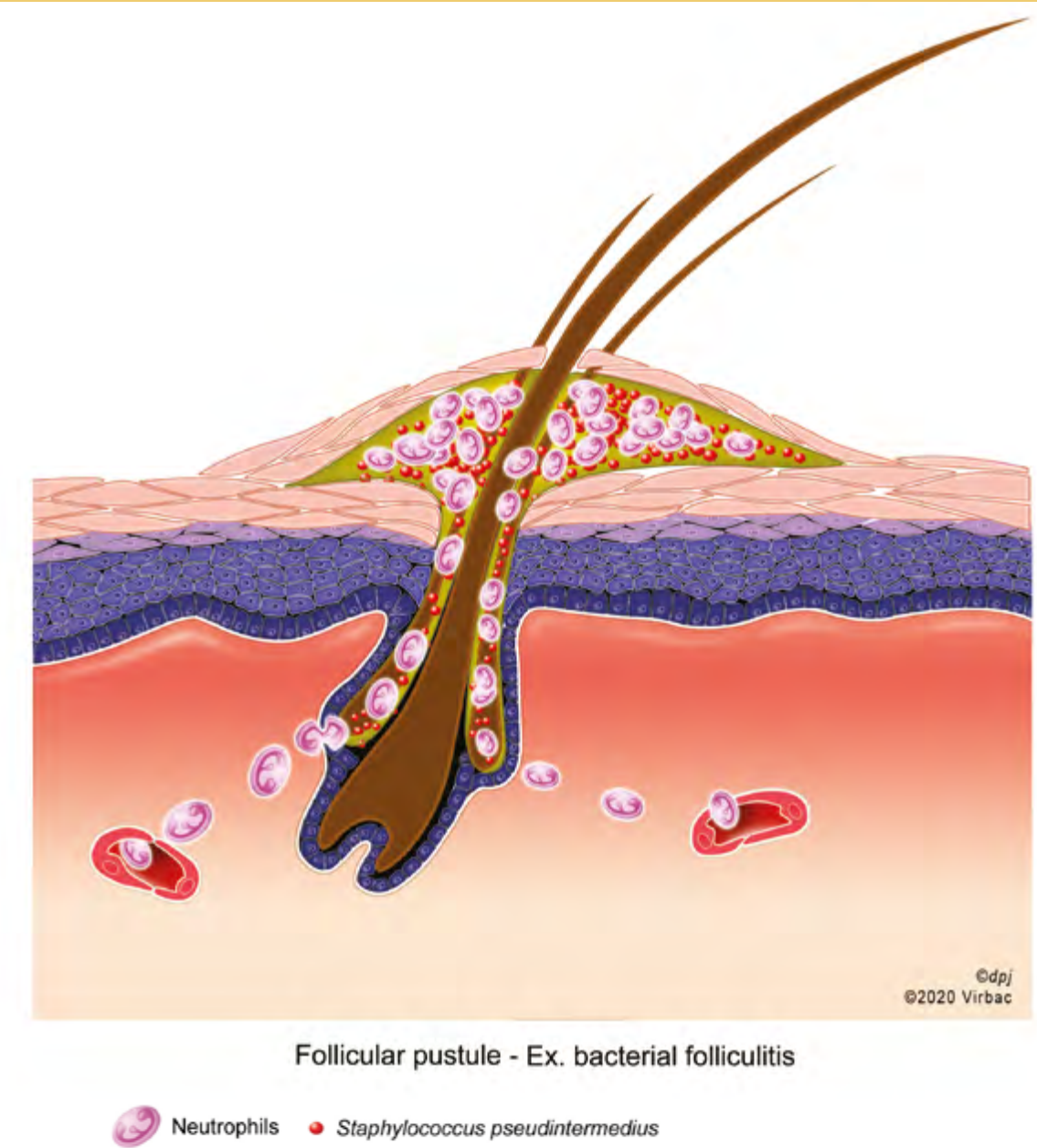
All young dog pyodermas and rare cases in the adult.

Young dogs: Intertrigo - Folliculitis - Impetigo**Adult dogs: Intertrigo - Idiopathic folliculitis****INTRODUCTION / DEFINITION**

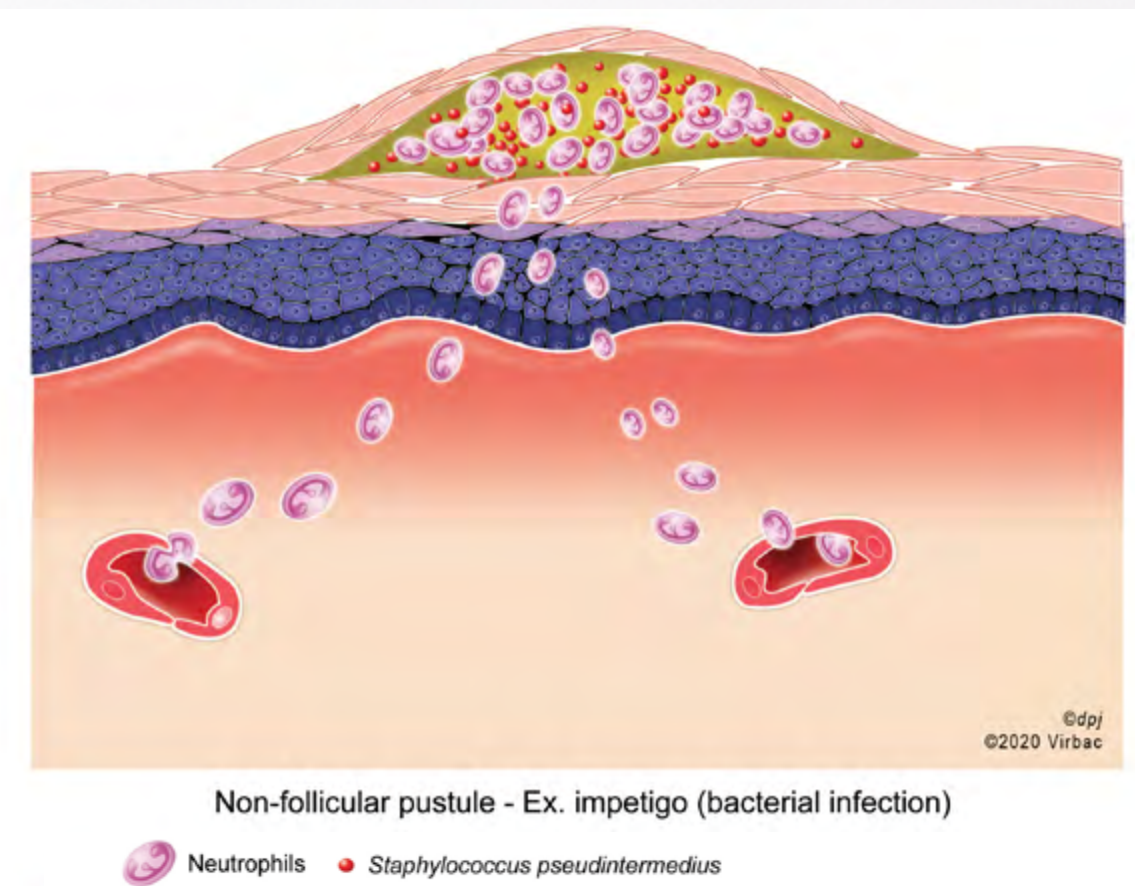
- ▶ The **simple approach pyoderma** can be **primary** or **idiopathic**, or **related** to underlying causes that need to be investigated in the first instance. These can be self-evident causes (folded skin in intertrigo) or other skin diseases, mostly ectoparasite infestations (particularly demodicosis and sarcoptic mange).
- ▶ **Therefore these pyodermas do not have identifiable underlying causes or they have causes that can be diagnosed simultaneously during the first step.**
- ▶ It is likely that some **genetic defects** that are not characterised are the cause for these pyodermas.
- ▶ One also needs to differentiate **single episodes of pyoderma**, which might have **no underlying causes**, from the **recurrent ones for which an underlying problem** likely exists.
- ▶ They concern mainly **superficial pyodermas: intertrigo** (or “**fold pyoderma**”), **folliculitis** and **impetigo**.
- ▶ **Intertrigo occurs in young as well as in adult dogs** and is **due to anatomical defects** (exaggerated skin folds).
- ▶ **In the young dog folliculitis** and juvenile **impetigo** are often found; most frequently idiopathic, but they can also be linked to parasitic infestation (especially sarcoptic mange). In some rare cases of juvenile demodicosis, a pyodemodosis may develop with presence of a furunculosis and/or a cellulitis (rarely a folliculitis), both demodicosis and deep pyoderma must be then treated simultaneously (**always perform skin scrapings when deep pyoderma occurs, especially in the very rare cases in young dogs!**). See the monograph on demodicosis.
- ▶ **In the adult dog idiopathic folliculitis** (so-called short-haired breeds pyoderma, so-called bacterial hypersensitivity) or folliculitis linked to parasitic infestation (mostly *Sarcoptes scabiei* because when *Demodex* are involved, the approach becomes “complex” as their presence in adults requires the exploration of an underlying cause).
 - **The so-called short-haired breeds pyoderma likely represents and exfoliative superficial pyoderma (ESP)** in which the *Staphylococci* proteases digest the bonds between the hair shaft and the inner root sheath. If we look at the edges of the circular alopecia, we will typically find the collarettes typical of ESP.
 - **The so-called bacterial hypersensitivity might not exist. It might just be an ESP or a *Staphylococcus* that produces specific virulence factors.**
- ▶ Impetigo, especially the bullous type, is due to *Staphylococcus pseudintermedius* producing at least one exfoliative toxin.
- ▶ **It is important to highlight that many forms of pyoderma may just depend upon the combination of virulence factors of the *Staphylococci* and host responses.**
- ▶ Relatively **frequent in young dogs, the simple approach pyoderma is seldom found in adults**, and is essentially idiopathic folliculitis in short-haired breeds (ESP).

AETIOLOGY / PATHOGENESIS

- ▶ **Intertrigo.**
 - Some animals are anatomically or “physiologically” (obesity, lactation...) predisposed to have an exceptionally folded skin that creates a warm, humid and dark environment favourable to **bacterial colonisation** and overgrowth. An excess of sebum, tears, saliva or urine in some folds are also aggravating factors.
 - The infection is due to cutaneous **micro-trauma** caused by continuous friction.
- ▶ **Folliculitis.**
 - Development of micro-abscesses (pustules) centred on hair follicles by **bacterial** multiplication and **invasion**.
- ▶ **Impetigo.**
 - Development of micro-abscesses (pustules) in or under the epidermal stratum corneum by **bacterial** multiplication and **invasion**.
 - There is invasion of the upper epidermis because of the production of exfoliative toxins that cleave the bonds between keratinocytes.



Courtesy of: P. Jasmin



Courtesy of: P. Jasmin

EPIDEMIOLOGY

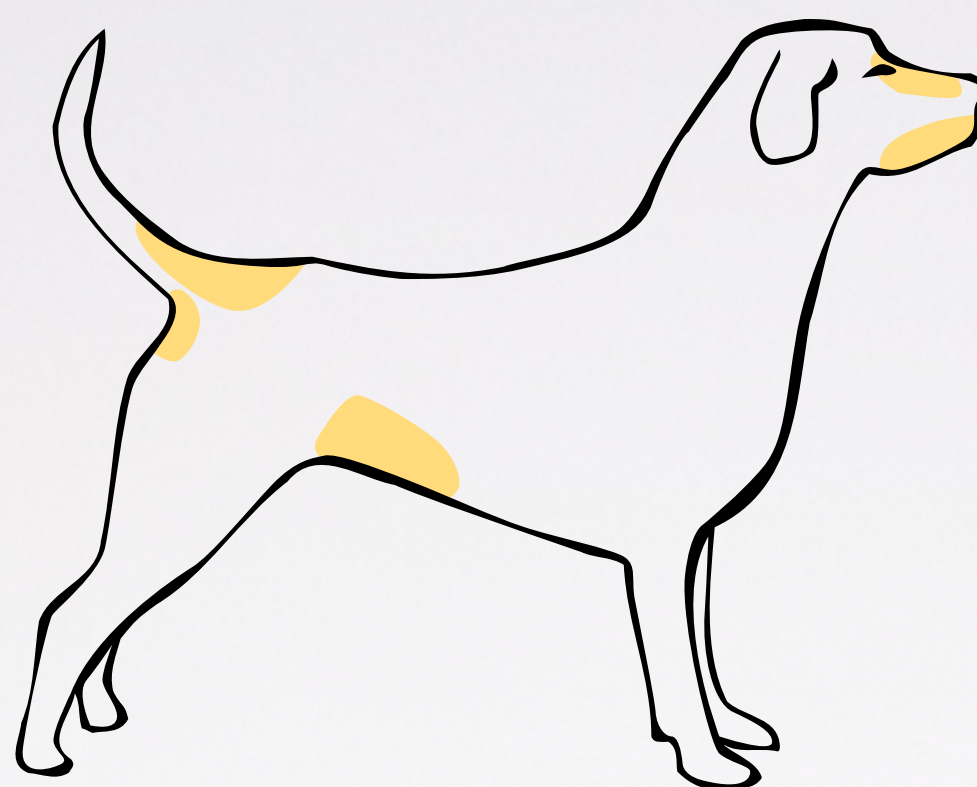
- ▶ **Intertrigo.**
 - Concerns the **young dog** as well as the **adult**, without any particular distinction.
 - The infection develops on skin surfaces that are in intimate contact with each other. Folds are therefore predilection sites of infection.
 - Dogs with very marked folds are more susceptible. The presence of folds may be due to hereditary or acquired anatomical defects.
 - According to the site of the infection, there are different types of fold pyodermas: **labial, facial, vulval**, caudal, ventral (between pendulous **mammary** glands), **obese fold pyodermas**, and/or more or less **generalised** in other parts of the body in very “folded” breeds.
- ▶ **Folliculitis and impetigo.**
 - **In young dogs, juvenile folliculitis and impetigo:**
 - Impetigo and folliculitis are non-contagious and most often idiopathic. They can be linked to an ectoparasite infestation and both may be present in the same animal.
 - **Impetigo is seen almost exclusively in young dogs.**
 - **Relapses** can be frequent **until adulthood**, but generally **stop spontaneously after puberty**.
 - **In adults dogs:**
 - Idiopathic folliculitis is non-contagious. Relapses may be frequent.
 - Impetigo is seldom seen in adults.

CLINICAL SIGNS

- ▶ **General remarks.**
 - Presence of **pruritus, erythema** (even though not always seen and sometimes discreet in impetigo), **papules** and/or **pustules** must automatically lead to a suspicion of **pyoderma** (chiefly **superficial in the young dog**).

Intertrigo.

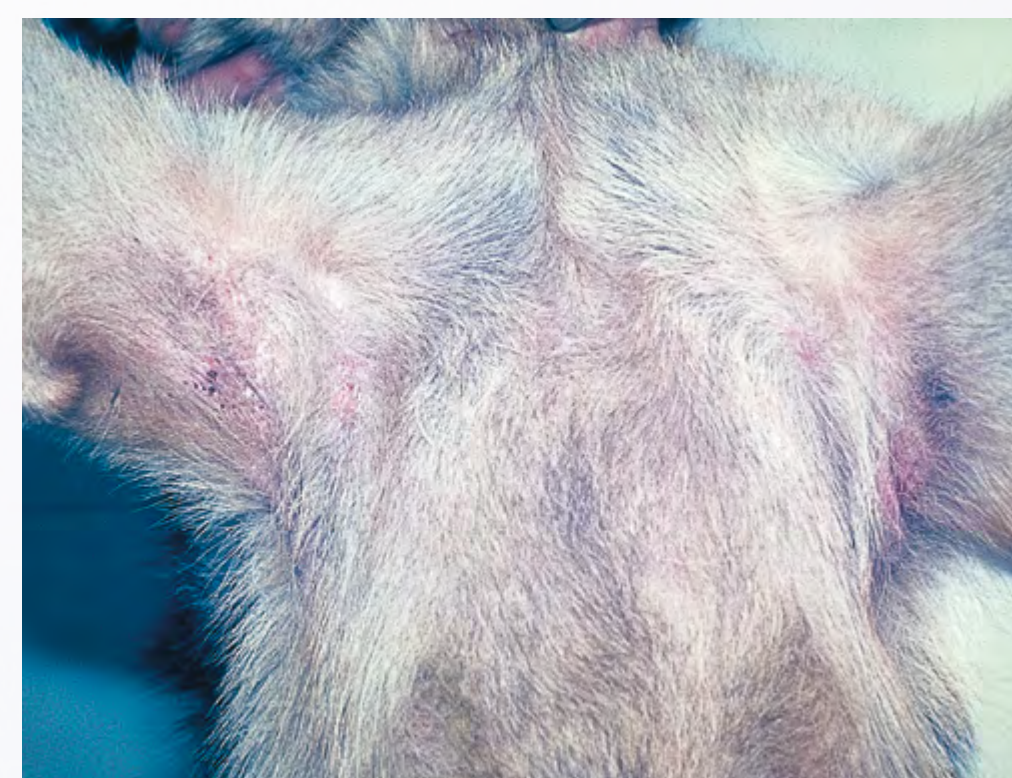
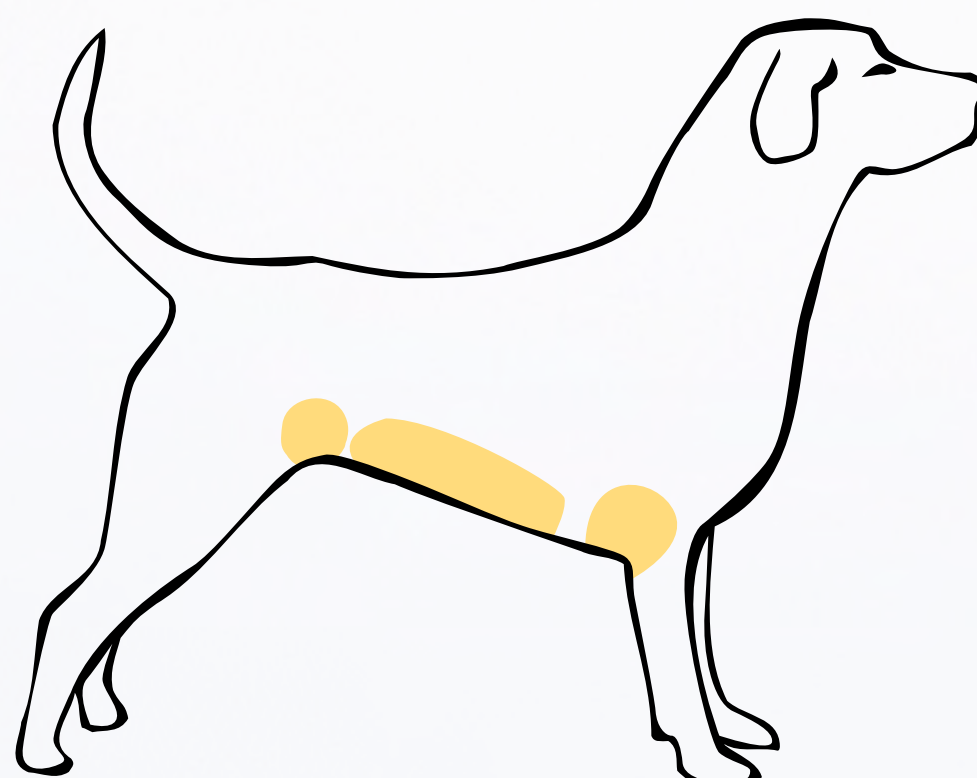
- **"Unfold" the suspected folds** (it may lead to an interesting discovery during a routine examination!).
- **Erythema, exudate and nauseating odour** may be discovered in the folds.
- **Pruritus of variable intensity** may be present.



Labial intertrigo. Courtesy of: D.N. Carlotti

Folliculitis.

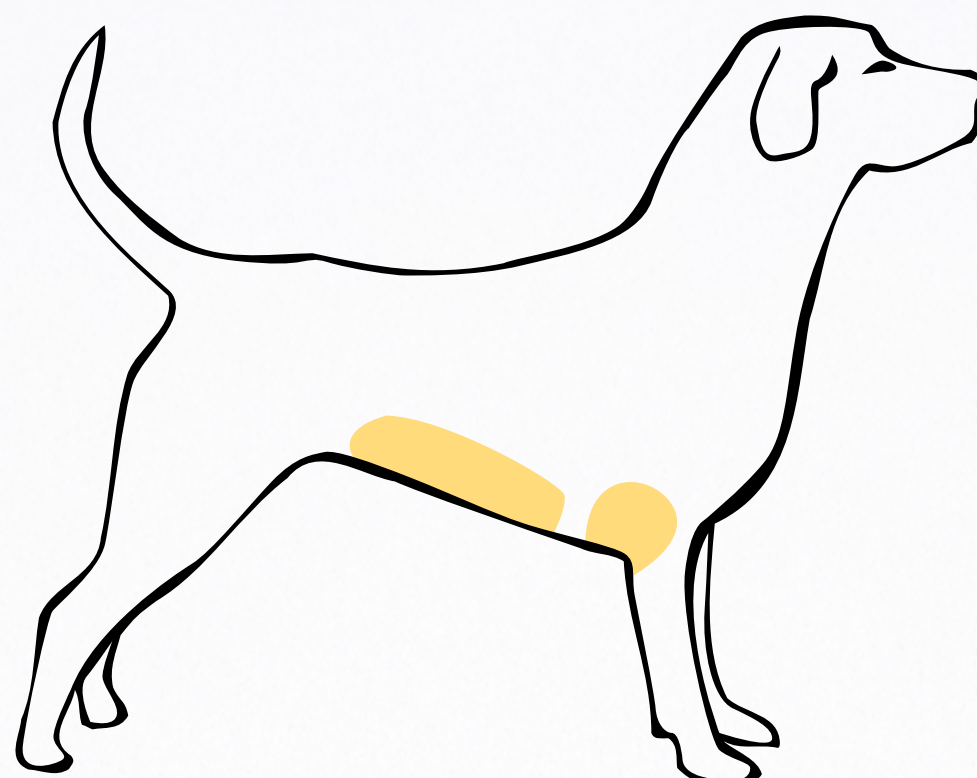
- **More or less pruritic**, sometimes **intensely**, with scratching responsible for modification of lesion. **This may depend on the toxins secreted and/or the host response.**
- Primary lesions: marked erythematous reaction (inflammation generally intense), relatively small **follicular papules and pustules** (therefore **centred on hair follicles, that need to be observed with a lens!**).
- Secondary lesions: follicular pustules are quite fragile and transient, they result in crusts after rupture. Due to the location of the pustules, significant **hair loss (alopecia)** may result. It is frequently the major **sign**, and **sometimes the only sign in cases of short-haired breeds folliculitis (coat with a "moth-eaten" look)**: look for pustules through the hair-coat with a hand lens, usually visible on the ventral aspect; this will lead to your diagnosis!
- Epidermal collarettes: it is now recognised that most folliculitis do not have an evolution with epidermal collarettes. On the other hand, most epidermal collarettes do not have follicular/papular lesions. The first lesion is a small elevation of the stratum corneum. Epidermal collarettes are present in exfoliative superficial pyoderma (ESP), a completely different form of pyoderma. Different forms can coexist in the same dog, but they are usually in different areas and caused by different *Staphylococci*.



Folliculitis in a young dog. Courtesy of: D.N. Carlotti

Impetigo.

- **Pruritus is generally not severe** (if intense, it usually indicates follicular involvement).
- Primary lesions: erythema (generally less marked than in folliculitis), **non-follicular papules and pustules** (therefore **randomly distributed, irrespective of hair follicles**), commonly located on the axilla and the abdomen (easily visible in this area). Follicular pustules present in folliculitis are not as easily recognised as the non-follicular pustules found in impetigo.
- Impetigo exists either as **bullous** (very pustular, which expands) **or crusted**, in which the pustules are transient and flat.
- Secondary lesions: impetigo pustules are very fragile and transient; after rupture, a yellow exudate dries into honey-coloured crusts.



Impetigo in a young dog. Courtesy of: D.N. Carlotti

DIAGNOSIS

History.

• General remarks:

- Pruritus and lesions appear at the same time.

• Intertrigo:

- Labial: **bad smell** from the animal's mouth.
- Facial: brachycephalic breeds with skin folds between the muzzle and the eyes; frequently associated with corneal ulceration.
- Vulval and on the limbs: due to obesity.
- Caudal: in breeds with corkscrew tail, folds at the tail base.
- Mammary (ventral midline): lactation.

• Folliculitis:

- Young dog.
- Short-coated breeds.
- Pruritus varies but can be severe. Folliculitis is a **major differential** diagnosis in **young dogs** with **pruritus**.

• Impetigo:

- Abdominal and axillary lesions in a young dog.

Clinical elements and distribution pattern of skin lesions.

• Intertrigo:

- Folds involvement, moist and greasy aspect with a bad odour.

• Folliculitis:

- Mainly **in young dogs**: evolves preferentially on the ventral aspect of the body (axilla, groin and abdomen), sometimes generalised, lesions are more papular than pustular.

• Impetigo:

- **Lesions** are essentially **abdominal and axillary** (variable pruritus and erythema, sometimes subtle).

Major differentials.

• Intertrigo:

- Especially if labial and vulval: demodicosis, candidiasis, auto-immune skin disease at the onset (mucocutaneous junction affected) and neoplasia.

• Folliculitis and impetigo:

- Sarcoptic mange with presence of papules:
 - » non follicular in sarcoptic mange,
 - » follicular in folliculitis,
 - » also non follicular in impetigo, but generally distinctly associated with pustules.
- Demodicosis, dermatophytosis and exceptionally sterile pustular dermatoses (pemphigus).

HISTORY SHEET	
Owner:	Date:
Dog's name:	Age:
Breed:	Sex:
Weight:	
GENERAL HISTORY	
1/ Age when acquired and origin (breeder, pet store...)	
2/ Geographical area of home, present and past (trips, kennels...)	
3/ Way of life, environment (exercise, house, garden, flat...) and in-contact pets...	
4/ Diet (current and previous).....	
5/ Reproduction (frequency of oestrus, pregnancy, behaviour of males...)	
6/ Previous diseases and surgery:	
7/ Unrelated previous dermatoses:	
8/ Current non skin-related problems:	
9/ Behavioural changes:	
CLINICAL HISTORY	
2/ Date of onset:	
3/ Pruritus, severity and time of onset (before or after lesions):	
• Itching of feet (licking, chewing):	
• Itching of head, lips, chin, periorbital area (scratching, rubbing):	
• Otitis, itching of ear pinnae (scratching, shaking):	
• Itching of anogenital area (rubbing, licking and chewing):	
• Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretion):	
• Upper respiratory signs, nasal discharge and/or sneezing:	
• Lower respiratory signs, asthmatic problems:	
5/ First cutaneous lesions observed and their development:	
6/ Seasonal influences:	
7/ Other affected animals (cohabiting, lineage) or human beings in contact:	
8/ Presence of fleas and anti-parasitic treatments given:	
9/ Shampoos and grooming:	
10/ Owner's view (personal opinion, remarks) on the dermatosis of his dog:	
11/ Previous treatments (date, products, dosage and duration) and responses:	



Short-haired breeds folliculitis.
Courtesy of: D.N. Carlotti

► **Cytologic findings characteristic of each type of pyoderma.**

• **General remarks:**

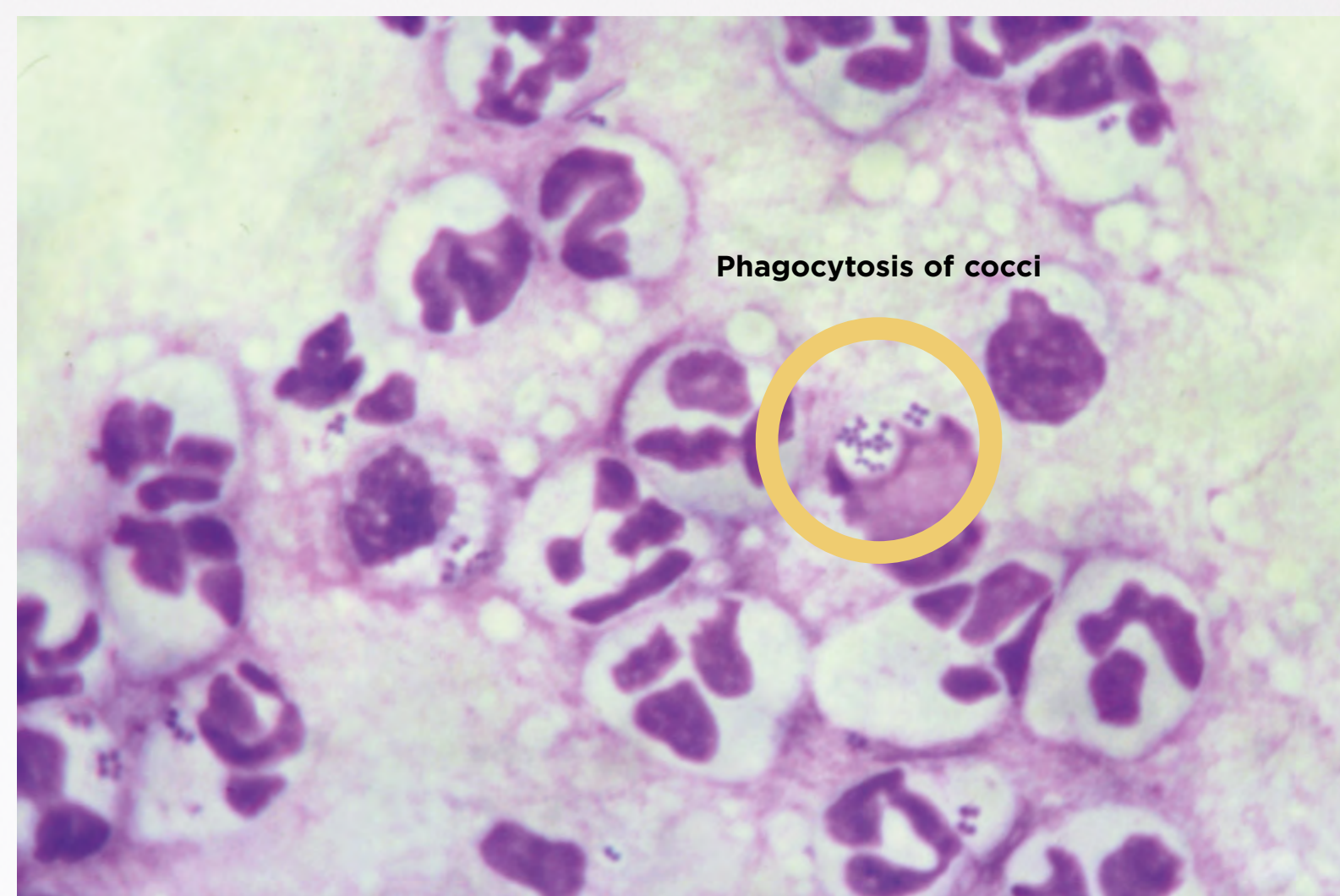
- Direct smear is a valuable aid to the diagnosis of pyoderma.
- **Refer to the chapter “general diagnostic means in pyodermas”.**

• **In intertrigo, bacterial colonisation will mostly be observed:**

- Numerous **healthy neutrophils**.
- Extracellular cocci (or possibly some rods).
- Impaired neutrophils, sometimes some are in the phagocytic state.

• **In folliculitis and impetigo, images of bacterial invasion:**

- Numerous **impaired neutrophils**.
- Cocci (rarely some rods):
 - » more or less abundant in an extracellular position,
 - » but mostly in an intracellular position (in impaired neutrophils in phagocytic state), **evidence of phagocytosis** is variable in frequency but should be looked for since it is always present!
- Eosinophils are sometimes present.



Cytologic picture of a bacterial invasion. (Diff-Quik stain, x1000). Courtesy of: D.N. Carlotti

► **Skin biopsies.**

- Histopathology is not a diagnostic aid routinely performed in the diagnosis of simple approach pyoderma. However, it may rule out or confirm its presence.
- Very beneficial in **atypical cases**, particularly when pustular lesions are not found **in spite of a thorough examination with a hand lens** (in those cases, biopsies of simple papular lesions will certainly lead to the diagnosis).
- In all cases, **perform biopsies on several primary lesions:** pustules (keeping them intact!) and papules, but also any other suspect lesion, in particular when the presence of pyoderma is doubtful.

► **Therapeutic trial.**

- Refer to “Therapy” and the chapter “General therapy of pyodermas”.
- Empirical systemic antibiotic therapy is required.
- It is perfectly conceivable when pyodermas are superficial, on a first intention basis.
- Prescribe a treatment for courses of 3 weeks (2 courses minimum + 1 additional week after clinical recovery) and monitor the patient:
 - continue the treatment if healing is evident (at least 50% of the lesions and/or the pruritus has disappeared),
 - occasionally, efficacy of the treatment may be questionable, mostly if improvement is transient, or if only discrete healing is present; however treatments rarely fail when proper antibacterial therapy is used (proper choice of the antibiotic, dosage and duration). This may be due to the onset of a bacterial resistance.
- If there is no demonstrated bacterial resistance, cast doubts on the bacterial involvement and challenge the diagnosis if no improvement is seen, or if the case worsens.

TREATMENT

► **Refer to the chapter “General therapy of pyodermas”**

► **Intertrigo.**

• **Topical therapy:**

- The use of **antiseptic** and/or antiseborrheic **shampoos** is necessary at least when initiating the treatment in order to physically remove most of the debris, pus, scales, crusts and bacteria. They must be used once daily, at least during the first week, then twice a week until lesions begin to heal, and then routinely to prevent recurrence.
- **Various** antibacterial or antiseptic **topical products** can also be used in addition to the shampoos, and in maintenance and prevention. Exceptionally (intense inflammation), an antibacterial lotion with corticosteroids may be prescribed for a few days.

• **Systemic antibiotic therapy:**

- Generally not necessary, may be prescribed only in addition to the topical therapy which remains essential.

• **Adjunctive therapy:**

- Corrective surgery could be performed in some cases.
- Weight loss is of benefit in obese fold pyoderma.

► **Folliculitis and impetigo.**

• **Topical therapy:**

• **Antiseptic shampoos:**

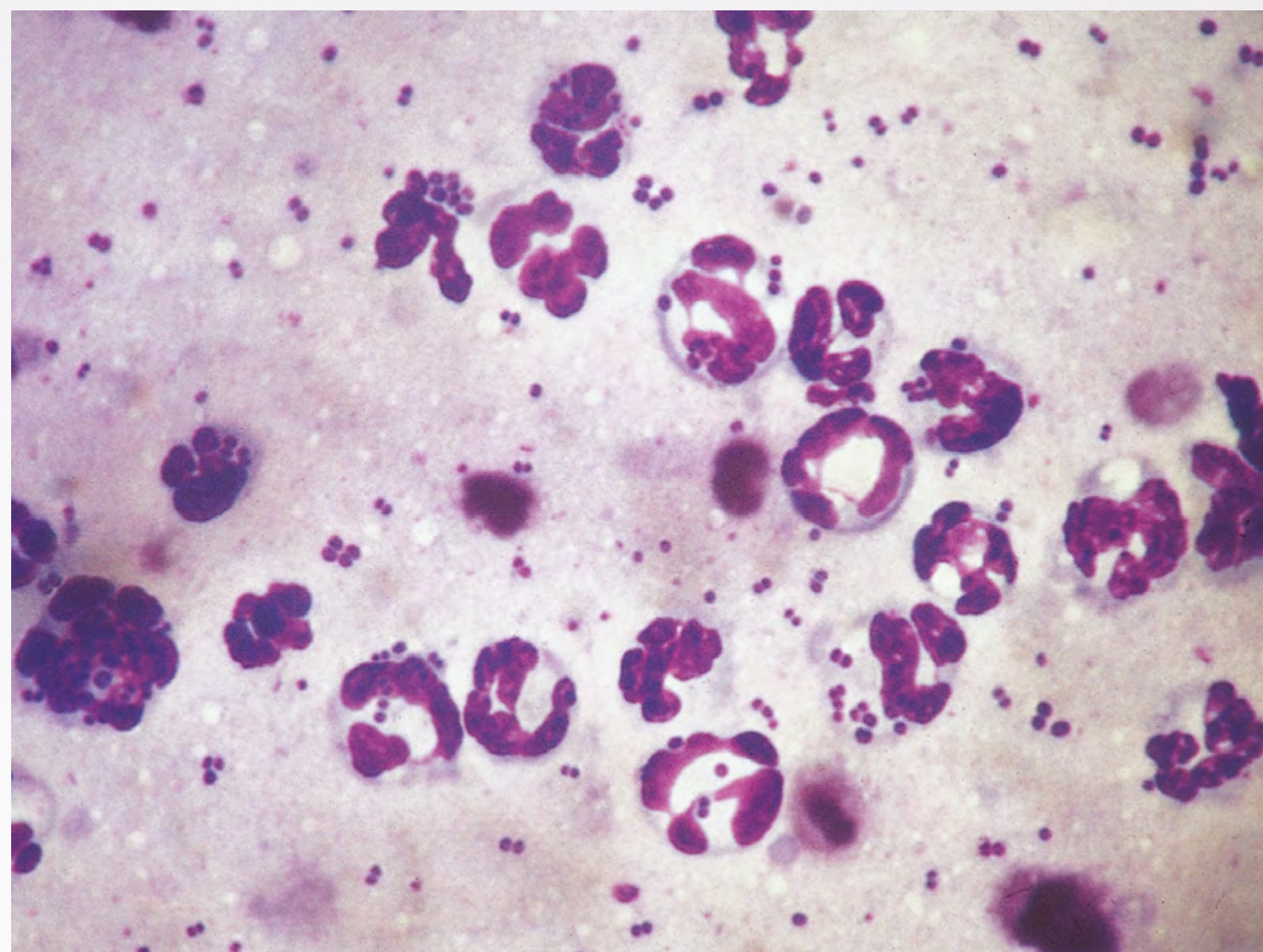
- » very useful as an **adjunct to systemic therapy**,
- » **hastens healing** and allows a **faster recovery**,
- » may be sufficient in young dogs, particularly in cases of impetigo.

• Antiseptic lotions:

- » might be used in between shampoos.

• **Systemic therapy:**

- **Systemic antibiotic therapy** (usually empirical), by courses of 3 weeks, renewable until resolution, including 1 week after lesion healing:
 - » **beneficial in the young dog** for a faster recovery,
 - » **mandatory in the adult dog.**
- **Corticosteroid therapy: usually not necessary**, as **pruritus may decrease very quickly** with an appropriate antimicrobial treatment.



Cytologic picture of a bacterial colonisation. (Diff-Quik stain, x1000). Courtesy of: D. Pin

► **Important remarks.**

• **Intertrigo:**

- As long as predisposing factors are present (folds), **relapses are frequent.**
- **A maintenance prophylactic topical therapy** is usually necessary.

• **Folliculitis and impetigo:**

• **In young dogs:**

- » they can clear spontaneously without any treatment (but not in adults!),
- » **relapses can be frequent**, without any particular reason. However, they respond well to therapy,
- » a sole **topical therapy** is sometimes sufficient and may prevent or limit relapses,
- » **pruritus ceases when the lesions disappear!** (As compared to folliculitis secondary to allergic dermatitis in adults).

• **In adult dogs:**

- **systemic therapy** is **mandatory**,
- **topical therapy** is **very useful** in addition to systemic therapy or as a maintenance therapy to prevent recurrence.

PROGNOSIS

► **Intertrigo.**

- Variable in the long term if predisposing factors (folds) are not controlled.
- However, appropriate topical therapy is normally effective.

► **Impetigo and folliculitis.**

• **In young dogs:**

- Good with appropriate systemic therapy.
- Good in the long term, often clears completely at puberty.

• **In adult dogs:**

- The prognosis is relatively good in short-coated breeds if folliculitis is treated properly with systemic antibiotic therapy, but a permanent follow-up is necessary in the long term.
- NB: impetigo in adults (rare) has a poorer prognosis because the underlying cause might be serious.
- The prognosis of exfoliative superficial pyoderma (ESP) might be better as the lesions are so superficial (intracorneal), and thus more responsive to antiseptics.

FOLLOW-UP

► **During the treatment.**

- Follow-up by courses of 3 weeks if systemic therapy has been prescribed.
- Renew the antibiotic therapy by courses of 2 weeks until lesion healing, normally 3 to 8 weeks, including a week after clinical recovery.
- Preferably monitor after 1 week for intertrigo and at the beginning for juvenile folliculitis and impetigo if only a topical therapy is prescribed.

► **Recurrence follow-up after recovery.**

• **Simple approach pyodermas relapse!**

- Start another systemic therapy if necessary as soon as the lesions reappear, based on culture and sensitivity testing.
- Limit relapses by prescribing permanent topical therapy - this will be accomplished as often as possible:
 - With antiseptic shampoos, perhaps once to twice a week or eventually every 15 days if sufficient - needs close co-operation of owners.
 - With the possible use in between of antiseptic lotions.

CONCLUSIONS

- ▶ **Pyoderma** is a **major consideration** in the differential diagnosis of skin diseases in **young dogs**.
- ▶ **Particular cases:**
 - A rare deep pyoderma in the young dog is called “**canine acne**” and clinically appears as furunculosis on the chin. The only feature in common with human acne is its chronic character and resistance to therapy. It seems to be related to keratinisation defects.
 - In adult dogs, “**nasal furunculosis**” is idiopathic and “**pressure points cellulitis**” is due to repeated trauma.
Those rare cases of deep pyoderma have a simple approach. They require prolonged systemic antibiotic therapy coupled with local treatment.
- ▶ A **folliculitis** can be an idiopathic **primary folliculitis**, as well as a **secondary folliculitis**. The symptoms resolve in the former after treatment and the follow-up is focused on treating the relapses. When the latter clears, other lesions and/or pruritus generally persist; follow-up includes treating the relapses as well as exploring an underlying cause (e.g. an allergic dermatitis). Refer to the following chapter.
- ▶ Giving a **3 week antibiotic course** followed by thorough and efficient monitoring is a prerequisite above all else when a pyoderma is suspected.
- ▶ “**When in doubt, treat!**”



Juvenile pyoderma in two puppies of the same litter. Not described here.
Courtesy of: P. Jasmin



Juvenile pyoderma in two puppies of the same litter.
Not described here. Courtesy of: P. Jasmin

COMPLEX APPROACH PYODERMA

Secondary to underlying dermatoses and only in adults.

Superficial pyodermas: **Folliculitis** - Impetigo

Deep pyodermas: **Furunculosis** - Cellulitis

Pyotraumatic dermatitis ("Hot Spot")

INTRODUCTION / DEFINITION

- ▶ **Complex approach pyoderma** is a skin infection for which an **underlying cause needs to be explored**.
- ▶ It can also be defined as a **secondary pyoderma** from an aetiology and pathogenesis point of view.
- ▶ It can be a **superficial pyoderma** (folliculitis or very rarely impetigo), a **deep pyoderma (furunculosis and cellulitis)** or a **pyotraumatic dermatitis ("hot spot")**.
- ▶ **Secondary pyoderma (or complex approach pyoderma)** most often involves **only the adult dog**.
- ▶ Impetigo is singular because of its seriousness, its possible confusion with a bullous auto-immune skin disease and its potential relation to a severe underlying disease, it is classified in group 3 of the dermatological approach and as such is not detailed here (only a few basics will be given).
- ▶ **Secondary pyoderma is very frequent**, especially **folliculitis**.
- ▶ The most frequent **underlying skin diseases** are classified in two major groups:
 - **Allergies**, which lead essentially to **folliculitis** or "**hot spots**", especially atopy in the former and flea bite allergy in the latter.
 - **Endocrine disorders**, possibly responsible for the occurrence of **deep pyoderma** as an example.



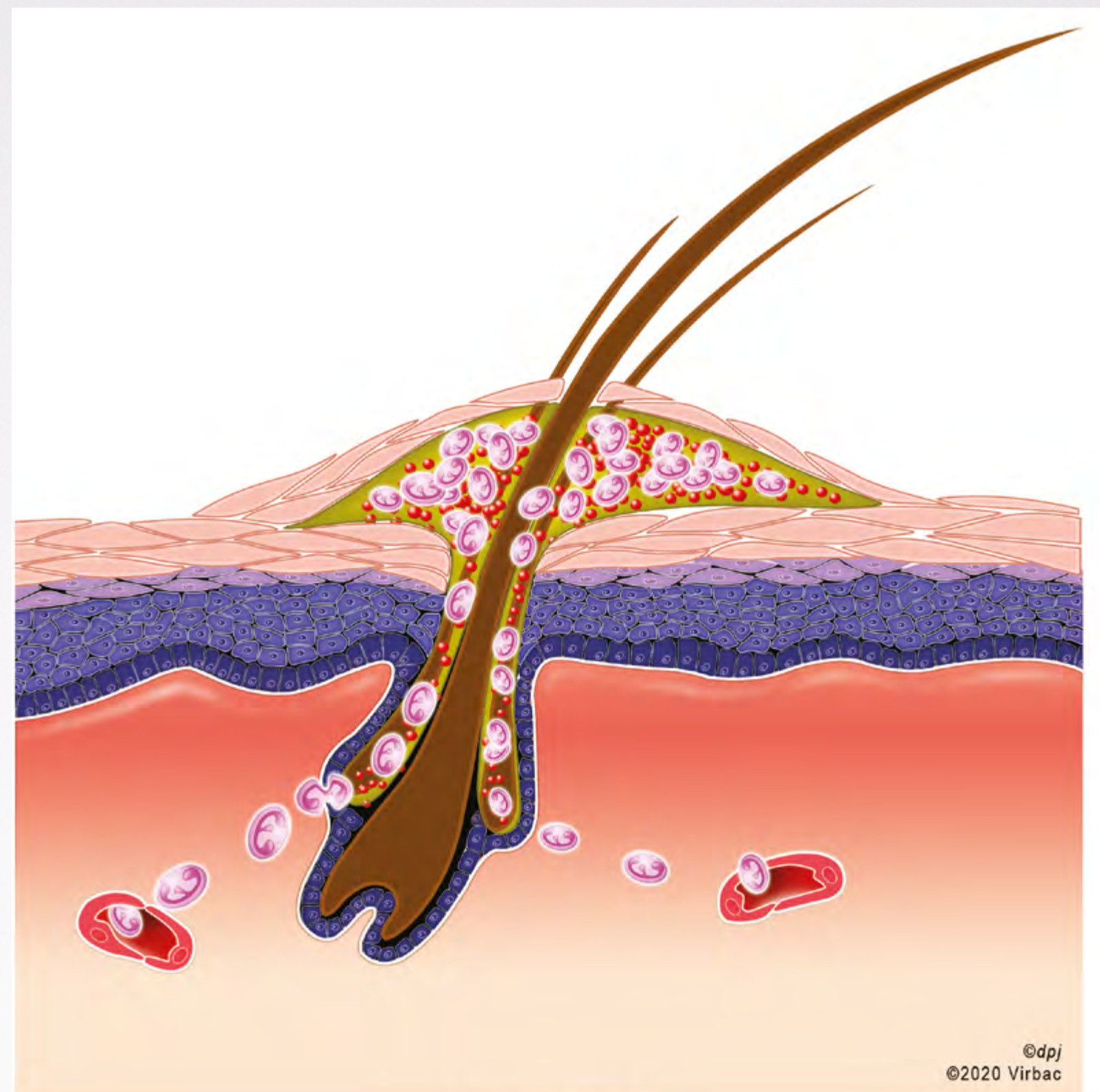
*Exfoliative Superficial Pyoderma (secondary bacterial folliculitis).
Courtesy of: T. Olivry*

AETIOLOGY / PATHOGENESIS

- ▶ **Introduction.**
 - Any physical or functional skin modification may result in secondary bacterial infection, superficial at first and deep when there is an immunodeficiency component.
 - Bacterial multiplication is either confined to the epidermis and its appendages in superficial pyoderma (hair follicles in folliculitis, or even sweat glands in hidradenitis) or invades the dermis in deep pyoderma. When infection is present in "hot spots", it is rather superficial and always of minor importance.
 - The initial pathogenic agent is generally ***Staphylococcus pseudintermedius***. Even though other pathogens may develop taking advantage of the lesions created by the staphylococci (especially Gram negatives - particularly in deep pyoderma), their pathogenic role is not clearly established. For this reason, the outcome of bacteriological cultures (especially isolation of *Staphylococcus pseudintermedius*) must always be considered in the context of the overall clinical investigation.

► **Secondary folliculitis.**

- Development of micro-abscesses (pustules) in the hair follicles by **bacterial** multiplication and **invasion** (in impetigo the micro-abscesses develop in or under the epidermal *stratum corneum*).
- In rare cases, an exfoliative superficial pyoderma (ESP, epidermal collarette type) due to *Staphylococci* producing proteases cleaving corneodesmosomes may occur and seems responsible for diffuse lesions with severe inflammation. A similar situation may also be found in idiopathic folliculitis (see previous chapter).



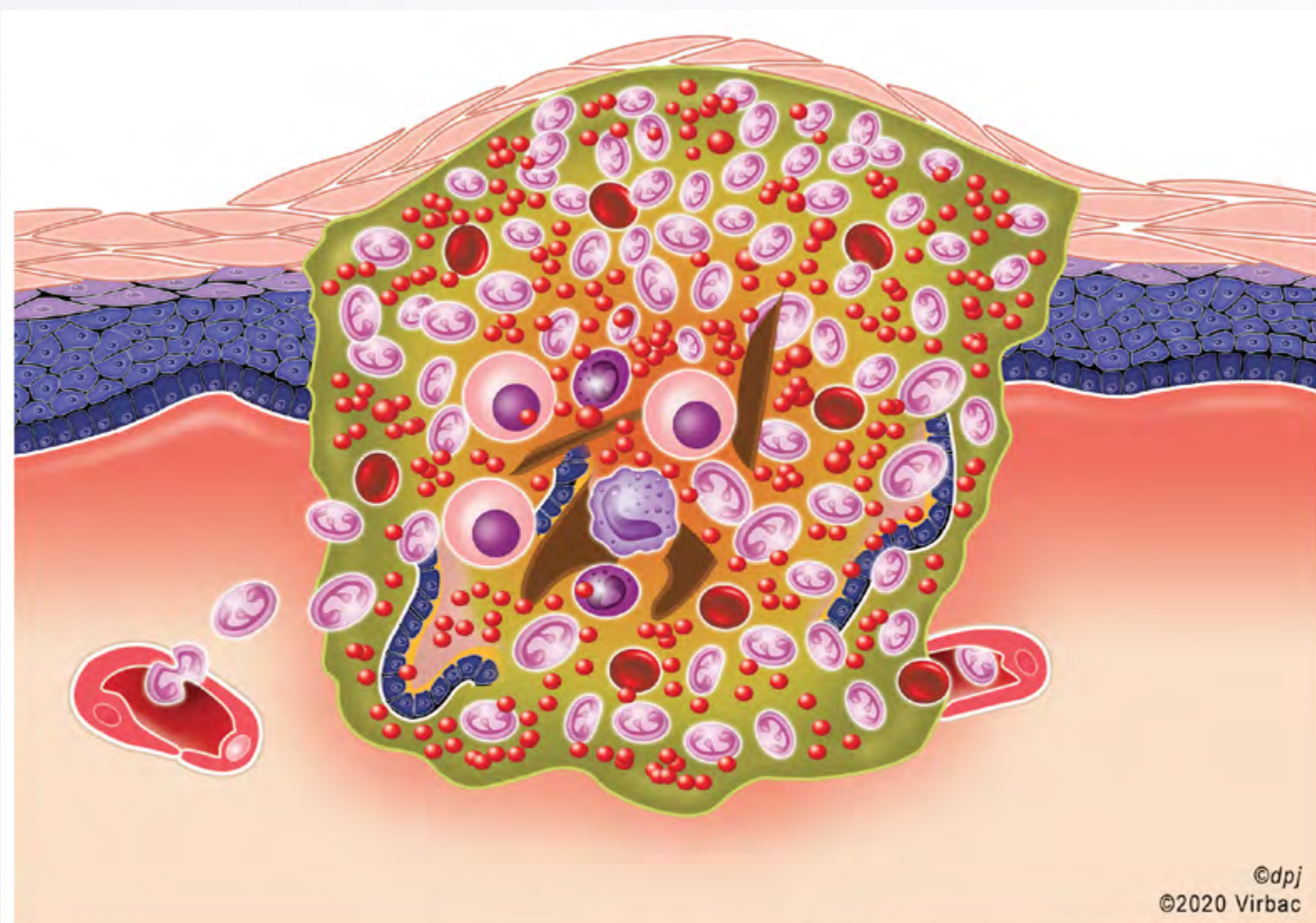
Follicular pustule -
Ex. bacterial folliculitis

Neutrophils • *Staphylococcus pseudintermedius*

Courtesy of: P. Jasmin

► **Deep pyoderma.**

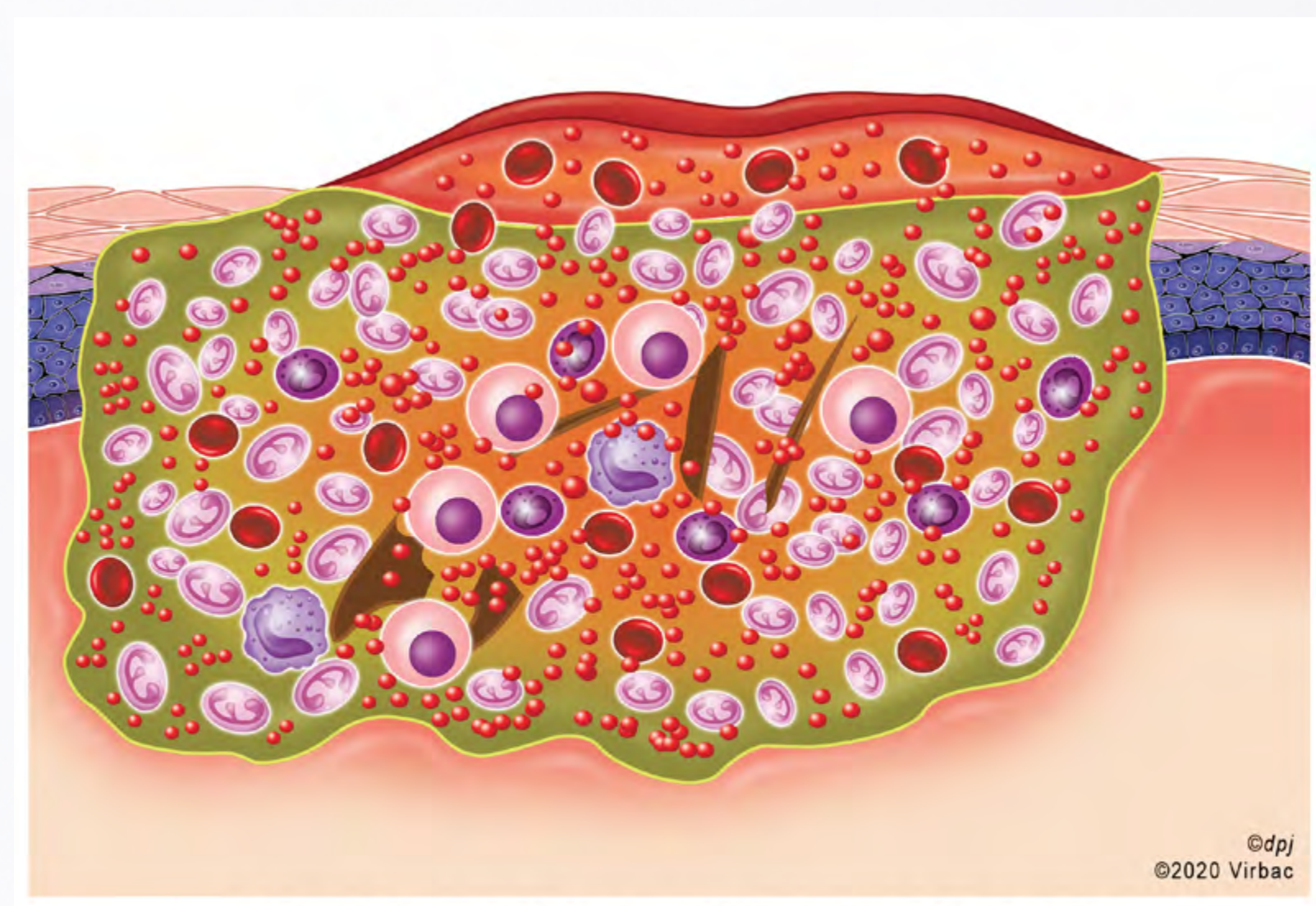
- In furunculosis, the hair follicle ruptures, resulting in intradermal micro-abscesses (pustules) centred on a follicular residue called a furuncle. Most of them follow folliculitis (which is generally transient).
- Cellulitis occurs when furuncles spread outward. Hence, the dermis (or even the hypodermis) is totally invaded by the infectious process that continues to extend.



Furunculosis: bacterial infection
with rupture of the hair follicle

Mast cells • Lymphocytes • Neutrophils • Eosinophils • *Staphylococcus pseudintermedius* • Erythrocytes

Courtesy of: P. Jasmin



Cellulitis: bacterial infection with invasion of the dermis

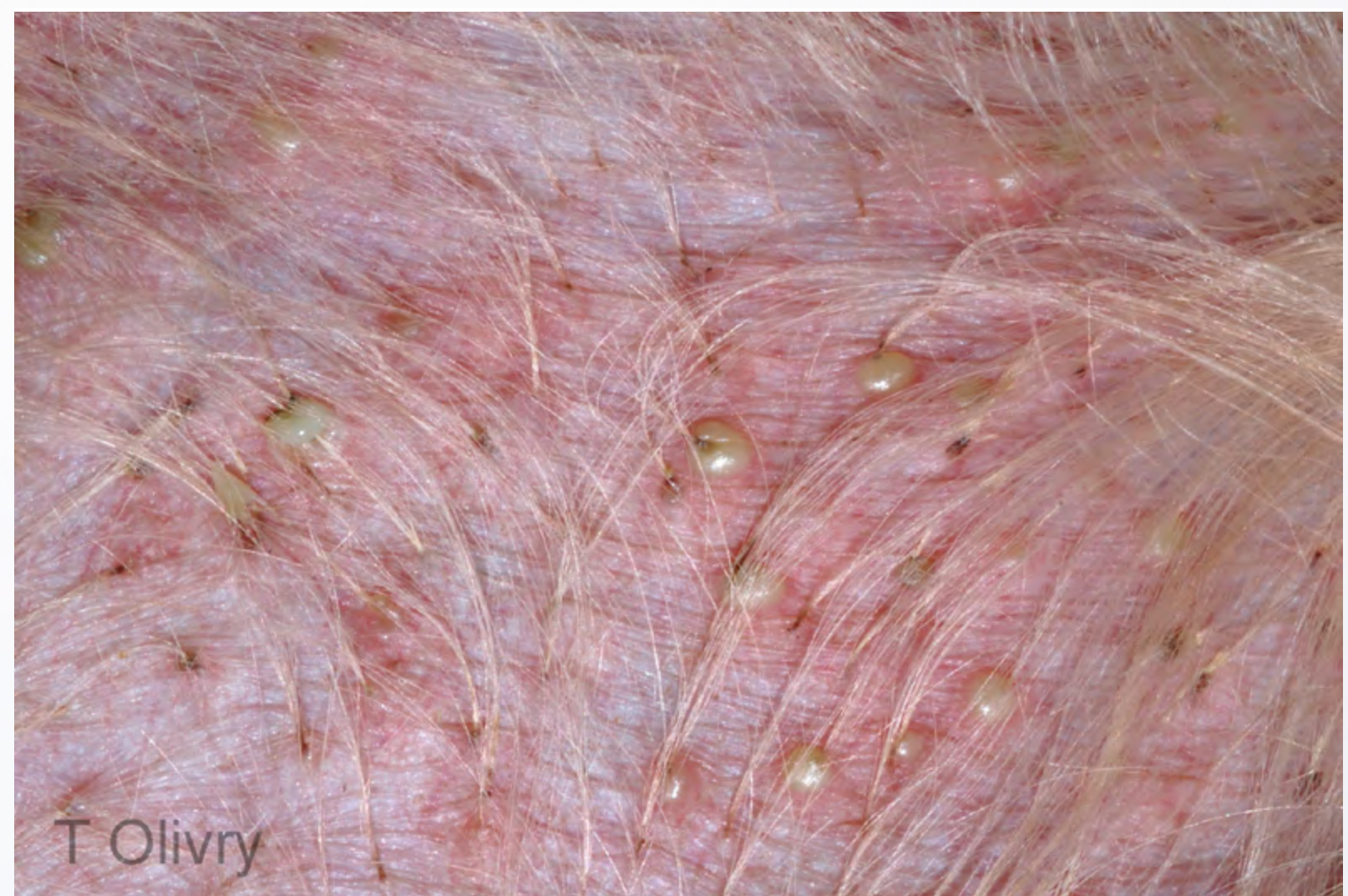
Mast cells • Lymphocytes • Neutrophils • Eosinophils • *Staphylococcus pseudintermedius* • Erythrocytes

Courtesy of: P. Jasmin

- Evolution of superficial pyoderma into deep pyoderma is possible and may be due to:
 - Trauma by pressure, licking, chewing or scratching.
 - Follicular lesions as in demodicosis.
 - Spontaneous immunodeficiency status (endocrine disorders) or most frequently iatrogenic in origin (corticosteroid therapy).
NB: demodicosis is frequently related to deep pyoderma lesions. **Pyodemodicosis** is one of the most severe canine skin diseases; its occurrence follows a **generalised demodicosis** and involves lesions of **cellulitis**. That is why **skin scraping** is the **first line of approach** to these lesions!
- More specific deep pyodermas occur rarely and have a simple approach: "canine acne" (juvenile furunculosis of the chin), "nasal furunculosis" and "pressure points cellulitis".
- ▶ **"Hot spots"**.
 - Localised erosive lesion following self-inflicted trauma.
 - Occurrence of "hot spots" confirms the presence of a pruritic condition.
 - Primary or secondary lesions of vasculitis could be present.
 - The warm environment due to a very dense undercoat may be a predisposing factor.
 - The role of **self trauma is much more important in perpetuating the lesions than the initial infection**.
 - Hot spots should be differentiated from pyotraumatic folliculitis, a true pyoderma (intact pustules of folliculitis/furunculosis surround the oozing and suppurative area).

EPIDEMIOLOGY

- ▶ Secondary pyodermas are non-contagious and generated by underlying diseases.
- ▶ Folliculitis and "hot spots" are very frequent, deep pyoderma is much rarer!
- ▶ **Secondary folliculitis.**
 - Accounts for a **very large proportion of canine dermatological cases**.
 - Occurs preferentially in dogs affected with allergic dermatitis, in particular atopic dermatitis.
- ▶ **Deep pyoderma.**
 - It is much rarer, but also more severe.
 - It may be associated with immunodeficiency in some cases.
 - Occurrence in the feet (especially if symmetrical) may have an allergic origin (atopy, food allergy).
 - Secondary furunculosis, more or less generalised, is the most common. More localised deep pyodermas (canine acne, nasal furunculosis and pressure points cellulitis) generally have a simple approach. Furunculosis can progress in cellulitis lesions.
 - An idiopathic furunculosis-cellulitis complex is seen in German Shepherds. It must be assessed as idiopathic only after having explored all possible underlying causes (refer to the conclusion).
- ▶ **"Hot spots"**.
 - Pyotraumatic dermatitis is a frequent canine skin disease.
 - It is secondary to pruritic skin diseases, especially allergies and more particularly flea allergy dermatitis.
 - It may occur after a self-inflicted trauma, but only in certain individuals and without any rational explanation.



Secondary bacterial folliculitis.
Courtesy of: T. Olivry

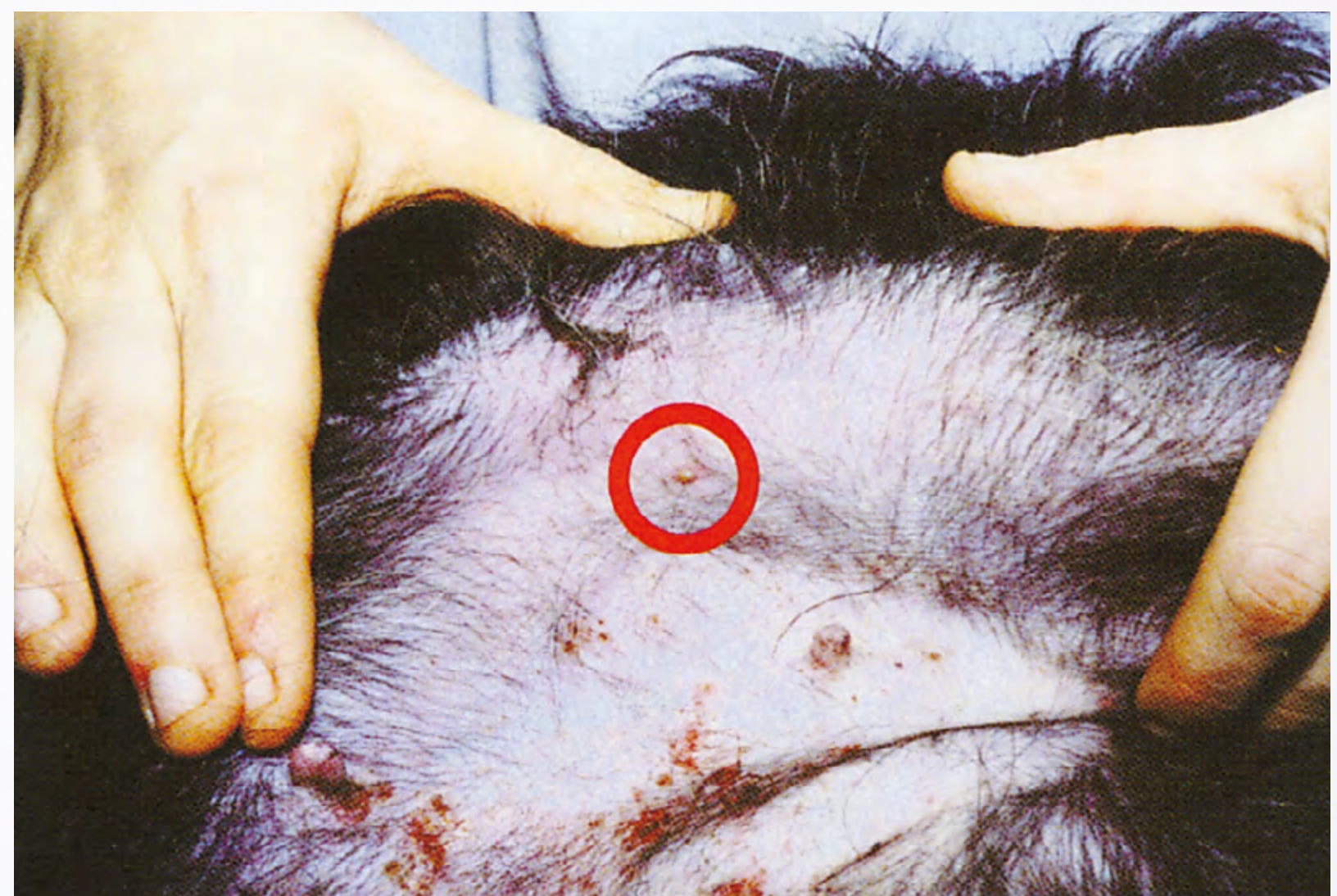
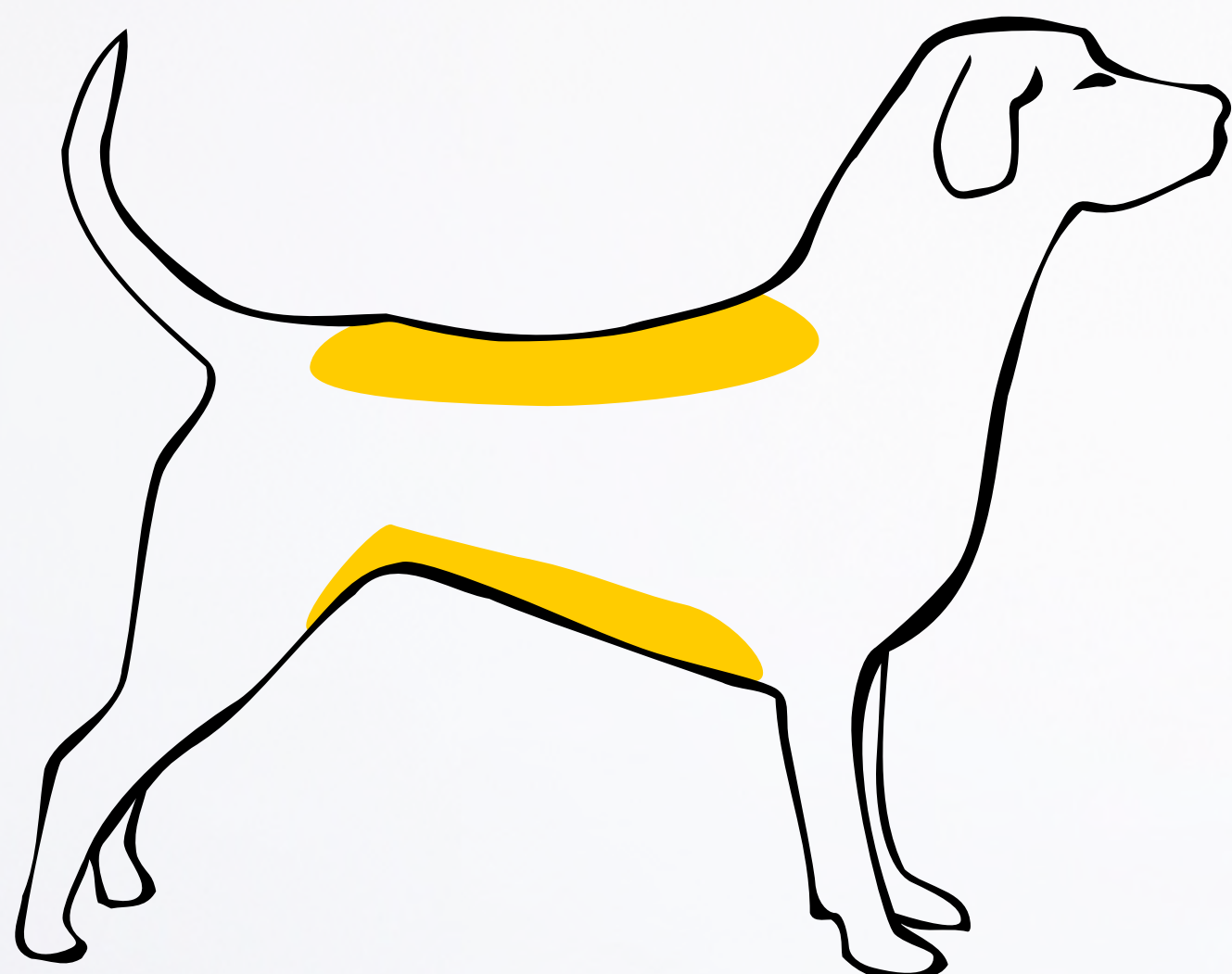
CLINICAL SIGNS

General remarks.

- **Clinical signs are extremely variable according to the type of pyoderma.**
- NB: Impetigo is seldom seen in adult dogs. The pustular pattern could be due to repeated micro-traumas (e.g. thorny bushes during hunting...). Numerous pustules are found on the most exposed areas (ears, neck, shoulders, axilla, limbs, abdomen...). A severe bullous condition occurs sometimes, particularly in severe immunodeficiency (Cushing's disease...).

Secondary folliculitis.

- Primary lesions: **marked erythematous reaction** (inflammation generally intense), relatively small follicular papules **and pustules** (therefore **centred on hair follicles that need to be observed with a lens!**). Always explore thoroughly all the hair-coat with a hand lens to locate the pustule - this will lead to your diagnosis!
- Secondary lesions: follicular pustules are quite fragile and transient, they result in **crusts** after rupture. Due to the location of the pustules, a significant **hair loss (alopecia)** may result. It is frequently a major sign, especially in short-coated breeds (coat with a "moth-eaten" look).
- **More or less pruritic**, sometimes **intensely**, with scratching responsible for lesion modification. NB: when pruritus occurs, it is absolutely necessary to treat the folliculitis first in order to assess if the underlying dermatosis is pruritic or not.



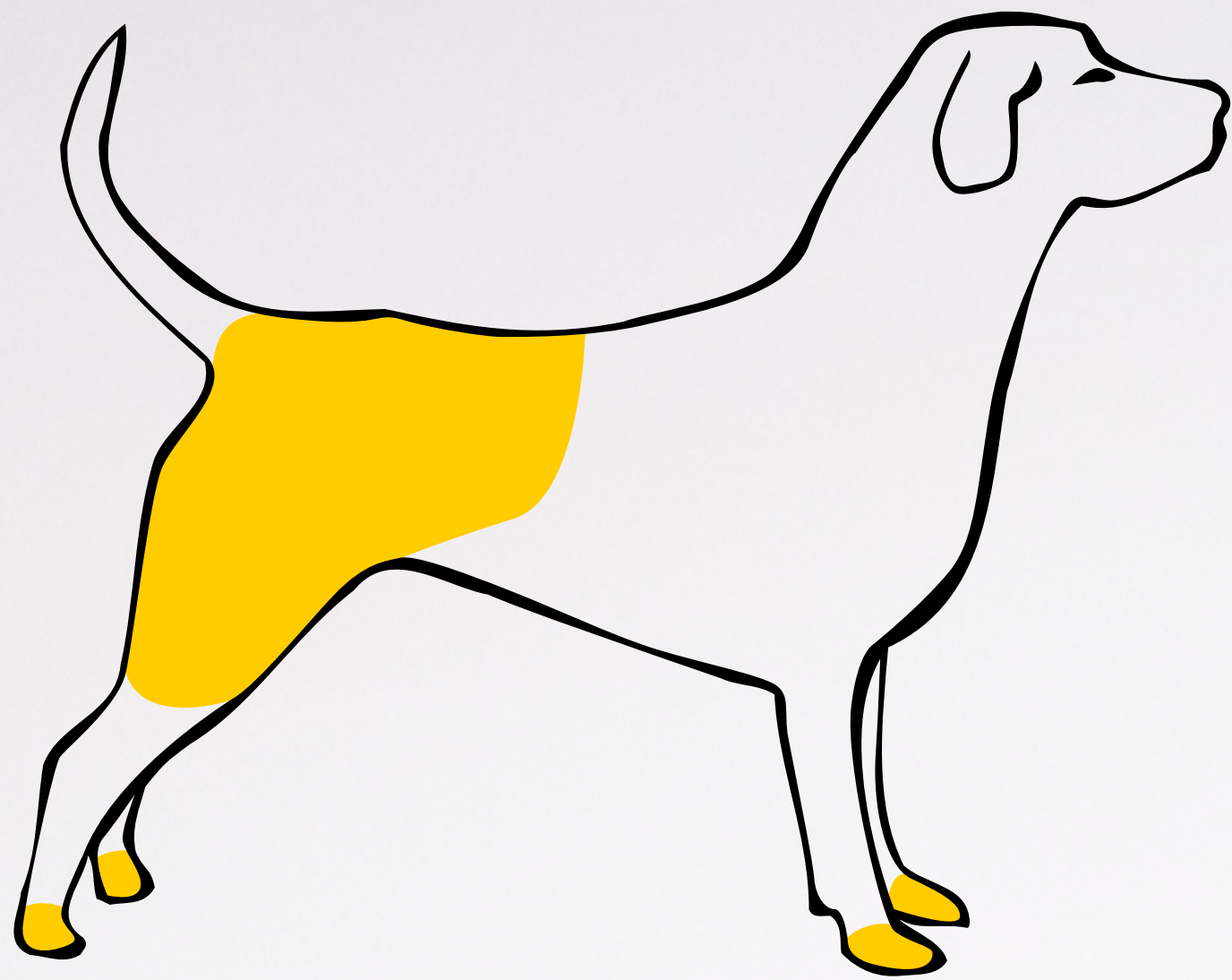
Follicular pustule discovered during a thorough exploration of all the skin surface.
Courtesy of: P. Jasmin

Deep pyoderma.

- Pruritus may be present but is usually **not severe**.
- Presence of **pain** is more **common**, as well as systemic signs.
- Furunculosis lesions: large prominent pustules, **erythema, cutaneous thickening, pus with blood, alopecia** and **scars**. These lesions can evolve in more extended cellulitis lesions: **crusts, ulcers, fistulas, suppuration** and **necrosis**. The former lesions can also be observed at first, without a visible furunculosis stage.
- Cellulitis can be localised or generalised, more severe and frequently associated with hyperthermia, generalised lymphadenopathy and debilitation.
- An exclusively pedal form called "pododermatitis" can be observed. Very uncomfortable for the dog, causes are multiple (including chronic friction and trauma, self-trauma from licking associated with allergic skin diseases, secondary infections...) and its therapy and diagnosis are a challenge for the clinician. Both sides of the web are affected, lesions can be ventral first and "migrate" to dorsal. The pads are usually intact but paronychia and onychia may be observed.

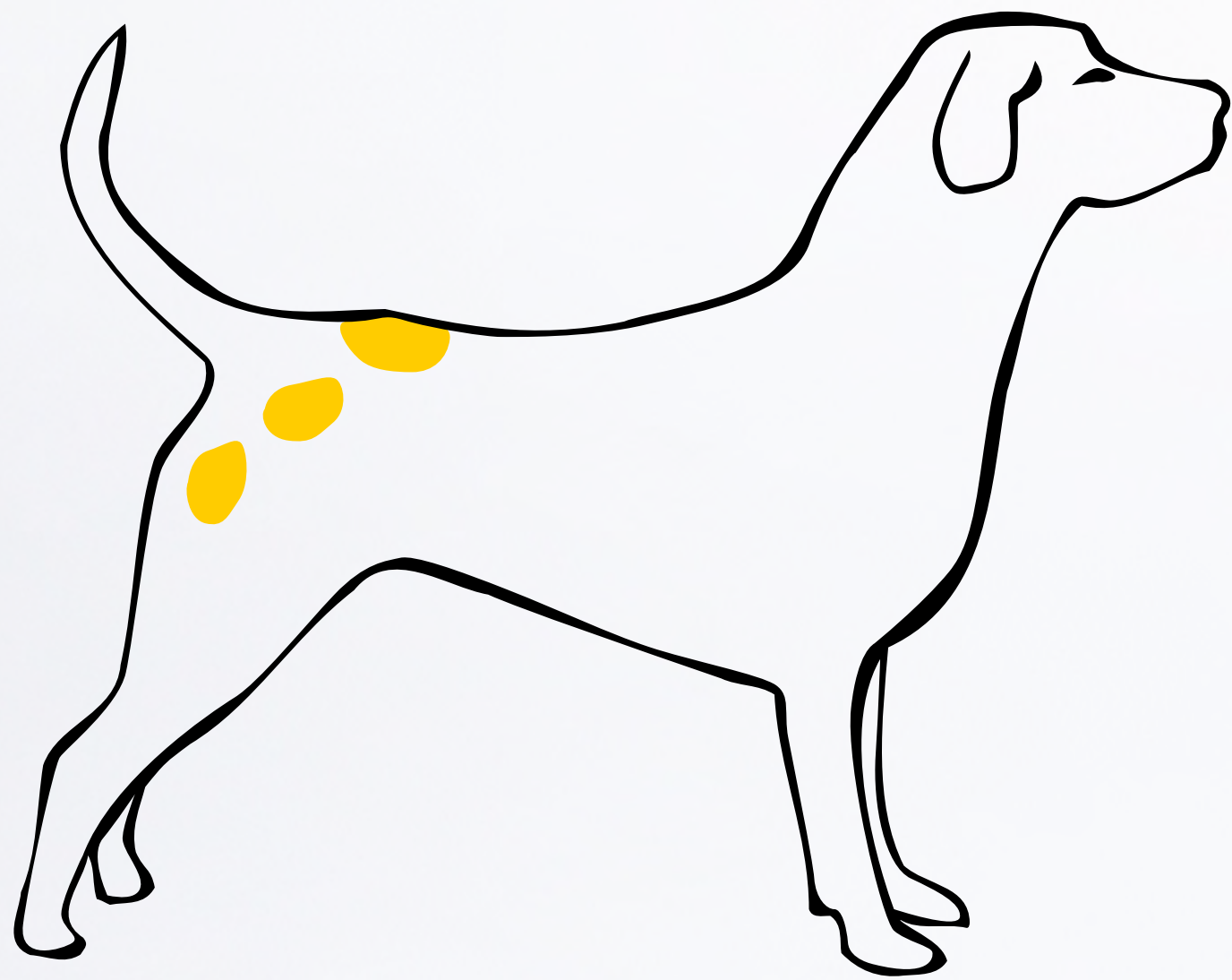


Deep pyoderma. Pododermatitis. Courtesy of: T. Olivry

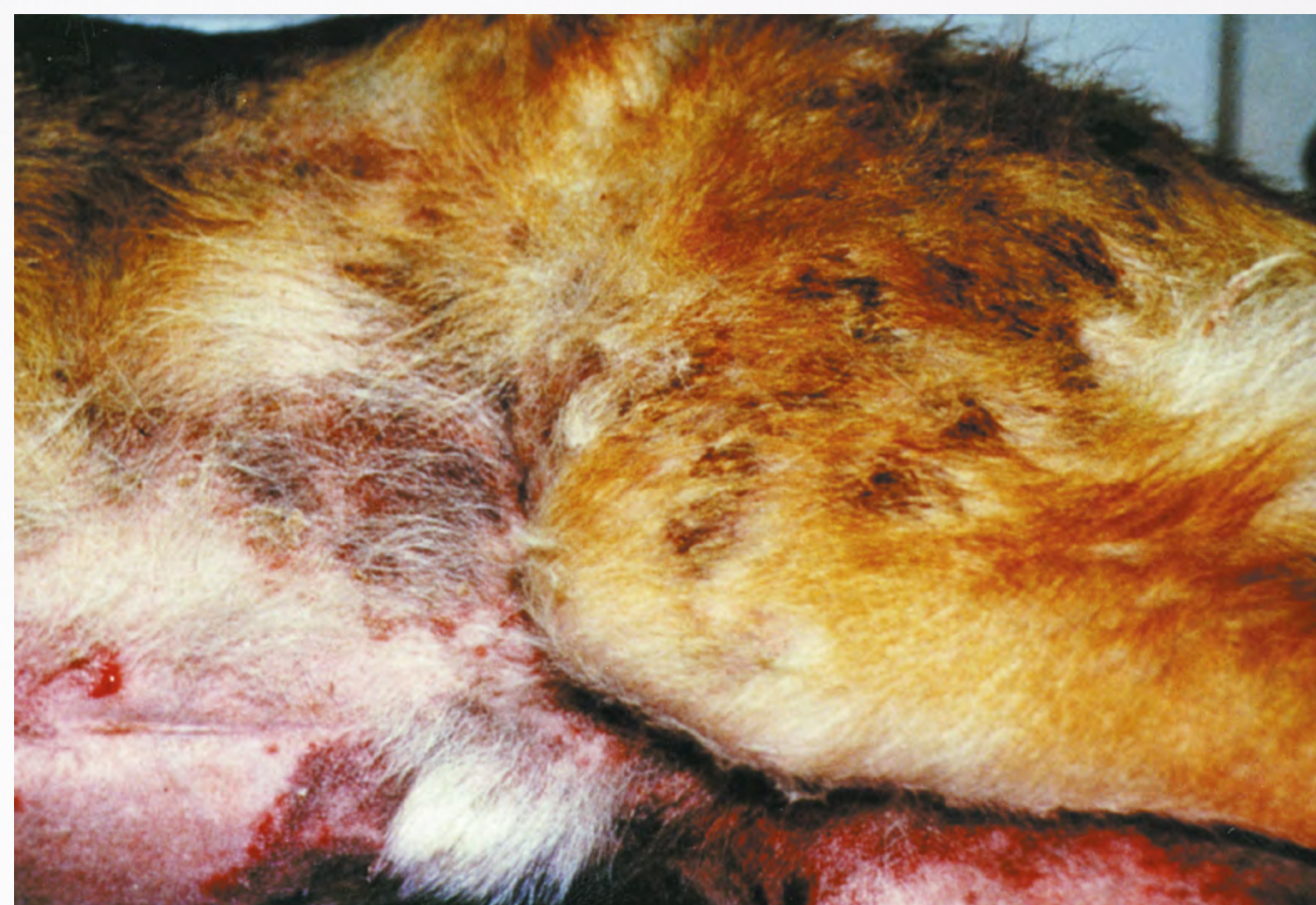


► **"Hot spots".**

- **Pruritus** is initially **very intense**, causing the dog to lick and bite itself incessantly. This self-inflicted trauma is responsible for most clinical signs. The pruritus is soon followed by **pain**.
- The lesion is frequently unique and well demarcated, very inflamed, erythematous and exudative. It **appears suddenly and extends very quickly** (in a few hours). Cutaneous thickening follows and the skin may be covered by a **layer of pus** due to **bacterial colonisation** (but not invasion).



Furunculosis. Courtesy of: D.N. Carlotti



Cellulitis. Courtesy of: P. Jasmin



Pyotraumatic dermatitis (hot spots). Courtesy of: P. Jasmin

DIAGNOSIS

► **History.**

• **General remarks:**

- Remember that **folliculitis** is **very frequent**.
- **Previous antibacterial therapy does not exclude this suspicion:**
 - » first, because of the specific requirements of antibacterial therapy in dermatology (especially concerning the choice of an adequate drug and the aspect of a sufficient duration of treatment), the previous treatment(s) may not have been properly conducted (most frequently),
 - » second, because even after well conducted therapy (at least three weeks with an established efficient antibiotic, clinical monitoring and continuation for one or two weeks after clinical recovery), relapses are typical and sometimes occur suddenly since these dermatoses are secondary.

• **Folliculitis:**

- Pruritus (scratching) may be severe. Folliculitis is a **major differential** in the case of **generalised pruritus** in a dog.
- Pruritus and lesions may appear simultaneously. More frequently, in cases of underlying allergic dermatitis, the pruritus appears prior to the lesions. In between:
 - » pruritus can first be localised and then generalised when the lesions appear.
 - » it can also be manifest in different ways before and after the lesions occur: extremity chewing and/or licking, rubbing the face (e.g. underlying atopy) followed by body scratching when the lesions occur (e.g. folliculitis).
- Partial corticosteroid response for example when *Staphylococci* produce virulence factors (superantigens, delta toxin...) that can create inflammation that would respond to low-dose corticosteroids.
- Eventually, only a partial response to well conducted antibacterial therapy but coupled with corticosteroid therapy.
- Good response to well conducted antibacterial therapy (relapses are normal if the cause is not controlled!).
- Improvement but no resolution when the antibiotic course is too short (less than three weeks), and failure when the antibiotic used is not adequate (see choice of antibiotics).



• **Deep pyoderma:**

- The lesions appear gradually and oozing is noted by the owner.
- Pruritus or pain appears simultaneously or after the lesions.
- Frequent debilitation and lameness when the pedal area is affected (sometimes exclusively).
- Previous corticosteroid treatments (particularly with long-acting injectables).

• **"Hot spots":**

- Usually a sole lesion, appearing suddenly with initial severe pruritus followed by marked pain.
- Constant licking/biting and lesion extension.
- Possible previous occurrences with spontaneous recovery.

► **Clinical elements and distribution pattern of skin lesions.**

• **Folliculitis:**

- Generally **pruritus** resulting in scratching of the body.
- More papular than pustular lesions, found on the ventral area of the body (axillae and abdomen), the head, the back, the thorax and the limbs, but the whole body may be affected.

• **Deep pyoderma:**

- A local or generalised lymph node reaction is commonly observed with a debilitating condition.
- Lesions of furunculosis can extend to the flanks and back and become generalised.
- Cellulitis lesions tend to occur on the rump and the thighs. Localised cellulitis tends to be secondary to furunculosis whether the generalised form is due to demodicosis or immunodeficiency (e.g. endocrine disorders).
- An exclusively pedal pattern of furunculosis and cellulitis is sometimes observed ("interdigital pyoderma complex"), and causes lameness. In this area, a very transient folliculitis stage may exist but irritation, digital friction and self-trauma are all factors favouring rapid development into deep pyoderma.

- **"Hot spots":**

- Intense pruritus followed by frequent marked pain.
- Spreading and localised lesion, usually on the dorsal area (particularly in case of underlying flea allergy dermatitis), or on the thighs.

- ▶ **Major differentials.**

- **Folliculitis:**

- Skin diseases that can result in follicular pustules: demodicosis and ringworm (other than bacteria, *Demodex* and dermatophytes are the two other invaders of the hair follicle). Cytological examination may give some clues (refer to corresponding monographs).
- Other pustular dermatoses (may not be follicular): particularly bullous auto-immune dermatoses (in particular pemphigus foliaceus). Cytological examination is a fundamental diagnostic step for these dermatoses.

- **Deep pyoderma:**

- Consider pyodermatitis! Furunculosis and cellulitis = deep skin scrapings! Especially when the feet are affected.
- Auto-immune dermatosis, neoplasia and when the pedal area is affected: foreign bodies, leishmaniasis, trombiculidiasis, *Pelodera* dermatitis, hookworm dermatitis, dermatophytosis (sometimes with onychia) etc.

- **"Hot spots":**

- Pyotraumatic folliculitis and eventually, dermatophytosis, localised demodicosis, neoplasia and calcinosis cutis.

- ▶ **Cytologic findings characteristic of each type of pyoderma.**

- **General remarks:**

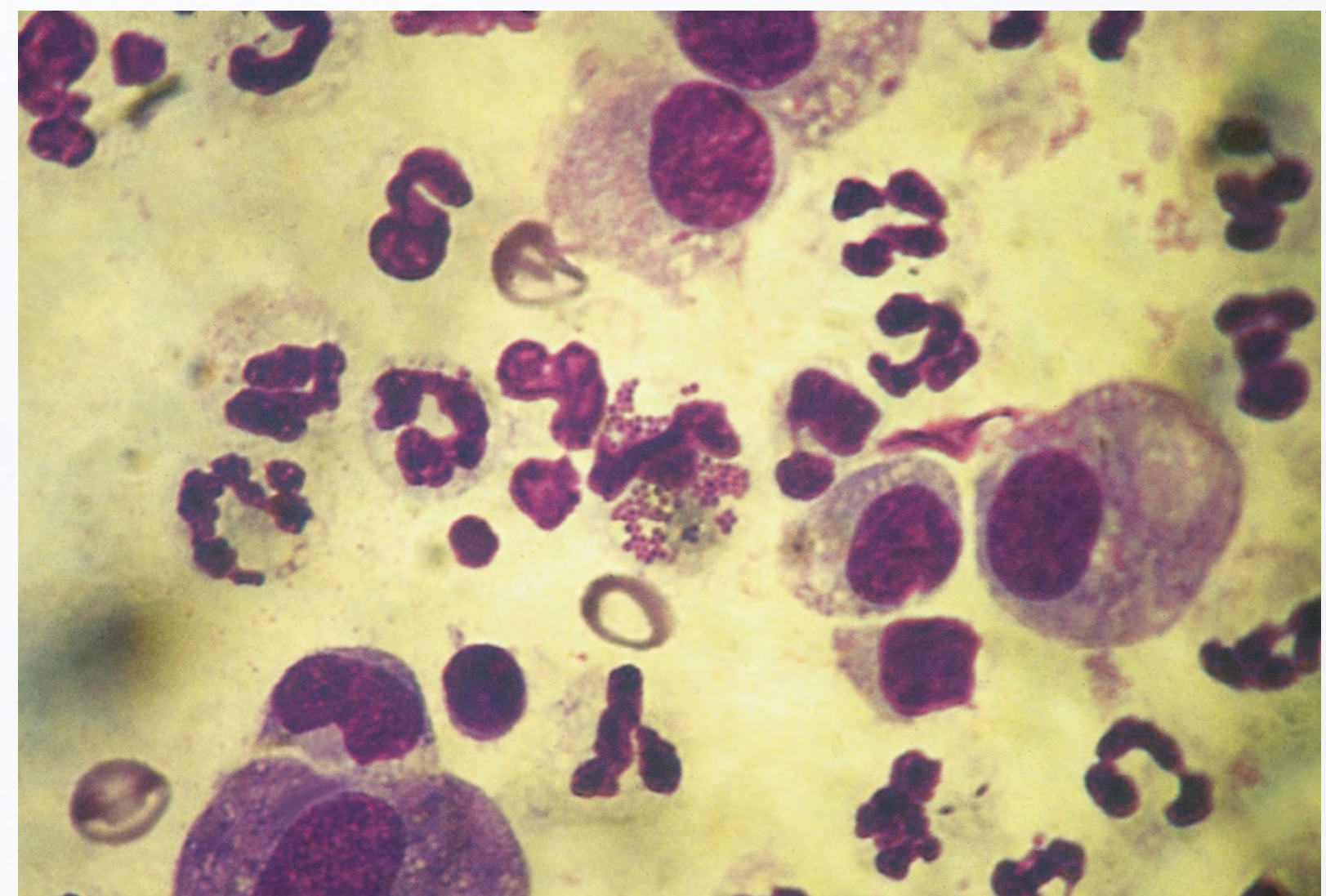
- Direct smear test is of paramount importance in the diagnosis of pyoderma.
- **Refer to the chapter describing general diagnostic methods of pyoderma.**

- **Folliculitis cytologic findings** are images of **bacterial invasion**:

- Numerous **impaired neutrophils**.
- Cocci (rarely rods):
 - » more or less abundant in an extracellular position,
 - » but mostly in an intracellular position (impaired neutrophils in state of phagocytosis), **phagocytic pictures** vary in number but **should be looked for** since they are always present!
- Eosinophils are sometimes present.

- **In deep pyoderma:**

- It is possible and necessary to verify the presence of an infectious process, considering the following:
- it is usually easy to sample pus from a furuncle (preferably), under crusts, or from a fistula,
- the condition is severe and the differential diagnosis is complex,
- it is not reasonable to perform a therapeutic trial.
- Images of **bacterial invasion, i.e. altered neutrophils and Cocci**, similar to those found in folliculitis will be observed.



Cytologic picture of a bacterial invasion (deep pyoderma). (Diff-Quik stain, x1000). Courtesy of: D. Pin

- But micro-organisms and **phagocytic pictures** are rarer, but they must however be looked for!
- In addition, the presence of macrophages and/or lymphocytes suggest a more chronic infection (pyogranulomatous reaction).
- Red blood cells are frequently present indicating a deep injury with vascular lesions.
- Epithelial cells (as in superficial pemphigus!) are not unusual.
- **"Hot spots"** are characterised by images of **bacterial colonisation**:
 - **Microbial agents** found are numerous Cocci (sometimes rods) in an extracellular position. Their pathogenic role is doubtful.
 - Some **healthy neutrophils**.
 - More or less numerous degenerate neutrophils in a state of phagocytosis (which has not an important significance since it is not observed inside a cutaneous lesion).

► **Skin biopsies.**

- Histopathology is not a diagnostic aid routinely performed in the diagnosis of complex approach pyoderma. However, it may rule out or confirm its presence.
- Very beneficial in **atypical cases**:
 - In folliculitis, when pustular lesions are not found in **spite of a thorough examination with a hand lens** (in those cases, biopsies of simple papular lesions will certainly lead to the diagnosis).
 - They should be done with no hesitation when deep pyoderma is suspected, particularly in the pedal area (biopsies are sometimes difficult to perform, but they provide consistent diagnostic data).
- In all cases, perform **biopsies on several primary lesions**: pustules, furuncles (keeping them intact!) and papules, but also any other lesion like ulcers (inside, around and on the margins), in particular **when the presence of pyoderma is uncertain**.

► **Therapeutic trial.**

- **Folliculitis**:
 - Refer to "Therapy" and the chapter "General therapy of pyodermas".
 - Empirical systemic antibiotic therapy is required and may evaluate the importance of the bacterial involvement in the condition.
 - It is perfectly conceivable when pyodermas are superficial.
 - However, resistant pyodermas are becoming common. Cultures and sensitivity testing should be used in suspicion of such cases.
 - Prescribe a treatment for a minimum of 3 weeks and monitor the patient:
 - » pursue the treatment if healing is evident (at least 50% of the lesions and/or the pruritus has disappeared),
 - » cast doubts on potential antimicrobial resistance or bacterial involvement and challenge the diagnosis if no improvement is seen, or if the case worsens,
 - » occasionally, efficacy of the treatment may be questionable, mostly if improvement is transient, or if only discrete healing is present. However, treatments rarely fail when proper antibacterial therapy is used (proper choice of antibiotic, dosage and duration).
 - Make your assessment exclusively on the regression of papules, pustules and epidermal collarettes, since erythema and pruritus may persist if the underlying dermatosis is pruritic.
- **Deep pyoderma**:
 - A therapeutic trial is not conceivable when deep pyoderma is suspected.
 - Establishing an acute diagnosis and ruling out the other differentials are necessary (history, clinical features, cytology, bacteriology may be sufficient, **histopathology** may be **useful**).
- **"Hot spots"**:
 - Since the diagnosis is relatively simple, it is not really a "trial".

TREATMENT

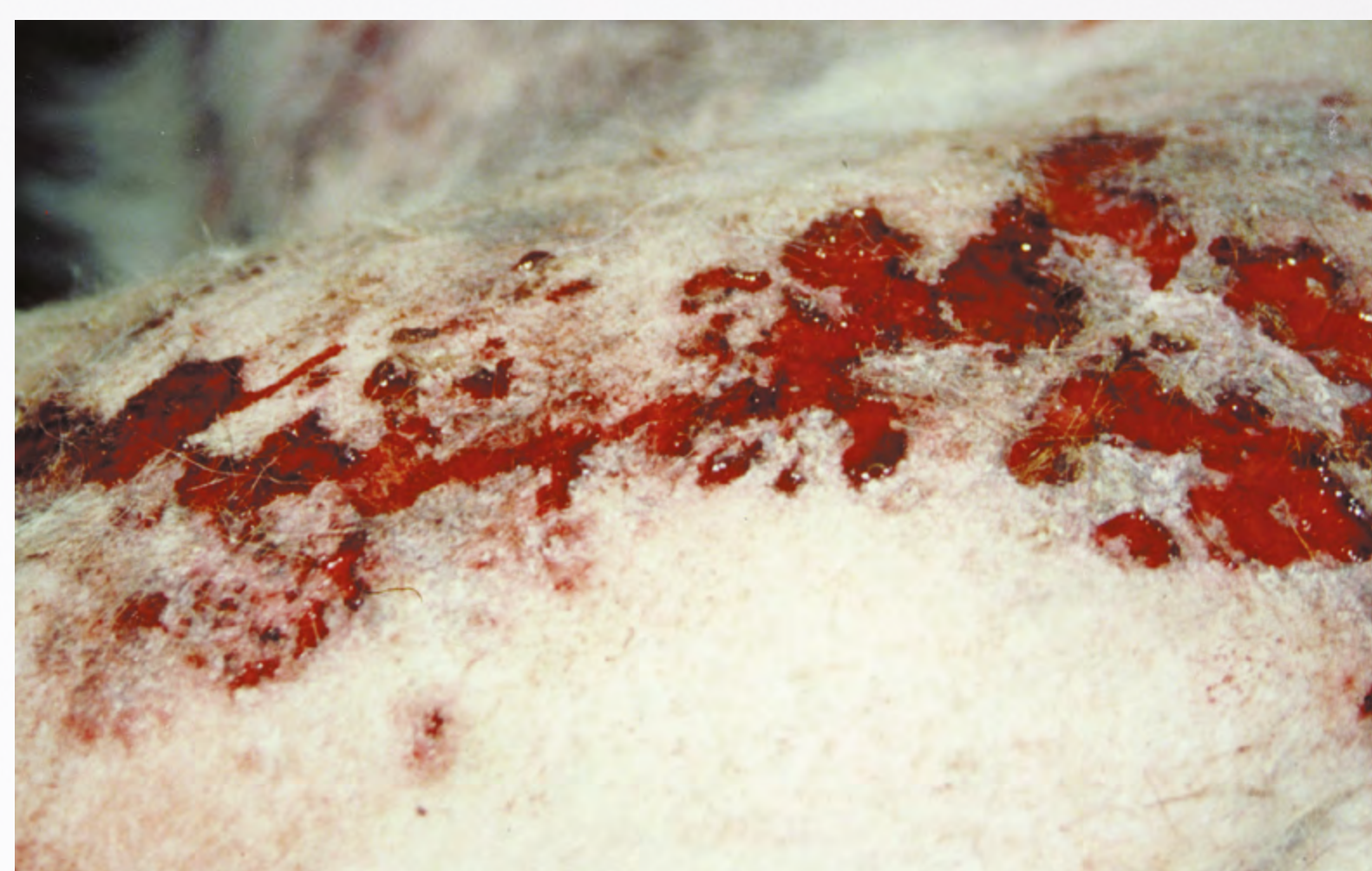
- Refer to the chapter "General therapy of pyodermas"

Folliculitis.

- Topical therapy:**
 - Antiseptic shampoos:**
 - » very useful as an **adjunct to systemic therapy**,
 - » **hastens healing** and allows a **faster recovery**.
 - Antiseptic lotions:**
 - » might be useful in between shampoos.
- Systemic therapy:**
 - Imperative systemic antibiotic therapy** (usually empirical but culture and sensitivity testing should be done in case of suspicion of resistance), by courses of three weeks, renewable until resolution, including one to two additional weeks after clinical recovery.
 - Corticosteroid therapy: contraindicated.**



Cellulitis. Lesional aspect before clipping.
Courtesy of: P. Jasmin



Cellulitis. Lesional aspect after clipping.
Courtesy of: P. Jasmin

Deep pyoderma.

- Topical therapy:**
 - Antiseptic shampoos:**
 - » very useful as an **adjunct to systemic therapy**,
 - » very beneficial in removing the majority of pus, debris, crusts along with bacteria,
 - » allows active oxygenation of the tissues essential to healing,
 - » hastens healing therefore allows a faster recovery and above all provides immediate relief to the patient.
 - Antiseptic lotions:**
 - » might be useful between shampoo applications to maintain local antiseptic pressure.
- Systemic therapy:**
 - Imperative prolonged systemic antibiotic therapy most often based on sensitivity testing** (refer to the general advice concerning culture and sensitivity at the beginning of the monograph), by courses of three weeks, renewable until resolution, including two to four additional weeks after clinical recovery.
 - Corticosteroid therapy: strictly contraindicated.**
- Adjunctive therapy:**
 - Clipping** the lesional areas is of **extreme benefit** and greatly contributes to lesion healing, particularly in the case of cellulitis. It must be done under general anaesthesia (**close clipping down to the skin, even if the lesions bleed**).
 - It is worth bathing the patient afterwards (with an **antiseptic shampoo**). Owners should be warned in advance of the procedure - to return a dog with multiple bleeding ulcers or showing much larger lesions than originally seen can be quite traumatic for pet owners.
 - Draining of potential abscesses (always in addition to a local antiseptic therapy and systemic antibiotic therapy) may be performed in interdigital pyoderma.
 - In some cases of **recurrent idiopathic cellulitis, immunotherapy** with staphylococcal extracts or autogenous vaccines (preferably with a *Staphylococcus pseudintermedius* strain).

► **“Hot spots”**

• **Topical therapy:**

- Local disinfecting with **antiseptic shampoos** is useful.
- **Various** antiseptic and **topical corticosteroid products** may be used as a sole treatment.
- Resolution should be obtained in a few days. Alopecia persists longer!

• **Systemic therapy:**

- Antibiotic: generally not necessary.
- Corticosteroid: generally not necessary but can be useful if the inflammation or the pain is intense (prednisolone 0.5-1 mg/kg/day, 3 to 5 days). To be avoided if a differential diagnosis of allergies is undertaken.

► **Important remarks.**

• **General remarks:**

- Prescribe a minimum duration of treatment of three weeks plus one to four additional weeks after clinical recovery and monitor the patient:
 - » the therapy must be pursued if healing is obvious
 - » efficacy of the treatment must be questioned if improvement is temporary, or if only discrete healing is present.
- In **true pyoderma, topical therapy is essential** and **systemic therapy mandatory**.

• **Folliculitis:**

- Pruritus is usually present but may be due, at least in part, to the underlying dermatosis.
- **Pruritus ceases** when the lesions disappear **if the underlying dermatosis is non-pruritic and persists if it is pruritic (most frequently)**. The “remaining” pruritus can then appear differently:
 - » the pruritus can first be generalised and then localised (face, ears, feet) when the lesions disappear,
 - » therefore, it can appear differently before and after the lesions disappear: prevailing body scratching followed by extremity chewing and/or licking, rubbing the face when the lesions disappear (e.g. underlying atopy).
- **Beware of previous use of corticosteroids.** Even if used long before, they could interfere with this assessment.

• **Deep pyoderma:**

- The search for an underlying cause is not mandatory for a single event pyoderma, but is warranted for recurrent episodes (relapse within weeks of stopping antibiotics).
- If the patient’s condition is causing concern, particularly if pruritus is absent, undertake an immediate investigation into an underlying immunodeficiency.
- **Beware of the euthyroid sick syndrome.** In this type of disease (or any other serious disease) low levels of thyroxin (basal T_4) are frequently observed, which might lead to a suspicion that the patient is suffering from hypothyroidism when it is in fact perfectly euthyroid. Hypothyroidism can be an underlying cause of deep pyoderma, but this is not as common as endocrine assay results might suggest.

• **“Hot spots”:**

- The treatment should be aimed at preventing self-trauma and to break the vicious circle lesions-pruritus-trauma. An effective treatment leads to rapid lesion healing.
- It is then mandatory to prevent any hypersensitivity reactions, largely suspected to be the cause of the lesions (especially from vasculitis). Among the **underlying causes** of pyotraumatic dermatitis, flea allergy dermatitis is the commonest, followed more rarely by atopy, food allergy or parasitic infestation (in particular sarcoptic mange).



Cellulitis. Courtesy of: H. Schroeder.

PROGNOSIS

► **Folliculitis.**

- The **prognosis is good** with the appropriate systemic antibiotic therapy but diagnosis and control of the underlying dermatosis is mandatory. This control may sometimes be difficult (**e.g. underlying atopic dermatitis**) and relapses may occur frequently.

► **Deep pyoderma.**

- **Usually more serious**, because of the pyoderma in itself and because of the underlying disease.
- The prognosis is better in the long term if it is a deep pyoderma due to abusive use of corticosteroids on an allergic animal (therefore proscribe these drugs).

► **“Hot spots”**

- **Very good prognosis**, an appropriate topical therapy is effective.
- **Relapses may be frequent** if the **underlying dermatosis** is not controlled. Since it is generally due to flea allergy dermatitis, this can be effectively controlled nowadays (refer to the monograph).

FOLLOW-UP

► **During the treatment of true pyodermas.**

- Monitoring every two to three weeks might be necessary. A monthly follow-up can then be planned for deep pyodermas.
- Renew the antibacterial therapy by courses of two to three weeks (or more for deep pyodermas) until lesion healing, normally 2 to 8 weeks for folliculitis and 4 to 12 weeks for deep pyodermas, then prescribe two to four additional weeks of therapy.

► **Follow-up after recovery: investigation of an underlying cause and control of relapses.**

- The **treatment** and **resolution** of a **secondary pyoderma** are of course **necessary** as a **first step**, but they are only a **stage** in managing the specific dermatological case.
- When marked symptoms and/or lesions persist or when relapses are too frequent and need repeated antibacterial therapy, it becomes necessary to **explore and control the underlying cause**.
- **Folliculitis** is frequently secondary to an **allergy**.
- Because in most cases the underlying dermatosis can not possibly be resolved but only more or less controlled according to the dermatosis involved, relapses of pyoderma are still possible and must be followed-up carefully.
- Limit the recurrence by prescribing a topical therapy suited to the underlying dermatosis, with shampoos and/or lotions, and start another systemic antibacterial therapy as soon as pyoderma lesions reappear.

CONCLUSIONS

- **Secondary folliculitis** is as **common** as **deep pyoderma** is **rare**!
- **Pyoderma**, in particular **folliculitis**, is a **major consideration** in the differential diagnosis of skin diseases **in dogs**.
- **Treatment** of the secondary pyoderma is a **prerequisite at first**, and effective **dermatological diagnosis will be established** by **reassessing** the patient **after recovery**.
- The **most frequent** case is a **folliculitis - recovery** will allow a further **differential diagnosis of allergies**. An appropriate **antibiotic therapy of three weeks, including one or two weeks after clinical recovery**, followed by a thorough and efficient monitoring with regard to history is a prerequisite above all suspicion of folliculitis.
- Managing a deep pyoderma involving a differential diagnosis of endocrine disorders (or broadly of immunodeficiency) is rare. However, these cases are more severe and require a precise diagnosis.

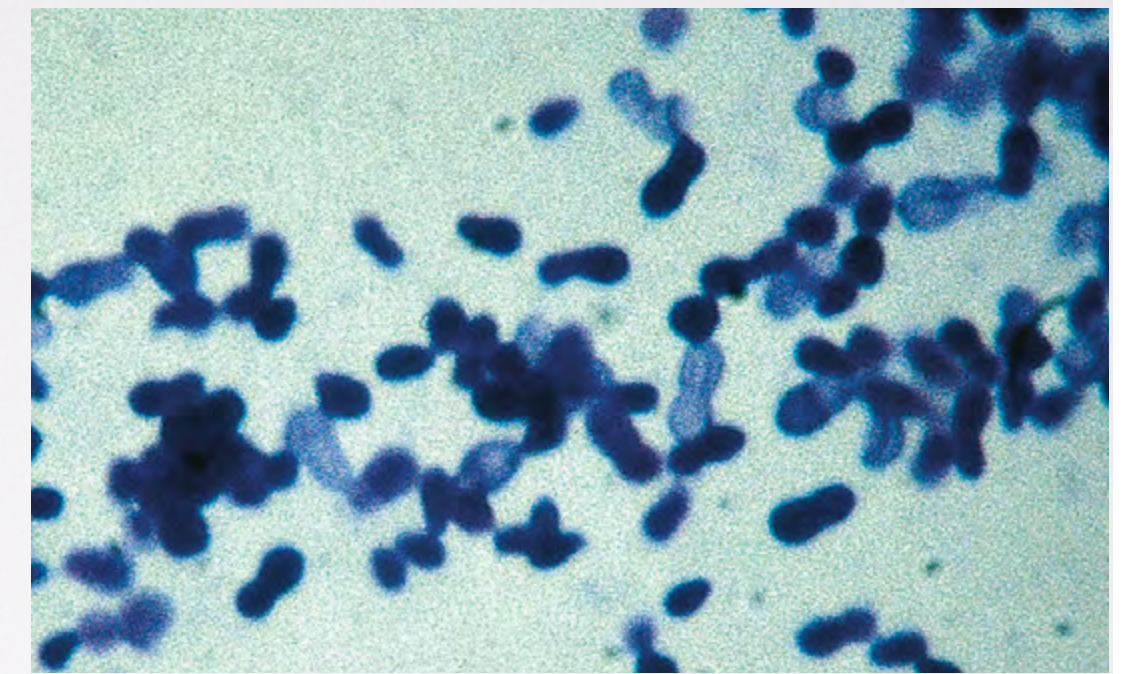
IMPORTANCE OF THE FOLLOW-UP AND OWNER EDUCATION IN COMPLEX APPROACH CASES

- A regular follow-up of the case is very important.
- A patient affected with pyoderma must not be “dropped off” its antibiotic treatment without any follow-up. **Success is due as much to a good follow-up as to the treatment!**
- Explain to the client that this **treatment is only a first step**: even though it is mandatory and will relieve the discomfort, symptoms due to an unavoidable underlying dermatosis may persist and/or the pyoderma has a high chance of recurring. Exploring the cause will certainly be necessary if we want to control the dermatological problem of the patient in the long term.
- In the case of **recurrent pyoderma**, any decision for further investigation must be taken **with the owner’s co-operation**, and when the patient’s discomfort is obvious or when very frequent antibacterial treatment is needed.
- In the case of **frequent relapses of superficial pyoderma** and/or if **persistent** moderate to severe **pruritus after cure**, a differential **diagnosis of allergies** might be undertaken.
- In the case of a **deep pyoderma**, explain that **the underlying cause must be explored immediately** because of the severity of the condition and unavoidable recurrence. Chiefly, an immunodeficiency must be explored: first as an endocrine origin (Cushing’s syndrome, hypothyroidism...) then consider other more unusual possible causes (auto-immune dermatosis, leishmaniasis, ehrlichiosis...). **If no cause is found**, this will allow us to declare the pyoderma as “**idiopathic**”, then prolonged and repeated antibacterial treatments must be prescribed. Immunotherapy must still confirm its efficacy.
- **The dogma that corticosteroids are contraindicated, may be revised.** It might be true for deep pyoderma, however, the use of corticosteroids in **atopic dogs** may help to normalise the skin barrier thus **reducing the risk of pyoderma recurrence**.
- Keep in mind that, **pruritus due to pyoderma may decrease very quickly** (in a few days) after the initiation of the antibiotic treatment.

MALASSEZIA DERMATITIS AND YEAST OVERGROWTH

INTRODUCTION / DEFINITION

- ▶ *Malassezia* dermatitis is a **fungal skin infection**.
- ▶ There might be several species involved, however, the main pathogenic agent, ***Malassezia pachydermatis*** (*Pityrosporum canis* in the past) is a **lipophilic yeast** belonging to the cutaneous microflora of the normal dog, along with *Staphylococcus pseudintermedius* (principal pathogenic agent of canine pyoderma).
- ▶ **In certain conditions**, related to cutaneous and/or immune-mediated factors, ***Malassezia* may proliferate** within the stratum corneum.
- ▶ The subsequent **yeast overgrowth** may then acquire a **real pathogenic capacity** and initiate a true dermatitis.
- ▶ ***Malassezia* dermatitis** is relatively **frequent** in dogs, and is **usually very pruritic**.
- ▶ Its **diagnosis** is of **major importance**, particularly in the differential diagnosis of pruritic dermatoses, as it can **mimic many dermatoses and mostly be secondary to them**.
- ▶ **It must therefore always be suspected in an adult dog**, with clinical signs compatible with this dermatosis.
- ▶ Since ***Malassezia*** are **frequently associated to other dermatoses** (which are also often pruritic) and since the **subsequent lesional aspect is far from specific, the component of the clinical signs due to the yeast can only be determined after an efficient antifungal treatment**.
- ▶ Consequently, "*Malassezia* dermatitis" designation should be only used when the presence of yeast is effectively responsible for the clinical signs, and therefore when the latter disappear after treatment (meaning after a "therapeutic trial"). The remaining clinical signs are then due to an underlying dermatosis, or if there are no symptoms left, the *Malassezia* dermatitis is idiopathic, this is however a rare phenomenon.
- ▶ However, and for this reason amongst others, **any yeast overgrowth must be eliminated whether an actual *Malassezia* dermatitis is present or not**.



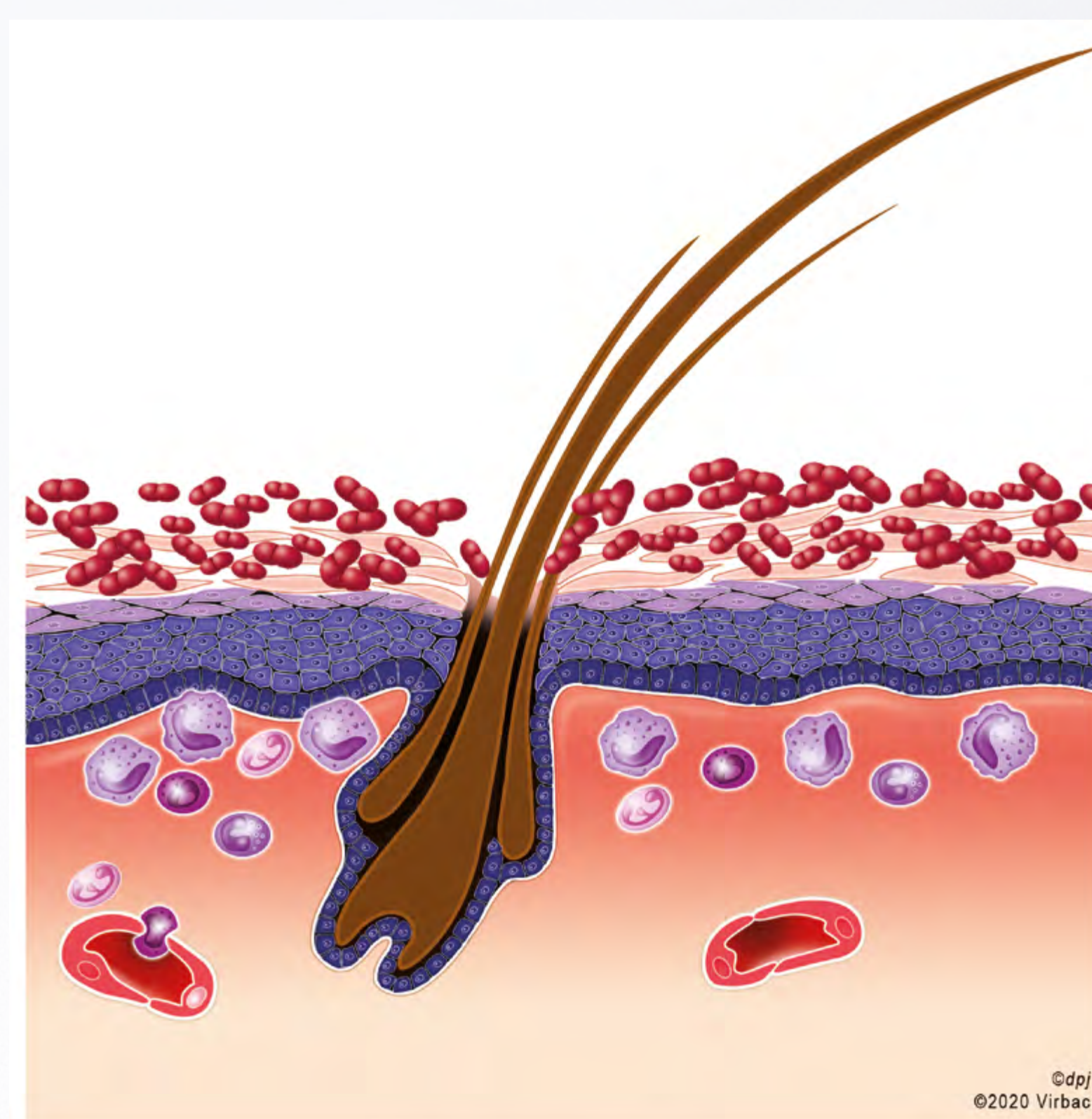
Microscopic view of a *Malassezia pachydermatis* culture. (Diff-Quik stain, x1000). Courtesy of: D.N. Carlotti

AETIOLOGY / PATHOGENESIS






- ▶ ***Malassezia pachydermatis***.
 - The *Malassezia* genus **includes unicellular lipophilic yeasts**, i.e. their **growth is favoured by the presence of lipids**.
 - Several species (e.g. *Malassezia furfur*, *M. sympodialis*, *M. globosa*, *M. obtusa*, *M. restricta*, *M. sloofiae*) are lipid-dependent, which means that their development requires the presence of long-chain fatty acids.
 - Only one species, *Malassezia pachydermatis*, is lipophilic but not lipid-dependent; it contents itself with short-chain fatty acids and readily grows on usual mediums.
 - The identification of species is difficult and is based on molecular biology techniques.
 - *M. pachydermatis* is characterised by a **monopolar budding from a broad base**. This type of reproduction leads to its characteristic "peanut-shaped" appearance under the microscope.
 - These yeasts are small (2-7µm) and they are better observed under **high power magnification (100X objective)**.
 - *Malassezia pachydermatis* belongs to the resident microflora of the dog's skin.
 - Approximately 50% of normal dogs carry this yeast in their haircoat and skin.
 - The perianal region seems to be the preferential site for *Malassezia* carriage and appears as a dispersion area, as is the case for staphylococci.
 - The external ear canal does not seem to be a preferential carriage area (nevertheless, *Malassezia* otitis is frequently observed).
 - The most frequent cutaneous locations in the normal dog appear to be the lips and limb extremities.

Pathogenesis.

- **Normal canine response to yeast presence on the skin surface:**
 - **non specific response mechanism** (neutrophil phagocytosis),
 - **specific cell-mediated response mechanism:** antigen presentation by Langerhans' cells, T cell induction, lymphokine production which stimulates macrophagic phagocytosis and basal keratinocyte multiplication.
- Consequences: **yeast elimination**, either directly by destruction, or indirectly by the shedding mechanic action.
- **Some pathogenic alterations** favour the development of the normally saprophytic *Malassezia pachydermatis* into a pathogenic status able to multiply and proliferate:
 - **disruption of the cutaneous ecological equilibrium,**
 - **modifications of the capacity and mechanism of host defence.**
- **Predisposing factors enhancing the multiplication of *Malassezia pachydermatis*:** excessive production and/or modification of the nature of the sebum and/or cerumen, excessive humidity, disruption of the epidermal barrier, presence of skin folds.
- These modifications are mainly due to structural alterations generated by **primary causes**.
- This explains why ***Malassezia* dermatitis is essentially secondary to other (so called) underlying dermatoses** and/or associated with other secondary dermatoses.
- It is thus **frequent in adult dogs** which may be affected by many **primary dermatosis**, essentially **allergies** and **endocrine disorders**.
- Amongst the **underlying or associated dermatoses**, the following are frequently observed:
 - skin allergies and most particularly **atopic dermatitis**,
 - endocrine disorders and most particularly hypothyroidism,
 - iatrogenic origin, most particularly corticosteroids treatment and especially when it leads to **iatrogenic Cushing's syndrome**,
 - **parasitic infestation** and in particular demodicosis,
 - **pyoderma**,
 - **ichthyoses** of various origin.
- These conditions are responsible for **skin alterations** that generate ***Malassezia* proliferation**, but the latter still **aggravates the cutaneous problems**:
 - by producing lipases that **modify the surface lipid film**,
 - by **speeding up the "epidermal turn-over"**,
 - by the development of an immediate **hypersensitivity to *Malassezia pachydermatis*** which then becomes an allergen as shown for example by: positive skin testing with *Malassezia* extracts and high levels of IgG and IgE in atopic dogs with or without *Malassezia* dermatitis in comparison with non atopic affected dogs and healthy dogs.
- All these **modifications contribute in diminishing the skin integrity and aggravating the lesional status** and are therefore responsible for the appearance or exacerbation of pruritus, which can become intense.
- **A true vicious circle can develop; an antifungal therapy then becomes the first key point of the dermatological treatment.**



Malassezia dermatitis

 Mast cells
  Basophils
  Neutrophils
  Eosinophils
  *Malassezia pachydermatis*

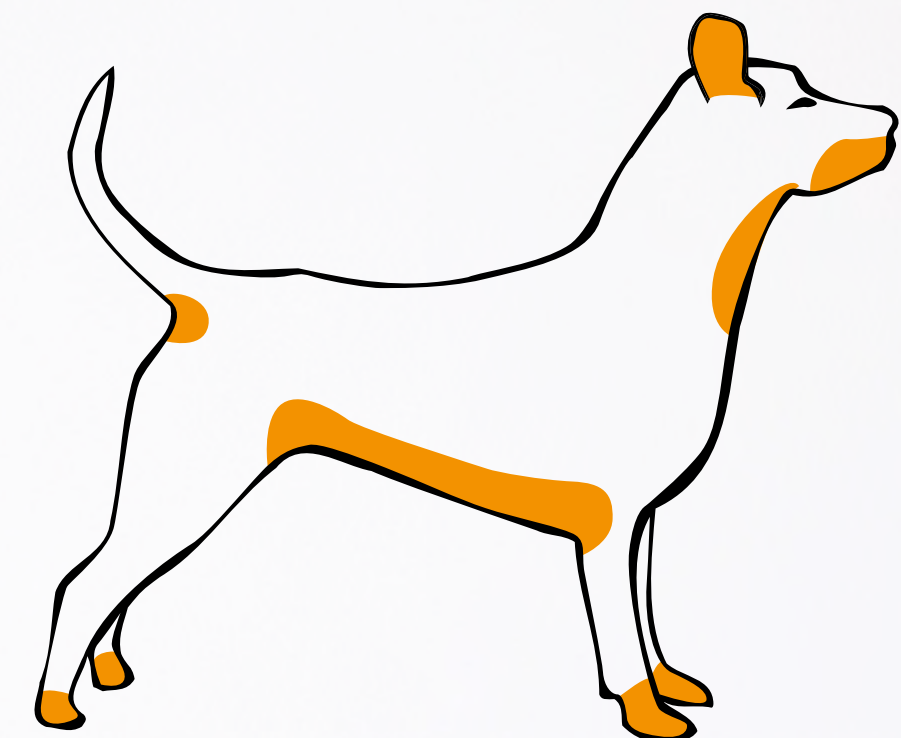
Courtesy of: P. Jasmin

EPIDEMIOLOGY

- Malassezia dermatitis is not contagious to other animals or humans.
- It affects adult **dogs of all ages** (puppies are uncommonly affected). There is no sex predisposition (neutered animals could be predisposed).
- Certain **breeds** seem **predisposed** to develop *Malassezia* dermatitis: West Highland white terrier, Basset hound, English setter, Shih Tzu, Dachshund, Cocker spaniel, American Cocker, Poodle, German shepherd, Collie, Shetland sheepdog, Jack Russell terrier, Silky terrier, Australian terrier, Springer spaniel and Shar pei.
- In temperate countries of the Northern Hemisphere, ***Malassezia* dermatitis often begins during the summer, a period of the year also favourable to the expression of allergic dermatitis. Thereafter, it may persist all winter.**

CLINICAL SIGNS

- Pruritus** is always present and is usually **intense**. For this reason, ***Malassezia* dermatitis must be unconditionally treated at first to be able to evaluate if the underlying dermatosis is pruritic and to what degree.**
- Primary lesions:** generalised or localised erythema, oedema with or without small papules.
- Secondary lesions:** greasy seborrhoea, crusts, diffuse alopecia, hyperpigmentation and lichenification when chronic.
- Lesions are preferentially localised **on the ventral aspect of the body (neck, axillae, abdomen, and inguinal area)** and the **perianal region**.
- Other areas also frequently affected are the **face (ears, lips, muzzle)** and the **limbs (medial thighs and extremities)**.
- An **offensive odour of rancid grease** is also frequently present.
- Erythematous-ceruminous otitis externa** is frequently associated (refer to the Otitis Monograph).



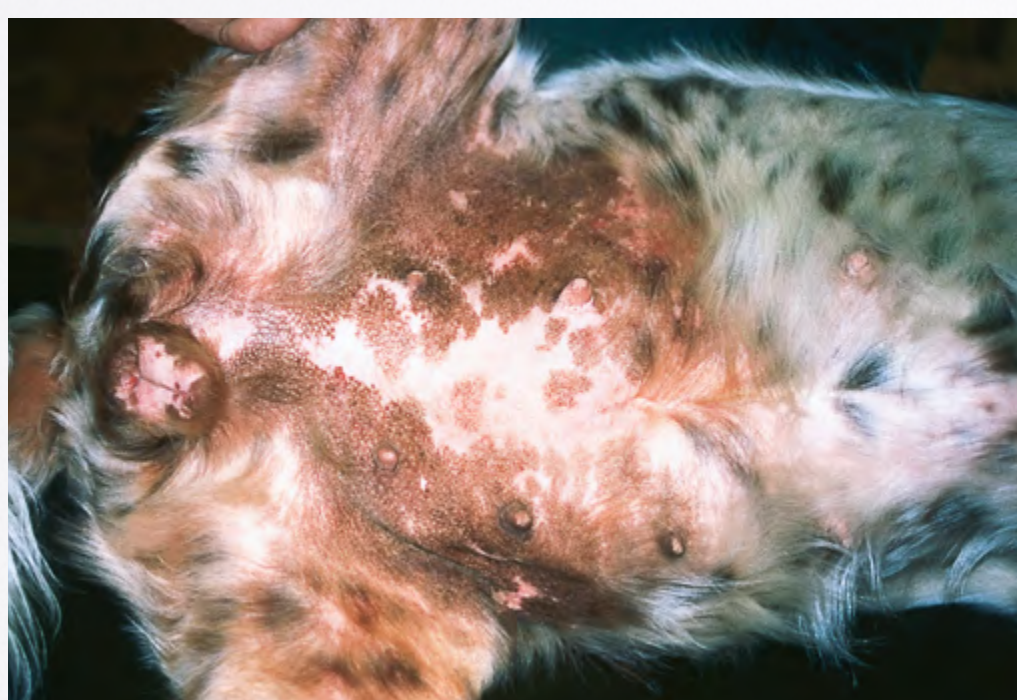
Malassezia dermatitis. Associated otitis externa. Courtesy of: D.N. Carlotti



Malassezia dermatitis. Lesional aspect of the chin and neck. Courtesy of: D.N. Carlotti



Malassezia dermatitis. Axilla lesional aspect. Courtesy of: D.N. Carlotti



Malassezia dermatitis. Lesional aspect of the groin and abdomen. Courtesy of: D.N. Carlotti



Malassezia dermatitis. Lesional aspect of a limb. Courtesy of: H. Koch



Malassezia dermatitis. Lesional aspect of the extremities. Courtesy of: D.N. Carlotti

DIAGNOSIS

General remarks.

- The diagnosis is based on **history, clinical examination, *Malassezia*** observation on the cutaneous lesions and on the response to a specific antifungal **therapy**.
- Yeast identification may be obtained by various means.
- **Clinical examination and cytology are essential** and justify by themselves the initiation of antifungal therapy.

History.

- **All breeds may be affected**, but certain breeds seem predisposed (see above).
- **Constant pruritus** (scratching), **sometimes intense**. *Malassezia* dermatitis is a major differential in case of generalised pruritus in a dog.
- **Pruritus and lesions generally appear simultaneously or the lesions are preceded by the pruritus** when the patient is affected by an **underlying allergic dermatitis**: very frequent case!

Clinical signs and distribution pattern.

- **Generalised pruritus**.
- **Pruritus localisation mimics atopic dermatitis** since the distribution is similar and since both conditions are frequently associated.
- **Erythema and keratoseborrhoeic disorders** on the **ventral aspect of the body**, the **neck**, the **face**, the **perianal region** and the **limbs**. The **whole body may also be affected**.

Cytology.

General remarks:

- **Cytology is reliable**, allows **rapid** performance and interpretation (it needs a few minutes at the patient's side) **and inexpensive!**
- Various sampling techniques exist:
 - » **direct impression smear**,
 - » **cellophane tape test (tape strip test)**,
 - » smear from a skin scraping,
 - » swab smear.
- The first two methods must be preferred, the swab smear being reserved for auricular sampling or when cutaneous exudate is important.

HISTORY SHEET

Owner: _____ Date: _____
 Dog's name: _____ Age: _____
 Breed: _____ Sex: _____ Weight: _____

Breed: _____

GENERAL HISTORY

1/ Age when acquired and origin (breeder, pet store, ...): _____
 2/ Geographical area of home, present and past trips, kennels: _____
 3/ Way of life, environment (exercise, house, garden, flat, ...) and in-contact pets: _____
 4/ Diet (current and previous): _____
 5/ Reproduction (frequency of oestrus, pregnancy, behaviour of males, ...): _____
 6/ Previous diseases and surgery: _____
 7/ Unrelated previous dermatoses: _____
 8/ Current non skin-related problems: _____
 9/ Behavioural changes: _____

DERMATOLOGICAL HISTORY

1/ Chief complaint: _____

3/ Pruritus, severity and time of onset (before or after lesions): _____

4/ Specific clinical signs and related behaviour: _____

• Itching of feet (licking, chewing): _____
 • Itching of head, lips, chin, periorbital area (scratching, rubbing): _____
 • Otitis, itching of ear pinnae (scratching, shaking): _____
 • Itching of anogenital area (rubbing, licking and chewing): _____

• Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretions): _____
 • Upper respiratory signs, nasal discharge and/or sneezing: _____
 • Lower respiratory signs, asthmatic problems: _____

5/ First cutaneous lesions observed and their development: _____

6/ Seasonal influences: _____

7/ Other affected animals (cohabiting, lineage) or human beings in contact: _____

8/ Presence of fleas and anti-parasitic treatments given: _____

9/ Shampoos and grooming: _____

11/ Previous treatments (date, products, dosage, duration) and responses: _____

- **Direct impression smear performance and fast-acting staining (Diff-Quik type):**

- **A slide is placed and rubbed against the lesional areas.** The edge (or even a corner) of the slide may be sufficient if the area to sample is small (interdigital area for example).
- Perform **several smears** in different lesional areas.
- Note the side where the sample has been placed. This will be the examination side.
- Let the samples dry for 1 to 2 minutes in open air.
- Immerse the slides in the three different solutions used for classic haematological fast-acting staining, following the advised contact times (generally 30 seconds each).
- Rinse the slides thoroughly with clear water and blot them carefully with an absorbent paper, examination side upwards, until the water is completely absorbed.
- A hair-dryer may be used (gently) for final drying.



Performing an impression smear. Courtesy of: D. Pin

- **Technique for a cellophane tape test and fast-acting staining (Diff-Quik type):**

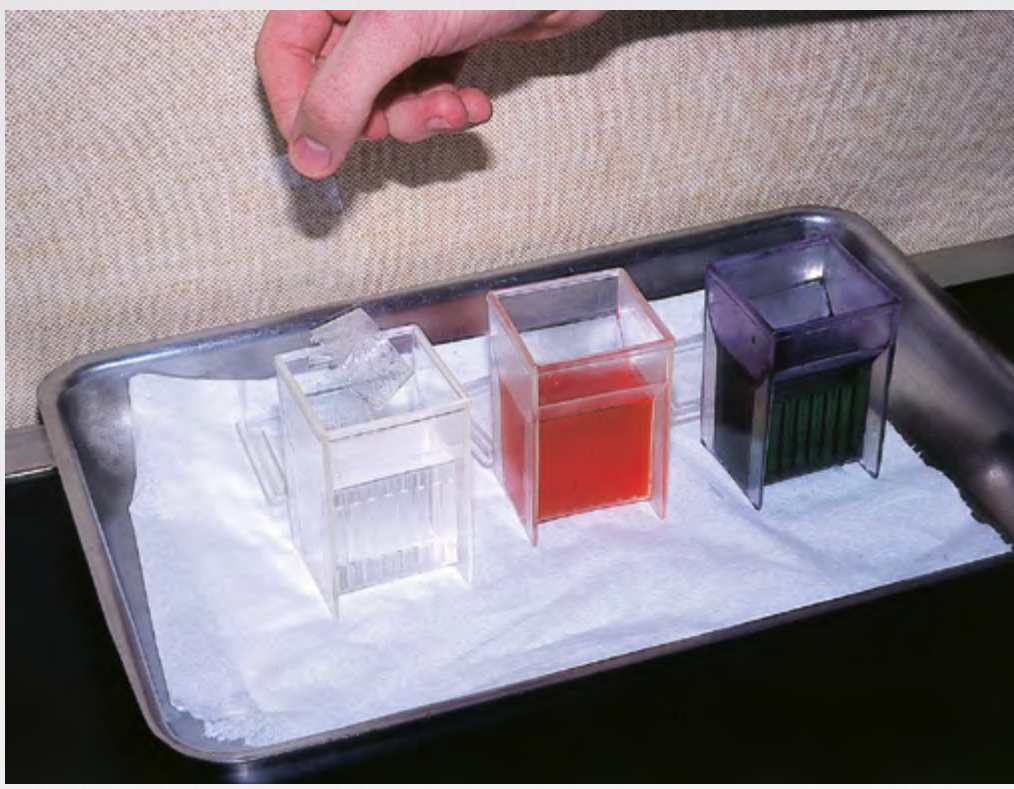
- A **clear cellophane tape is pressed firmly on the lesions.**
 - **Sample** several times in different lesional areas.
 - Make a loop with the piece of cellophane tape by fixing it at the end of a slide, the adhesive side carrying the material sampled outwards.
 - Immerse the different pieces of tape in the three different solutions used for classic haematological fast-acting staining, following the advised contact times (generally 30 seconds each).
 - Rinse the pieces of adhesive tape thoroughly with clear water. Eliminate excess water with an absorbent paper.
 - A hair-dryer may be used (gently) for final drying.
 - Unroll the adhesive tape and stick it on the slide.
 - **Here is a faster technique:**
 1. Take a long piece of cellophane tape.
 2. Tick the center of the tape several times to the area (tape stripping).
 3. Place a drop of the blue stain on a slide.
 4. Put the center of the tape over the blue stain.
 5. Stick the ends of the tape to the slide including around the edges.
- No need for drying, no need for coverslip.



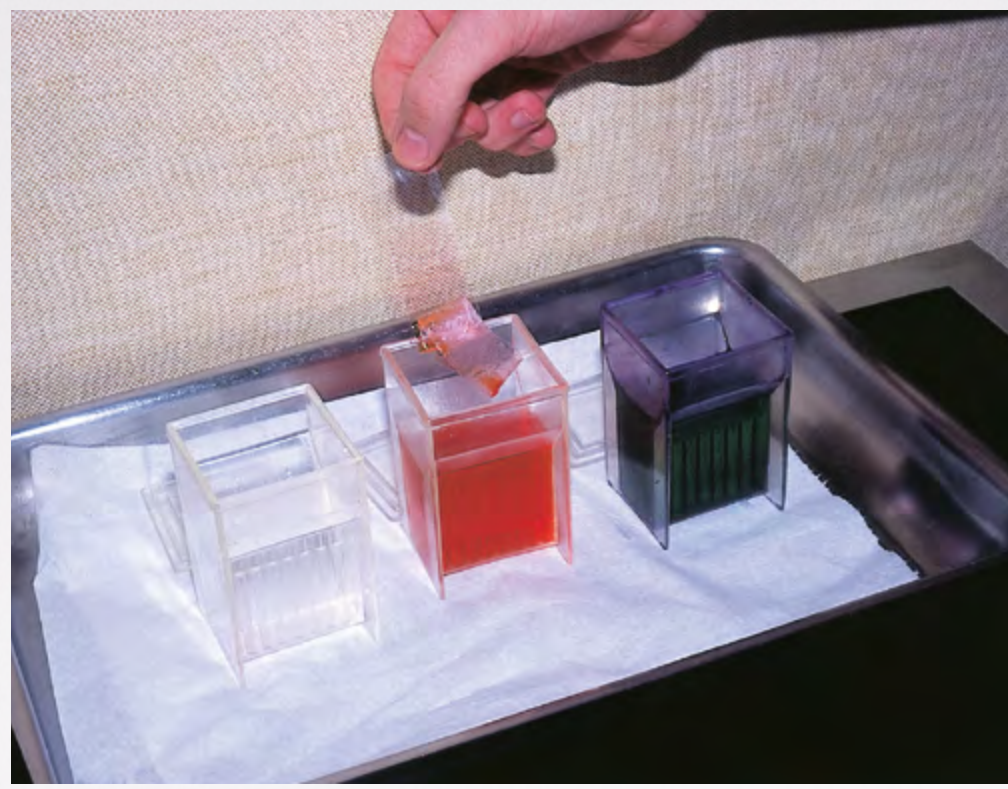
Cellophane tape test performance. Pressing a piece on a lesional area. Courtesy of: D. Pin



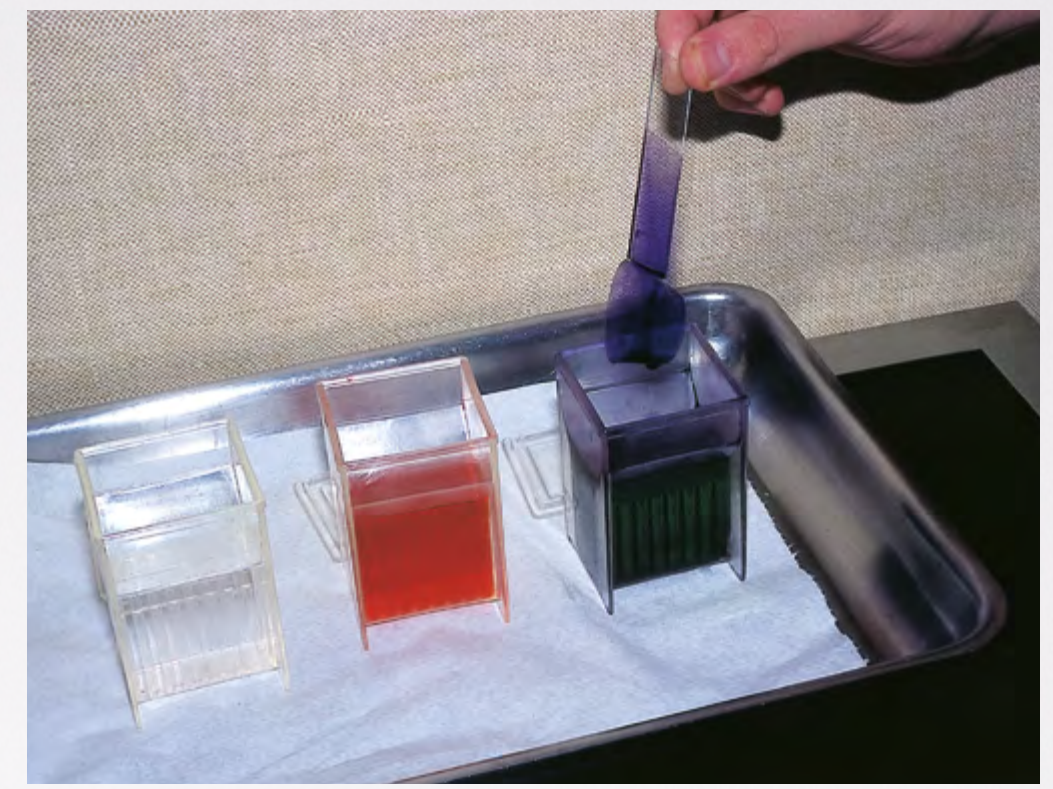
Cellophane tape test performance. Pressing a piece on a lesional area. Courtesy of: D. Pin



Cellophane tape test performance.
Fixing the piece at the end of the slide and staining.
Courtesy of: D. Pin



Cellophane tape test performance.
Fixing the piece at the end of the slide and staining.
Courtesy of: D. Pin



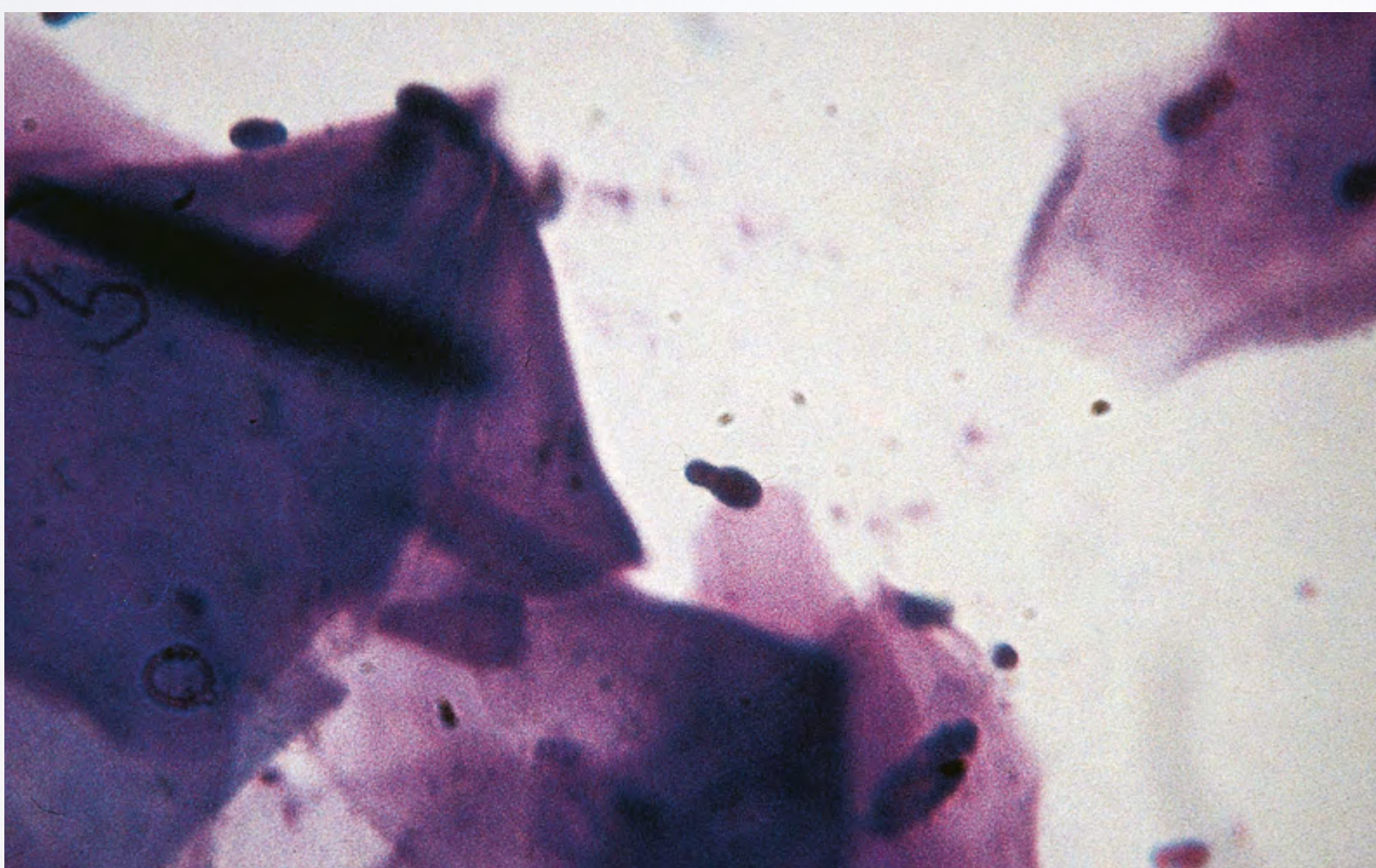
Cellophane tape test performance.
Fixing the piece at the end of the slide and staining.
Courtesy of: D. Pin

• **Microscopic observations:**

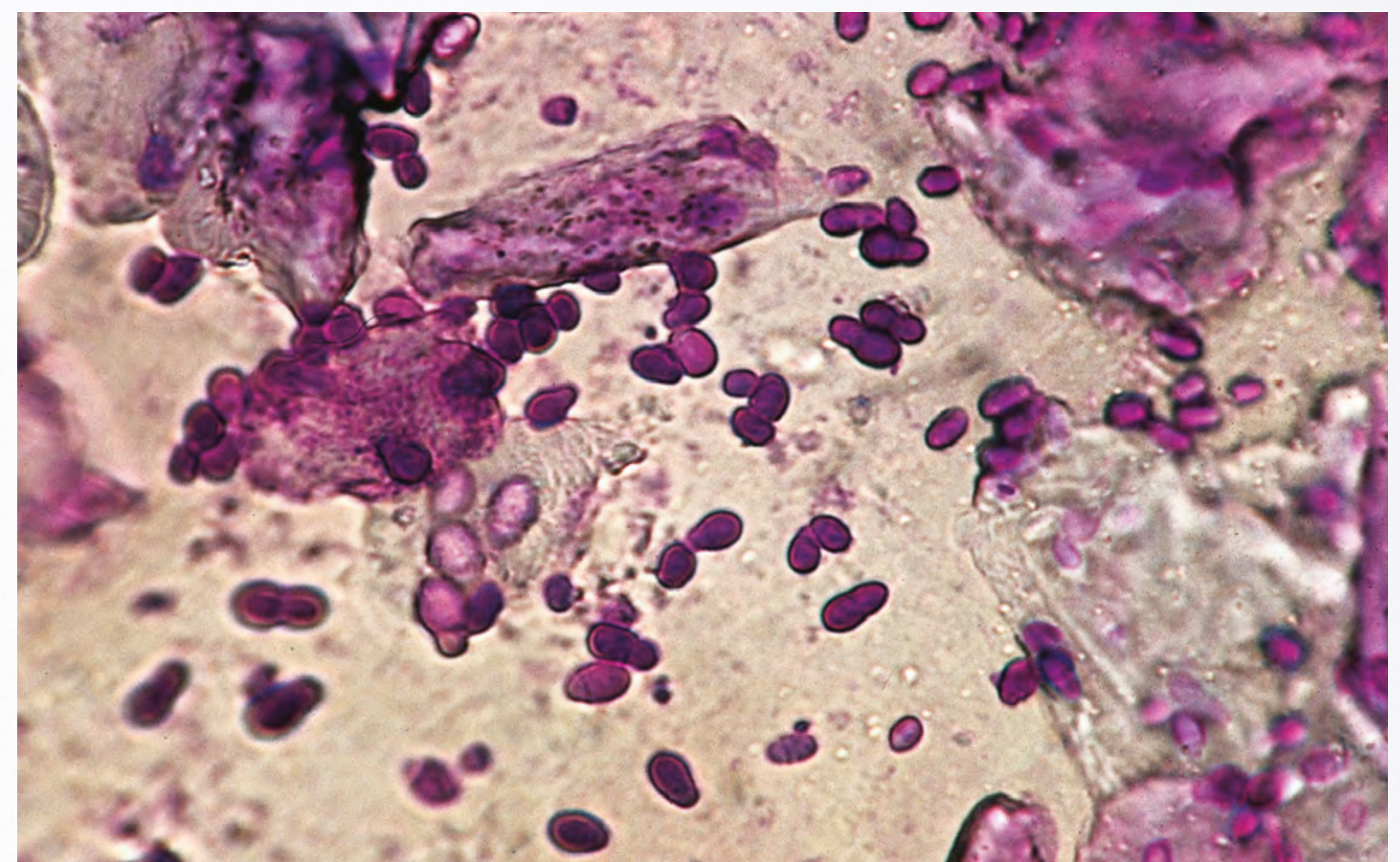
- **Locate macroscopically well stained areas** and centre them under the microscope lens.
- Take care in positioning the slide on the right side: material sampled (for a direct impression smear) or cellophane, upward.
- **Look for the areas with most cells under low (10X objective) magnification**, particularly epidermal cells debris, where *Malassezia* tend to cluster.
- **Then locate the areas likely to be best interpreted under the 40X objective.**
- **Without modifying the depth setting**, place the slide between two objective lenses and **apply a few drops of immersion oil** on the chosen area. **Turn to the high power objective (100X immersion)** adjusting the focus.
- If the image of a direct impression smear stays blurred, the slide may have been accidentally turned upside down, and the reading side may be on the other side!
- **Scan the sample over a large area** for a few minutes.
- **Quote semi-quantitatively** (scale from 0 to +++) **the numbers of *Malassezia* present.**

• **Interpretation:**

- The minimum number of yeasts allowing a diagnosis is not known; in fact it may be variable from one dog to another and from one site to another in the same.
 - » **The simple fact of observing yeast (*Malassezia pachydermatis*), whatever their number, must be taken into account for an animal clinically affected with a dermatological disorder:**
 - » even if the implication of *Malassezia* in the dermatitis has not been demonstrated, it represents a potential "danger";
 - » and even if it is true that the higher the number of yeast present, the higher the probability that they have a pathogenic role in the dermatitis, **a small number may cause important clinical consequences in case of hypersensitivity to the yeast.**
 - » The treatment could simply be adapted to the number of yeasts present, and/or to the gravity of the clinical signs.
- **However, the ultimate proof of the implication of *Malassezia* is a positive response to therapy.**



Microscopic view of a direct impression smear. *Malassezia pachydermatis*. (Diff-Quik stain, x1000). Courtesy of: D.N. Carlotti



Microscopic view of a sample on cellophane tape. *Malassezia pachydermatis*. (Diff-Quik stain, x1000). Courtesy of: D. Pin

- **Fungal culture and sensitivity:**

- This test may be **useful in rare, specific cases**. Its realisation has no actual additional benefit compared to cytology, being more complex and results are delayed.
- Several methods are used for collecting material to culture: collected hairs, swab, Mackenzie Brush Technique...
- The material may be placed on Sabouraud medium supplemented with antibiotics and olive oil.
- **Sensitivity testing is generally useless**, since *Malassezia* is normally sensitive to classic antifungal and antiseptic agents (see "therapy").
- These tests should rather be reserved for difficult cases: unsuccessful therapy, multiple relapses when patients are treated several times...
- Keep in mind that *Malassezia* belongs to the normal microflora of the dog's skin: as for any opportunist agent, it is the number of colonies that should be taken into account.

- **Histopathology:**

- **Skin biopsies are usually not necessary** in the diagnostic work-up of *Malassezia* dermatitis and the sensitivity of this test is chiefly inferior to that of **cytology**.
- May be performed to confirm the presence of yeast, to appreciate their implication in the dermatosis, but never to exclude their presence or their implication.
 - » Yeasts can be seen virtually at the skin surface (in particular in samples stained with Periodic Acid-Schiff: PAS), but their absence does not exclude the possibility of their presence on the animal, even of a high population.
 - » **The presence of a histopathological pattern evoking a true *Malassezia* dermatitis** may lead to conjecture regarding its implication in the dermatosis.

- **"Therapeutic trial":**

- Its goal is not to give evidence of yeast overgrowth, but of its implication or not in the clinical signs observed, i.e. the presence or absence of a true *Malassezia* dermatitis.
- This "trial" must therefore always be preceded by the observation of *Malassezia* "overgrowth" on cytology, so that an allowance can be made for the interpretation of "overgrowth".
- A systemic antifungal therapy will be preferred. Nevertheless, the use of efficient topical therapy may confirm the diagnosis in maintaining remission (see "treatment").

- **Differential diagnosis.**

- The differential diagnosis is complex since the clinical signs of this pruritic dermatitis are not specific, and the principal primary lesion, the erythema, may be observed in all dermatitis!
- Moreover, *Malassezia* dermatitis is associated and/or aggravated by most dermatoses belonging to the differential diagnosis.
- However, this dermatitis is a major differential to be ruled out or treated, particularly as a secondary dermatosis, before investigating primary causes (essentially allergies and particularly atopic dermatitis).
- The differential diagnosis includes (refer to corresponding monographs):
 - Hypersensitivity skin conditions (atopy, FAD, food allergy, or even contact dermatitis) which are also the most frequent primary causes.
 - Parasitic dermatoses (sarcoptic mange, and more rarely, infestations by other parasites).
 - Any other cause of keratoseborrhoeic disorders combined with a dermatitis.

TREATMENT

General remarks

- The therapy of *Malassezia* dermatitis is based on the **sole use of topical therapy or in combination with a systemic antifungal treatment**, depending on the gravity of the clinical signs, the importance of the overgrowth, the desired potency of the treatment and the potential secondary effects.

- **The combination ensures a faster improvement and healing and this confirms the diagnosis (see above).**

Furthermore the maintenance of remission

with the sole topical therapy is also helpful in confirming the diagnosis. However, when confronted by tolerance and economic reasons, **a sole topical treatment correctly applied may be justified and sufficient.**



Malassezia dermatitis. Courtesy of: H. Koch

Antifungal systemic treatment.

Products:

- **Ketoconazole**, the dosage for dogs is **5 to 10 mg/kg SID** taken at the beginning of meals.
- This drug is well tolerated, but **biochemical parameters must be monitored** when **treatments are prolonged**. Indeed, an increased level of serum **ALT** precedes the onset of clinical signs of intolerance (anorexia, vomiting) due to **liver toxicity**.
- **Itraconazole**, with **5 mg/kg once daily, or for two consecutive days a week**, being the most often recommended dosages.
- The possible **use twice a week only** (thanks to a lipophilic drug) may **reduce cost and potential side-effects** (even though **quite well tolerated azole**).
- Terbinafine might provide some efficacy given orally at 30 mg/kg once daily for 21 days.
- **Griseofulvin is not active against *Malassezia*.**

Evolution and duration:

- The initial prescription must last a **minimum of three weeks**.
- **Pruritus diminishes in the first week and the lesions start healing during the second.**
- A **treatment of a few weeks** is generally necessary and must be **continued after clinical recovery** (7 to 10 days).

Topical therapy.

- **Topical treatment is essential, and may be sufficient by itself.** In any case, it is **extremely beneficial when combined with a systemic treatment.**
- Available topics are mainly **shampoos** and **lotions** (which can be used in addition to or after shampooing).
- These topical agents include antiseptic or antifungal agents (**chlorhexidine, miconazole, econazole, enilconazole, ketoconazole...**).
- The use of antiseptic or antifungal shampoos, **2 or 3 times a week for two weeks and then every week until healing**, first enables the **mechanical removal** of a large quantity of debris and yeast and then **directly counteracts the microbial proliferation.**
- The use of **antiseptic lotions**, as often as possible in combination with shampoos **reinforces the efficiency of topical therapy** and may allow reducing the frequency of shampoos.
- **Antifungal lotions** are also available for use after an antiseborrheic shampoo for example.
- **Regular use of antiseptic shampoos and/or lotions may effectively prevent relapses.**

- ▶ **Corticosteroid therapy.**
 - **Should be used with caution.** However, **could be useful and even efficient alone in case of underlying allergic dermatitis such as atopic dermatitis.**
 - As an example, there are few valid options to treat *Malassezia* (seborrheic) dermatitis in humans. One of these is **topical corticosteroids**. In fact, the corticosteroids will reduce lipid secretion, epidermal turnover and **will make the milieu less hospitable for the *Malassezia*.**
- ▶ **Course follow-up.**
 - **Assess the animal for the first time preferably after 3 weeks** (efficacy of the treatment may not be properly assessed before 15 days).
 - **Then assess the animal at least every 3 to 4 weeks.**
 - **Assess by cytology at each consultation the decrease of cutaneous yeast counts.**
 - **The remission of clinical signs may not be obtained if the underlying dermatosis is severe, therefore the efficacy of the treatment will be assessed by yeast counting.**
 - **Interpretation of clinical signs improvement:**

If **clinical signs disappear or regress** after yeast overgrowth clears, it was indeed a ***Malassezia* dermatitis**.

- If the **clinical signs disappear completely**, the *Malassezia* dermatitis is “**idiopathic**” (rare).
- If they **simply regress, an underlying dermatosis must be investigated** (frequent):
 - If pruritus ceases, the underlying dermatosis is not pruritic (rare case).
 - If pruritus persists, the underlying dermatosis is pruritic (very frequent case).
- **Beware of previous use of corticosteroids which may come to confuse this analysis.**

If the **clinical signs persist** once the yeast overgrowth has cleared up, there was no ***Malassezia* dermatitis**.

- The microbial population must be always controlled in any case.
- Further dermatological work-up needs to be done.

PROGNOSIS

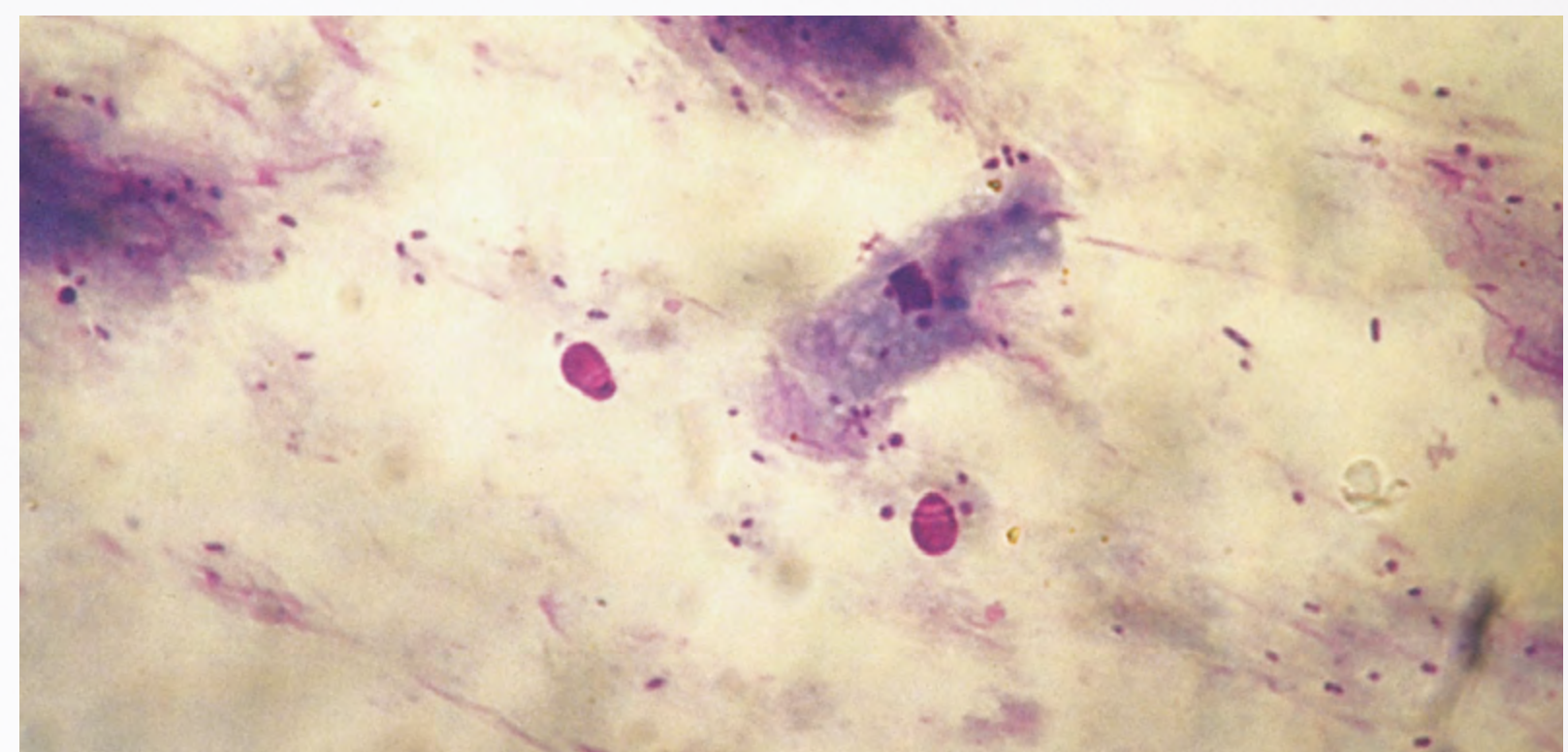
- ▶ **The prognosis is usually good with an appropriate therapy.**
- ▶ Nevertheless, ***Malassezia* dermatitis secondary to an underlying dermatosis** requires a **permanent long-term follow-up**.
- ▶ **Control of the underlying dermatosis may sometimes be difficult (atopy) and relapses may be frequent.**

FOLLOW-UP

- ▶ Frequent follow-up is necessary and remains the key point to therapeutic success.
- ▶ Cytological examination at each consultation also represents a key feature.
- ▶ **Treatment** of a **secondary *Malassezia* dermatitis** might be **necessary** but this is only a **step** in the management of the dermatological case.
- ▶ **Investigation of an associated or underlying dermatosis, follow-up and prevention of relapses after healing are required.**

CONCLUSIONS

- ▶ ***Malassezia* dermatitis is a superficial cutaneous disorder without any characteristic primary lesions, and may then mimic and worsen an allergic skin disease.**
- ▶ **Secondary *Malassezia* dermatitis is, at least potentially, frequent!**
- ▶ It is a **major differential** in the diagnosis of pruritic dermatoses in dogs.
- ▶ **The most frequent case is a *Malassezia* dermatitis where recovery leads to the need for carrying out a differential diagnosis of allergies.**
- ▶ The **underlying dermatosis** and **relapses** need to be controlled.
- ▶ ***Malassezia pachydermatis* and *Staphylococcus pseudintermedius* may have a similar and concomitant role, however, their proliferations in atopic dogs might be solved by an efficient control of the underlying atopic dermatitis.**



Microscopic view of a sample on cellophane tape.
Combined proliferation of *Malassezia* and staphylococci.
(Diff-Quik stain, x1000). Courtesy of: D. Pin

IMPORTANCE OF THE FOLLOW-UP AND OWNER EDUCATION

- A regular follow-up of the case is very **important**.
- **Explain to the client that this treatment is only a first step**, certainly **essential** and will relieve the discomfort. **Yet, specify that symptoms** due to a possible underlying dermatosis **may persist and/or that the dermatitis has a high chance of recurring and that exploring the cause will certainly be necessary** in order to control the dermatological problem in the long term.
- The decision for further investigation must be taken with the owner's co-operation when the patient's discomfort becomes obvious or when treatments become too frequent.
- **Indicate that corticosteroids are contra-indicated**, first for medical reasons, and then strictly if **any further dermatological work-up needs to be done**.
- **Corticosteroids** act as "**pro-infectious**" factors and are **responsible for "rebound" effects**.
- **Eventually**, if necessary, **and always out of infectious periods, corticosteroids may be prescribed to help control an underlying allergic dermatitis**: mostly atopy as flea allergy dermatitis and food allergy are easily controlled by other means (refer to corresponding monographs). Prescribe the "lowest" dosage possible **and monitor rigorously and regularly for microbial infection or overgrowth: pyoderma, *Malassezia* dermatitis, bacterial overgrowth or both** (concurrent *Staphylococcus pseudintermedius* and *Malassezia pachydermatis* overgrowth). **Stop corticosteroids and renew anti-microbial therapy as soon as a skin infection recurs**. Always **try to discontinue the use of corticosteroids: inform, educate and convince the owners** about that.
- Moreover, **pruritus due to *Malassezia* dermatitis decreases quickly** (in a few days) **after initiating the treatment**.
- **Keep also in mind that controlling the fungal problem may lead to a sufficient reduction in general pruritus, thus allowing a delay in the necessity for controlling the eventual underlying pruritic dermatosis!**

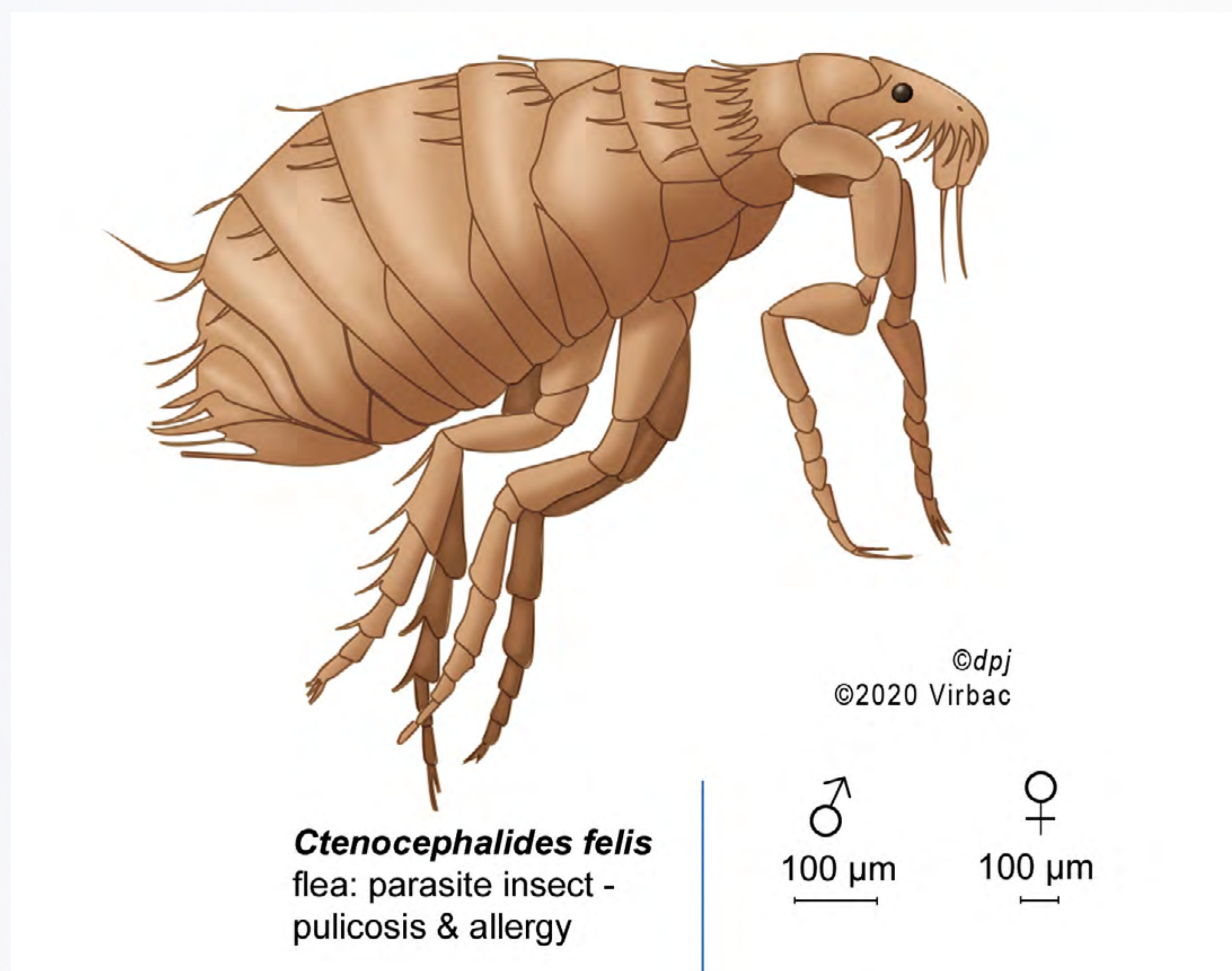
FLEA ALLERGY DERMATITIS (FAD)

INTRODUCTION / DEFINITION

- ▶ FAD is a **pruritic dermatitis** arising from a hypersensitivity to the **bites of fleas** (most often *Ctenocephalides felis*).
- ▶ **Very frequent**, it is one of the commonest causes of pruritus in dogs.
- ▶ FAD is **one of the three major allergic skin diseases** that have to be considered in the differential diagnosis of pruritic dermatoses, the others being atopic dermatitis (AD) and food allergy (FA).

AETIOLOGY / PATHOGENESIS

- ▶ **The flea.**
 - Fleas are extremely **common** in **temperate** and **warmer climates**, with varying levels of infestation of pets and their environment, closely linked to ambient temperature and humidity.
 - A clear **understanding** of the **life cycle** and environmental requirements is **essential** in order to develop flea control strategies and obtain **owner compliance**, especially when overt signs of infestation are lacking.



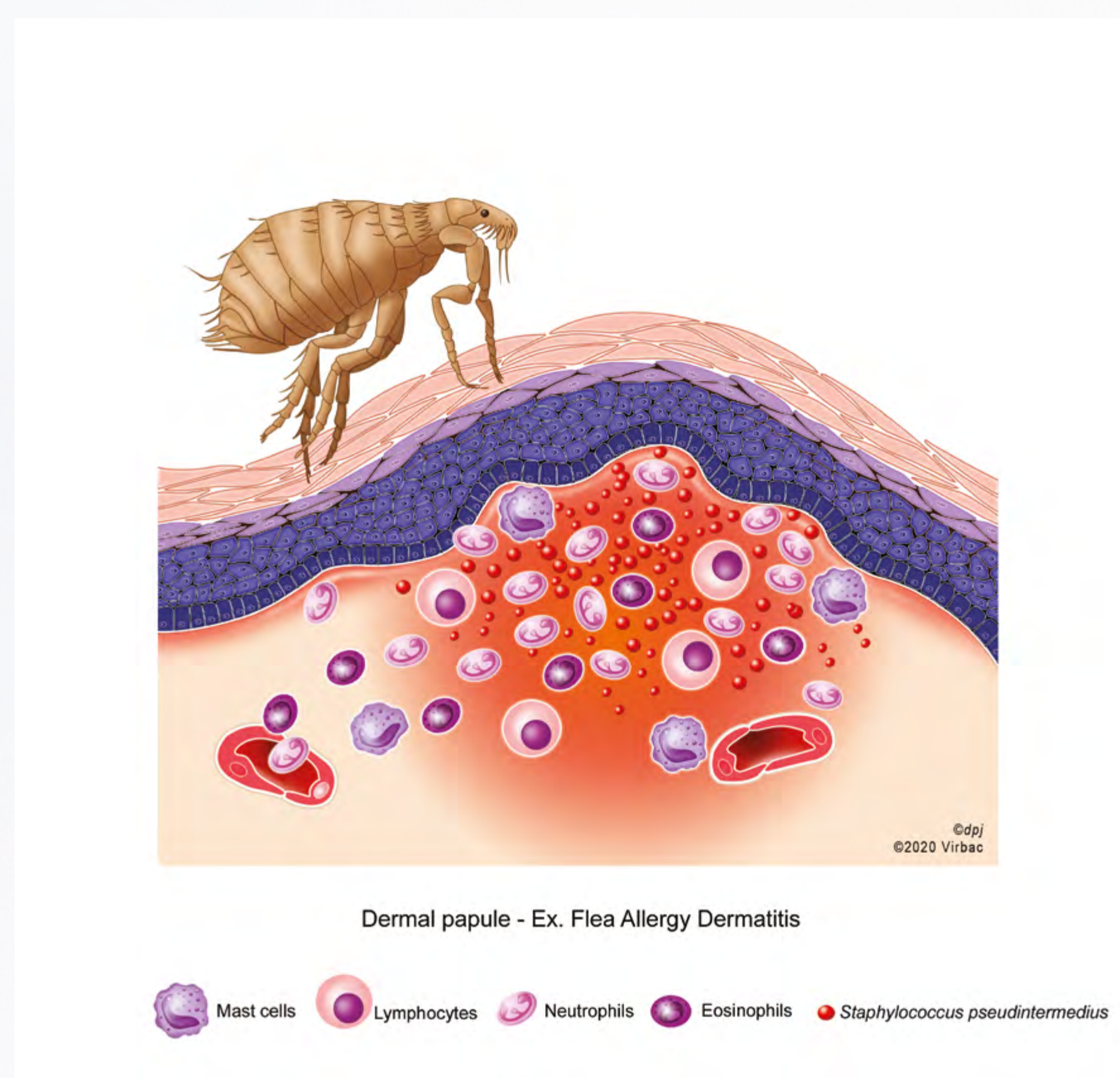
Courtesy of: P. Jasmin

► **The development of hypersensitivity.**

- Factors that determine whether or not a dog becomes allergic to fleas include:
 - Exposure to fleas early in life tends to reduce the likelihood that a dog will become allergic to fleas.
 - **Intermittent exposure** to the bites of fleas **favours** the development of **hypersensitivity**, whereas continual exposure tends to be protective, and leads to immunological tolerance.
 - **Dogs** that are **atopic**, and suffer from atopic dermatitis (AD) are **predisposed to** the development of **flea allergy**.

► **The pathogenesis in a hypersensitive dog.**

- Both **immediate and delayed hypersensitivity** are involved, and can be visualised following **intradermal skin testing** when a reaction at both 15 to **20mins and 48hrs** is seen.
- The sequence of events that occurs following the bite of a flea in a hypersensitive individual are as follows:
 - The **flea saliva** contains a number of protein antigens to which the patient will have been sensitised by prior exposure.
 - **Hypersensitive dogs** can develop their disease via a number of immunopathogenic pathways, which are:
 - » the majority of sensitive dogs develop **IgE antibodies (immediate, or type I hypersensitivity)**, and thus mast cell-derived mediators are involved,
 - » in addition, some dogs manifest cutaneous **basophil hypersensitivity** with an influx of basophils armed with IgE antibody into the site of the application of allergen,
 - » most dogs also have **cell-mediated, delayed, or type IV hypersensitivity**. Injection of the allergen causes an influx of lymphocytes and macrophages and a variety of interleukins are involved. In a certain number of cases (probably 15 to 30%), **delayed hypersensitivity alone** exists.



Courtesy of: P. Jasmin

EPIDEMIOLOGY

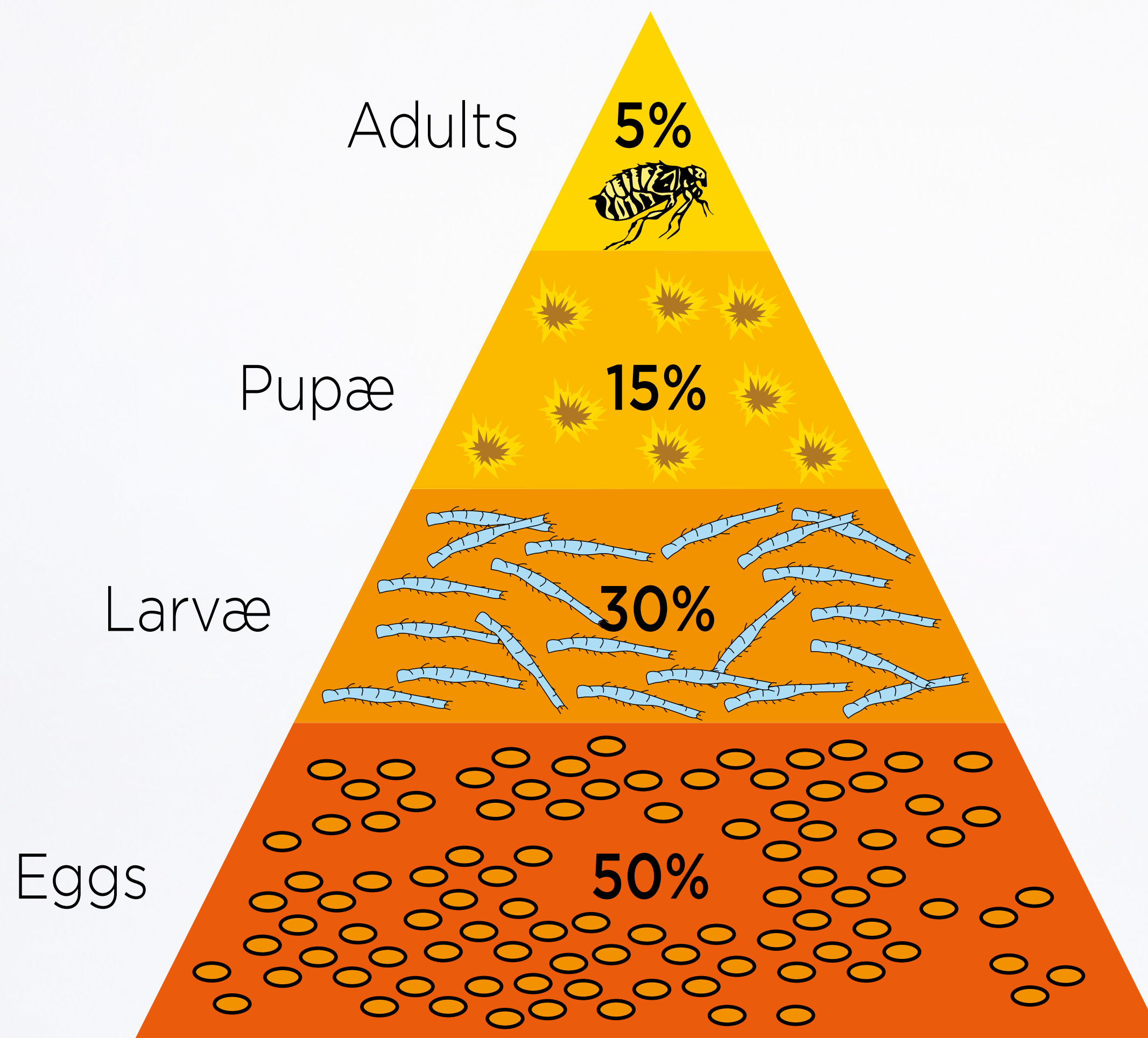
The **incidence** and **epidemiology** of this condition is inextricably **linked to the environmental requirements of the cause which is the flea**. Types of fleas involved are:

- ***Ctenocephalides felis*** is the major species involved world-wide.
- In some areas of some countries, *Ctenocephalides canis* is implicated. The latter is generally less well-adapted, and less hardy.
- Infestations with flea species more usually associated with human infestations, namely *Pulex irritans* and *Pulex simulans* are occasionally found.
- Sometimes, fleas whose natural hosts are poultry and wildlife are implicated. Such infestations are usually readily controlled.

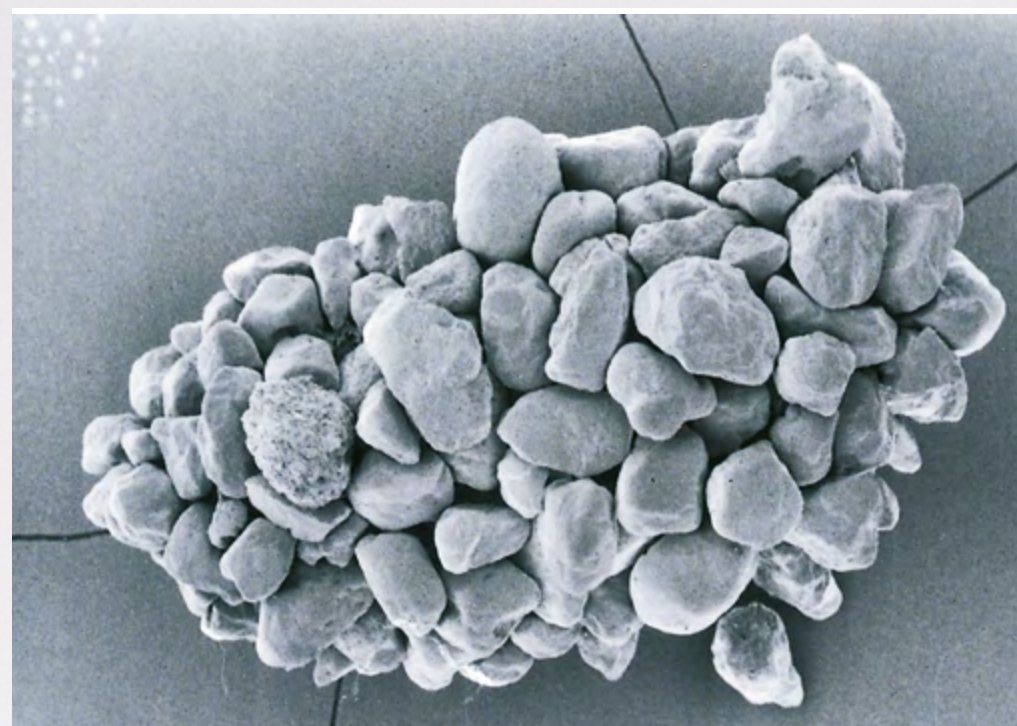
The **environmental conditions** most **suitable** for the **reproduction** and **survival** of the flea are:

- Moderate **temperatures of 18-30°C**
 - High relative **humidity of 70-80%**
 - They do not survive in colder climates, or in hot climates with low humidity.
- ▶ Flea infestation without allergy is actually much more common than is **FAD**.
 - ▶ FAD is non contagious but flea infestation is!
 - ▶ The major features of the **biology of *Ctenocephalides felis*** and the pre-adult components of the life cycle are as follows:
 - Adult fleas are host-dependant blood-sucking **ectoparasites**.
 - **They may attack humans** in heavily infested environments where more suitable hosts are scarce or absent.
 - They can leave their host and survive in a standard house-hold environment but will die quickly unless a new host is found. They should then be considered **permanent** rather than transient **parasites**.
 - Under optimum conditions, **adults** can **live** for long periods **without feeding** and **1 to 2 weeks** under household conditions, but a **blood meal** is **necessary for reproduction**, which takes place on the host.
 - **Feeding fleas** can **survive** up to **100 days on their host**.
 - When well fed, a **female can lay up to 50 eggs/day** and up to **2000 during her entire lifetime**.
 - **Eggs** are laid on the host and **fall into the environment** for development. Females lay preferentially at night and therefore the animal's sleeping areas will be most heavily infested and require special attention in the control programme.
 - Eggs hatch to larvae (3 larval stages).
 - **Larvae** are **very active, negatively phototactic** and **positively geotactic**. After hatching they **migrate downwards** and **away from light**. They will then be found preferentially for example in cracks in the flooring, between floor planks and deep in the pile of carpets. This **knowledge** is of **major importance** when **treating the environment**. It is not necessary, for example, to treat all the tiled floor of a very bright kitchen, but one must be careful to treat cracks and crevasses and underneath and behind furniture.
 - Very little **food** is necessary for the development of the **larvae** which live on **blood-containing faecal pellets** that fall from the host.
 - The third larval stage pupates into an oval **sticky cocoon**.

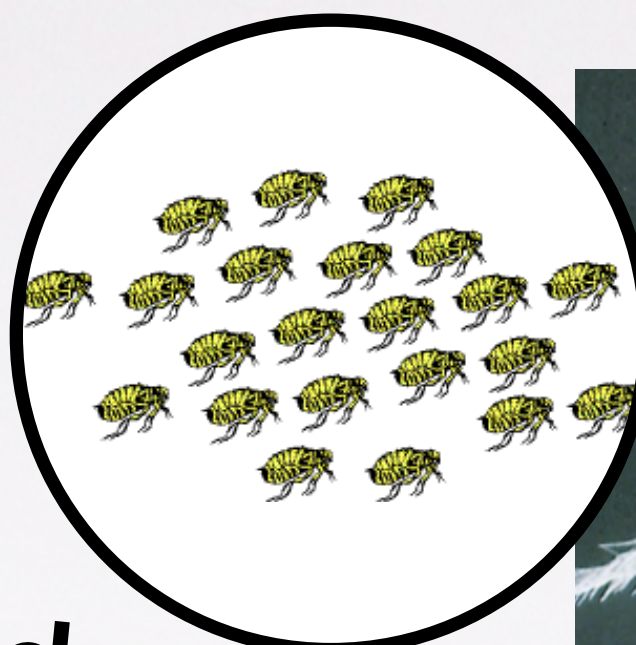
- This stage is the most **resistant** to both insect growth regulators (IGRs) and to adulticides. Thus, environmental control alone may not be sufficient, and FAD affected **pets must be protected from the newly emerged adult fleas** by treatment with adulticides, at least at the beginning, and when any new environmental contamination occurs.
 - Each **cocoon contain a pre-emerged adult** which can lie dormant for long periods, up to 3 or 4 months.
 - In the presence of **appropriate stimuli** (vibration, increased carbon dioxide and heat), **adult fleas emerge** from cocoons. These **stimuli** can, of course, be **provided by the presence of an animal**. This explains for example why a **house** where an infested animal has lived, even if **uninhabited for a long time, may remain an important source of infestation** for a newly arrived animal.
 - The **life-cycle** is **typically** completed in around **4-5 weeks**. It may be accelerated to 3 weeks or less, or slowed to 6 months, depending upon environmental conditions.
- **Approximate percentages of the different parasitic stages present in the household.**



CTENOCEPHALIDES FELIS LIFE CYCLE IN THE ENVIRONMENT AND ON THE HOSTS



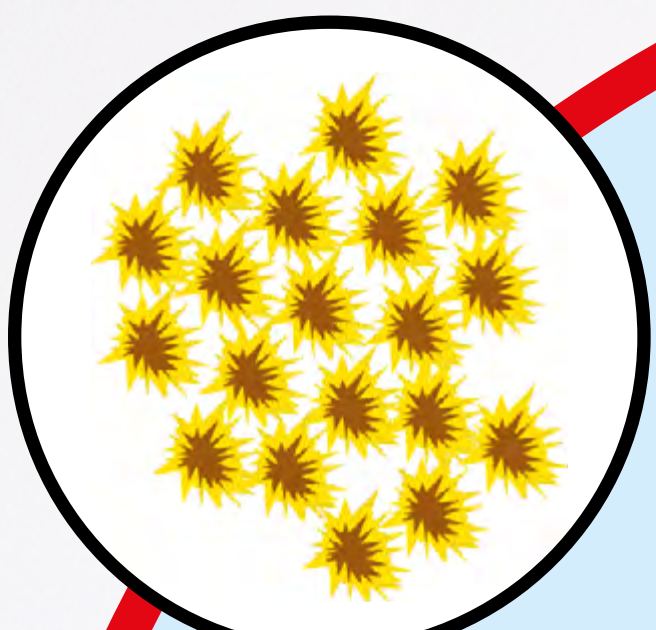
Scanning electron micrograph of *Ctenocephalides felis* pupa. Courtesy of: Royal Veterinary College, London



5 to 10 days

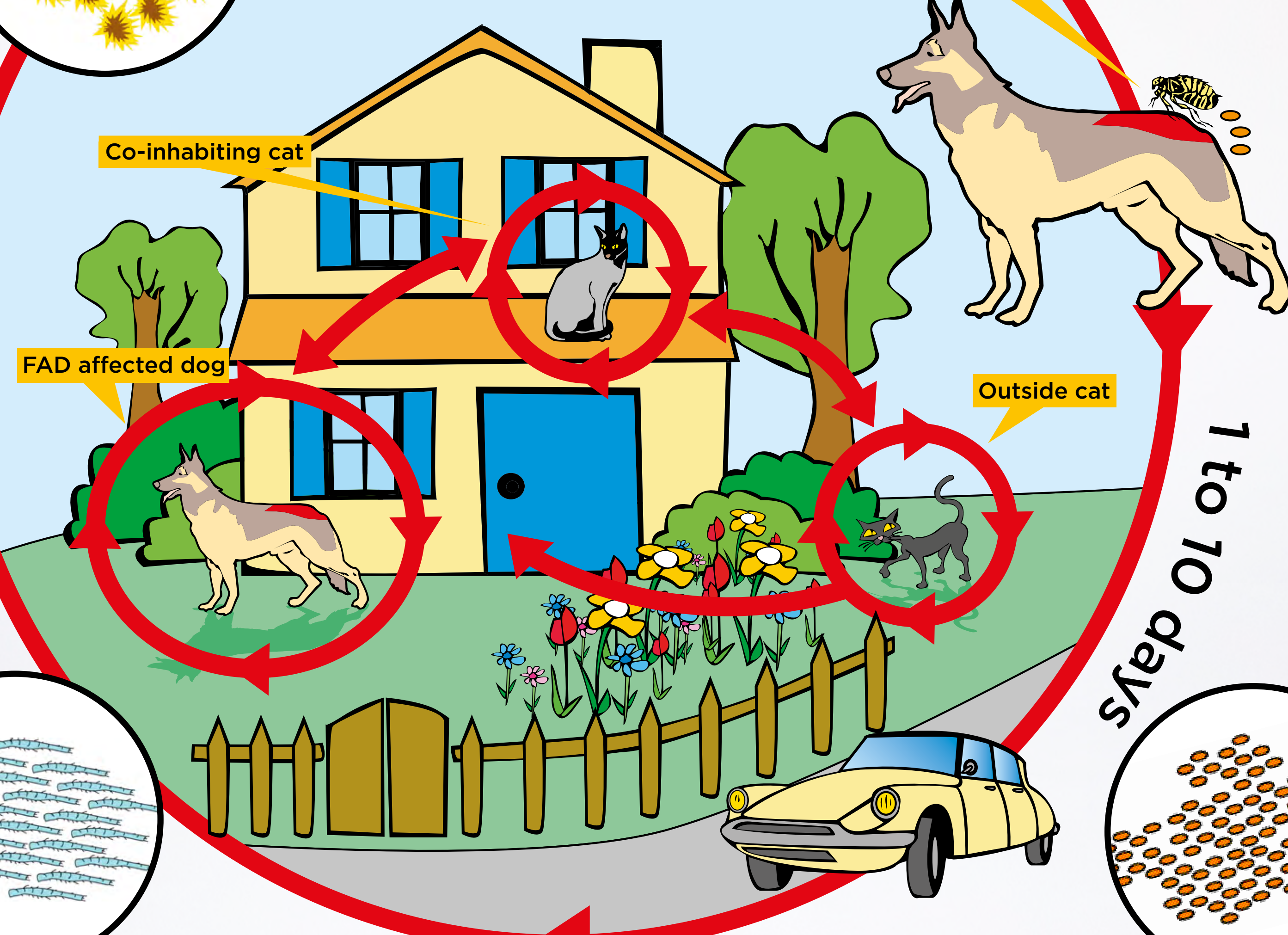


Scanning electron micrograph of *Ctenocephalides felis* adult. Courtesy of: Royal Veterinary College, London

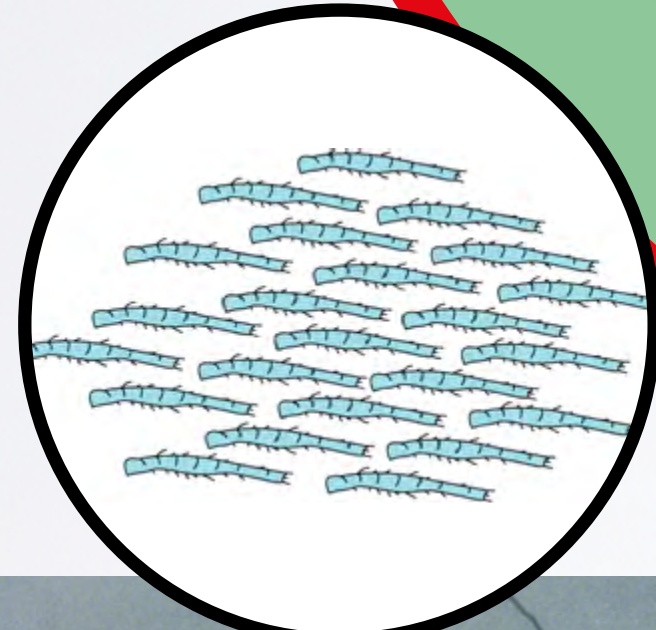
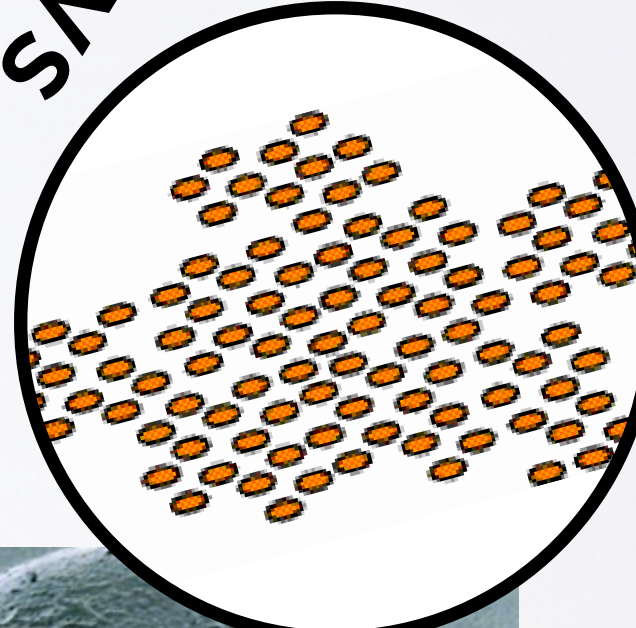


Adult fleas may survive 1 to 3 months on the host. They may represent a very low percentage of all the parasitic stages which occupy the house!

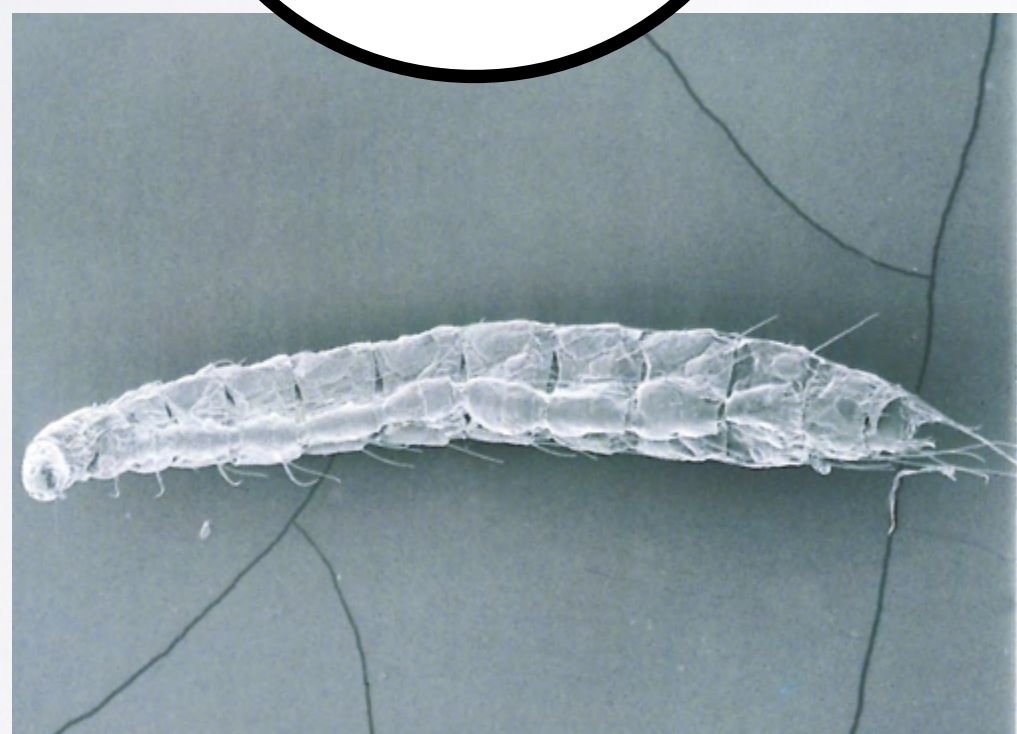
5 to 10 days



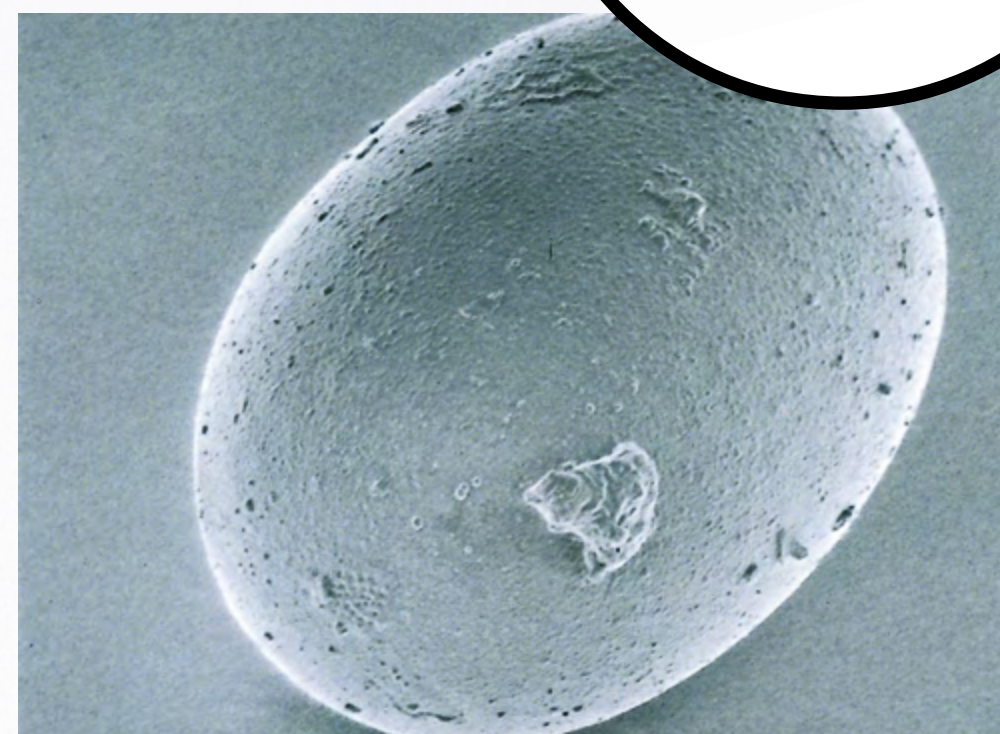
1 to 10 days



2 to 10 days



Scanning electron micrograph of *Ctenocephalides felis* larva. Courtesy of: Royal Veterinary College, London



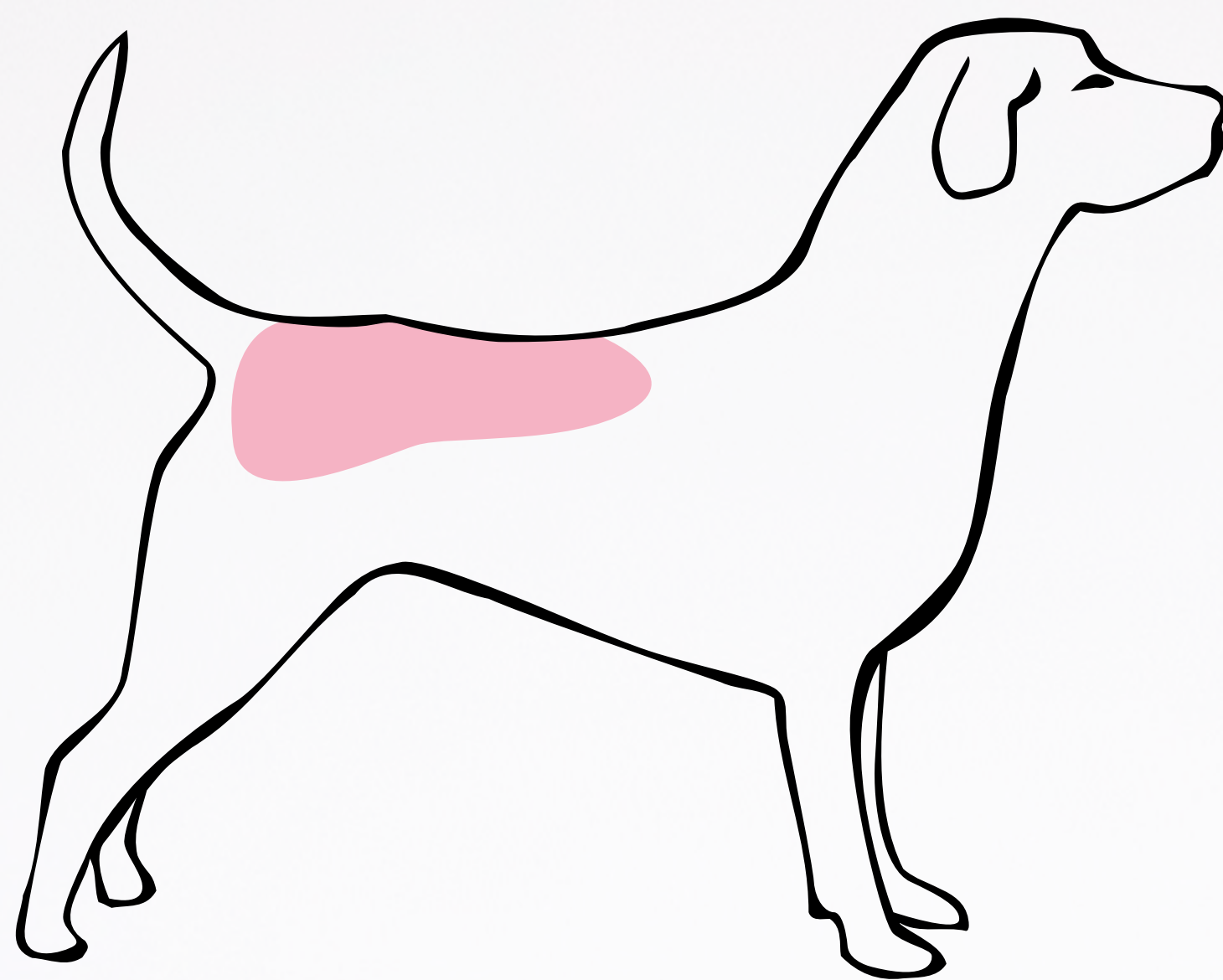
Scanning electron micrograph of *Ctenocephalides felis* egg. Courtesy of: Royal Veterinary College, London

Reservoirs of fleas (host-environment life cycle)

Sources of infestation

CLINICAL SIGNS

- FAD is still sometimes called "summer eczema"!
- The primary eruption is an erythematous papule, which may develop a crust before disappearing in 2-4 days.
- The distribution involves mainly the **lower back** and posterior and inner thighs. These are also the sites most favoured by the fleas.
- **Secondary lesions** resulting from **self-trauma** due to the **intense pruritus**.
- Changes seen in chronic cases include seborrhoea, crusting, alopecia and eventually lichenification.



Dog affected by FAD and by demodicosis secondary to corticosteroid therapy. Courtesy of: H. Schroeder

HISTORY SHEET	
Owner: _____	Date: _____
Dog's name: _____	Age: _____
Breed: _____	Sex: _____
Weight: _____	
GENERAL HISTORY	
3/ Way of life, environment (exercise, house, garden, flat...) and in-contact pets:	
4/ Behavioural changes:	
DERMATOLOGICAL HISTORY	
1/ Chief complaint:	
2/ Date of onset:	
3/ Pruritus, severity and time of onset (before or after lesions):	
• History of head, lips, chin, periorbital area scratching, rubbing:	
• Otitis, itching of ear pinnae scratching, shaking:	
• History of anogenital area rubbing, licking and chewing:	
• Dermatological signs, conjunctivitis and/or episodic lacrimal secretion:	
6/ Seasonal influences:	
8/ Presence of fleas and parasitocidal treatments given:	
11/ Previous treatments (date, products, dosage, duration) and responses:	

DIAGNOSIS

History.

- Age of onset : **young adult dogs (1 to 6 years)** in 75% of cases).
- The history should document exposure to fleas.
- However, in exquisitely sensitive animals, **only one or two fleas** may be present, and **may escape notice**.
- The owner also may notice the presence of **flea faeces**, small comma-shaped dark material which **leaves a red stain** behind **when rubbed on moistened white paper**.
- **Demonstration of fleas or flea excreta supports the diagnosis but absence of those elements do not exclude it: in one study up to 2/3 of confirmed FAD affected animals showed no evidence of fleas, and 1/3 showed no evidence of fleas or of flea faeces!**
- However, a **careful examination** for both **fleas** and **flea faeces** must **always be undertaken**.
 - Fleas and flea faeces are more readily demonstrable with the use of a flea comb. Also, the use during consultation of a **quick knock-down flea spray** (e.g. permethrin) will **kill many fleas**, which then will fall **onto the examination table**. A brushing may help render them directly visible to both the owner and the veterinarian. This may convince those who state that their dog never has any fleas!
 - If **faecal pellets** only are found, **demonstrate to the owners** that the findings are not merely dirt by **rubbing** the flea faeces **on moistened white paper**. They may then be convinced at least that fleas have recently been on the pet.



Flea faeces rubbed on a moistened white paper. Courtesy of: D. Pin

- The **area of pruritus** is also an important consideration.
- **Previous parasitocidal treatments** may **not exclude** the **diagnosis** depending on the products used and the rigour of application.
- There is usually a **good response** to **systemic glucocorticoids, followed by a relapse** unless the fleas are controlled at the same time.
- What about fibropruritic nodules?
- **Seasonal influence:**
 - More likely to appear in favourable seasons (e.g. late spring, summer and early autumn in temperate climates).
 - May however be present **during the whole year in favourable climates**, with the constituent parts of the life cycle **surviving indoors** in the **winter**.
 - **Clinical signs** may also persist **year-round**, even in the absence of fleas, if the **FAD** is **associated** with a concomitant disease (e.g. **atopic dermatitis** due to house dust mites).

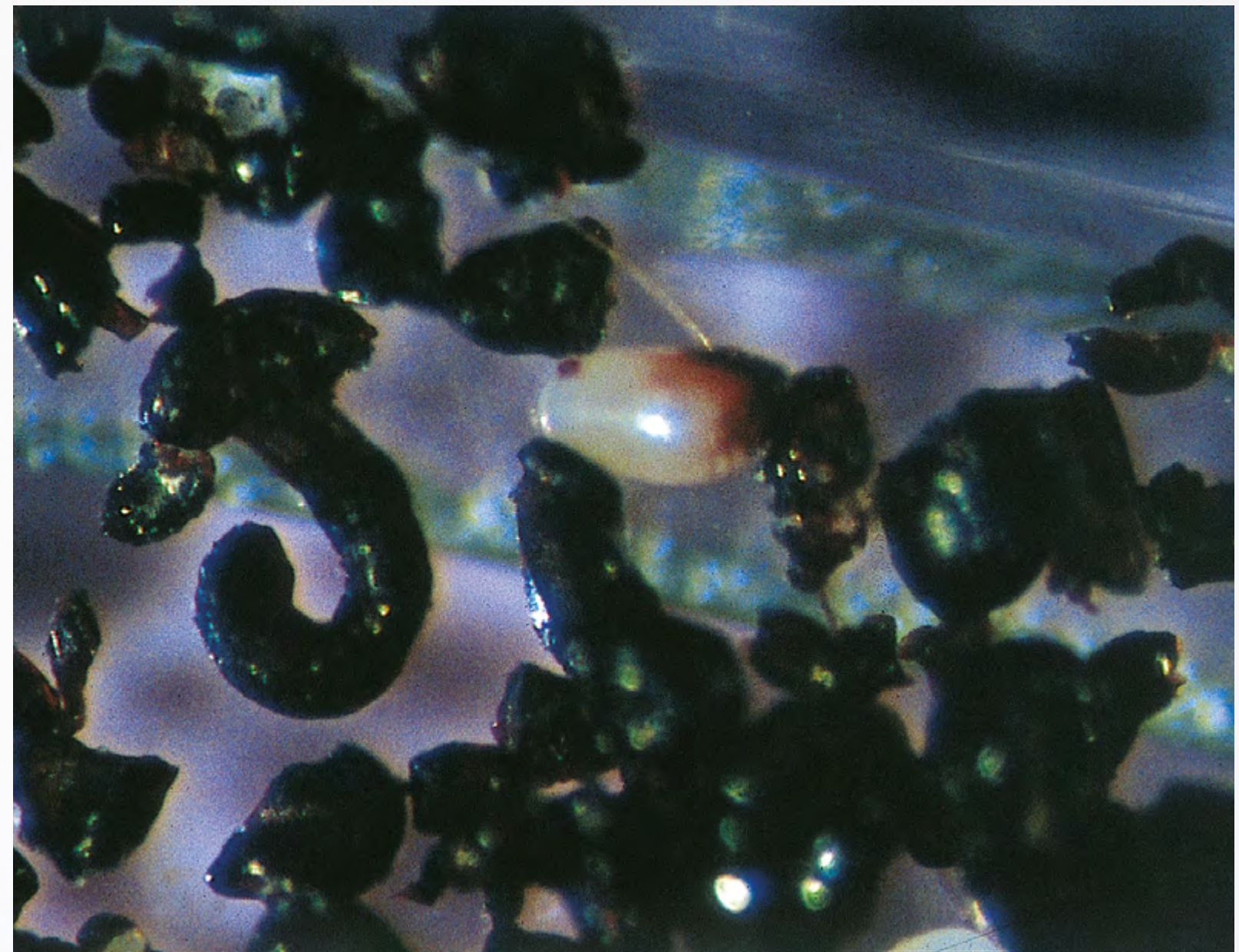
► **Clinical elements.**

Key clinical features that are supportive of the diagnosis are:

- **Characteristic distribution.**
- Evidence of a papular and crusting primary eruption, accompanied by a variety of secondary changes.
- The **presence of fleas and/or flea faeces**, although **absence** of these **may not exclude the diagnosis**.

► **Major differentials.**

- The major differential is **atopic dermatitis**, although it must be remembered that the **two conditions may co-exist** in the same patient:
- **In atopy**, the genetic predisposition to develop IgE-mediated hypersensitivity will **predispose dogs to sensitise to fleas**.
- **In one study 4/5 of dogs with FAD were also affected by atopic dermatitis!**
- **Also, 1/3 of dogs with atopic dermatitis were also affected by FAD!**
- **Key distinguishing features of atopic dermatitis:**
 - The **distribution** is **facial** and **ventral**, with folds, flexural and friction areas affected.
 - There is usually a concomitant **otitis externa**.
 - Refer to the monograph on atopic dermatitis.



Photomicrograph of *Ctenocephalides felis* faeces. Courtesy of: P. Bourdeau



Dog affected by FAD and atopy. General view. Courtesy of: R.E.W. Halliwell



Dog affected by FAD and atopy. FAD lesions involving the lower back.
Courtesy of: R.E.W. Halliwell



Dog affected by FAD and atopy. AD lesions involving the ventral area, axillae.
Courtesy of: R.E.W. Halliwell



Dog affected by FAD and atopy. Close view of FAD lesions involving the lower back.
Courtesy of: R.E.W. Halliwell



Dog affected by FAD and atopy. Close view of AD lesions involving the ventral area, axillae.
Courtesy of: R.E.W. Halliwell

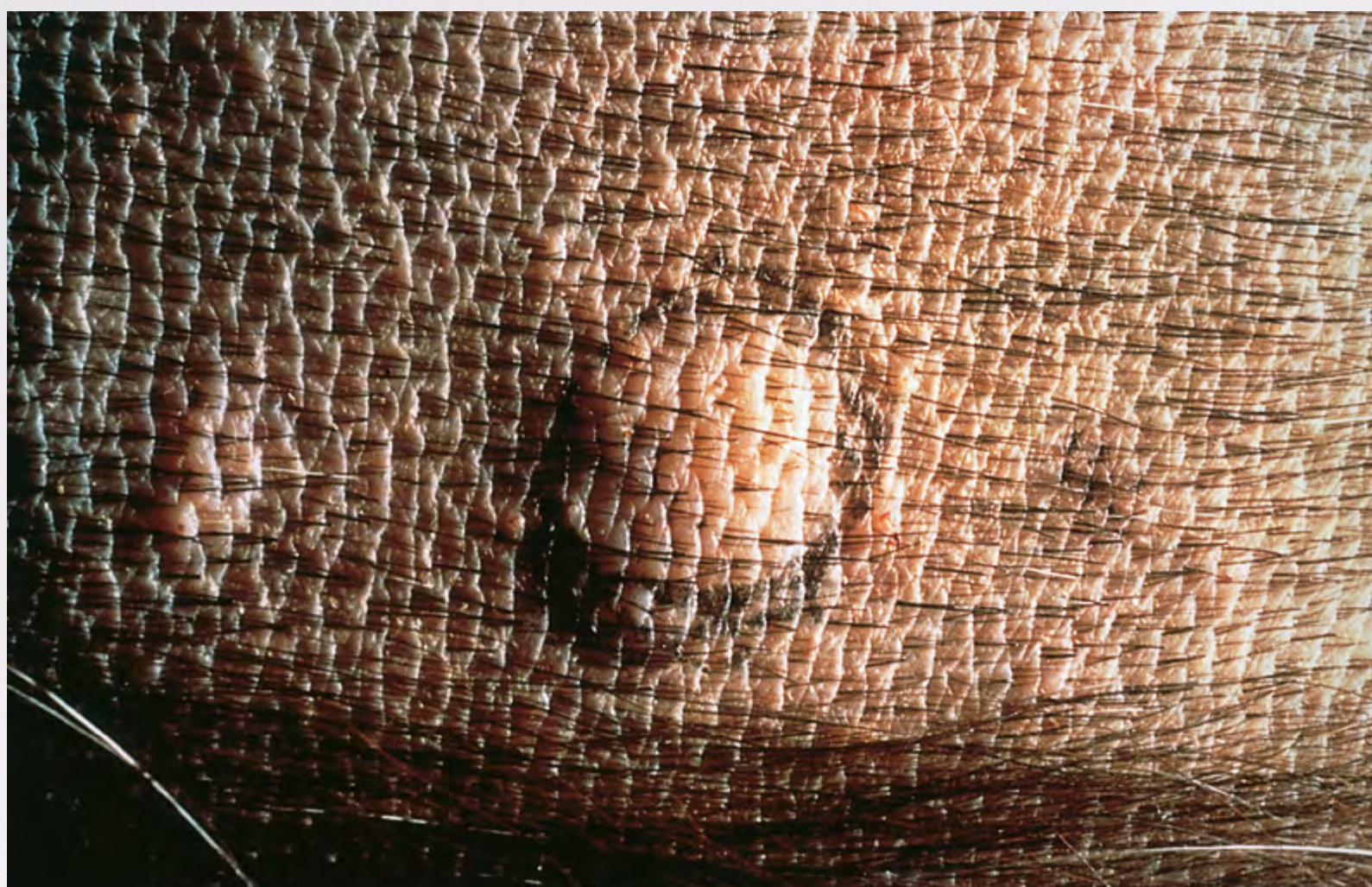
- Care must also be taken to exclude **other parasitic dermatoses** including infestation with *Cheyletiella*, *Trombicula* and lice.
- Depending upon the geographic location, **FAD** may well be by far the most common allergic skin disease in small animal practice, and **must be confirmed or excluded with certainty during the differential diagnosis of allergies, once the common parasitic and microbial skin diseases have been excluded** (dermatoses of groups 1a and 1b).

► **Diagnostic tests.**

- Confirmation of the diagnosis of FAD should be made.
- Historically, diagnosis could be confirmed with an **intra-dermal skin test** showing a positive immediate (10-20 minutes) or delayed (24-48 hours) reaction to flea allergens. This test can be performed **in conjunction with intra-dermal injections of other allergens** to detect hypersensitivity **in atopic dogs**, but may **also** be performed **alone** with a positive (histamine) and negative (diluent) control.



Positive intradermal skin test at 20'.
Courtesy of: D.N. Carlotti



Positive intradermal skin test at 48hrs. Courtesy of: D.N. Carlotti



Positive intradermal skin test at 48hrs. Courtesy of: D.N. Carlotti

- **In vitro assays** for **allergen-specific IgE** are available but they are **less reliable**, both in terms of sensitivity and specificity. They can be performed using either monoclonal or polyclonal anti-canine IgE, or with the Fcε receptor assay. However, some **15-30% of cases of FAD** will show **delayed hypersensitivity only** and will thus have a true positive delayed skin test, but a **negative in vitro test**. This could be due to the extracts used for assays not being enriched in salivary antigens including the Cte f1 allergen.
- It must be remembered finally that the demonstration of hypersensitivity does not alone justify a diagnosis of FAD. All it means is that the patient is hypersensitive to flea extracts, but it does not necessarily mean that the dermatitis observed is the result of FAD or of FAD alone.
Response to parasitidal therapy is then of major significance.

► **Therapeutic trial.**

- The **only true way to confirm the diagnosis** is by a therapeutic trial.
- For full details, **see the section on flea control.**
- **The aim is to eliminate the flea bites over a 2-3 week period to allow resolution of the clinical signs.**
- **Main considerations:**
 - **All pets** in the household should be **treated**.
 - If there is a heavy **environmental contamination**, this should also be treated with an **adulticide and an IGR**.
 - A **spray formulation** is likely to give the quickest response for on-animal use.
 - Ideally a product with a **quick killing action** should be used.
 - **Permethrin** deserves special consideration for such a trial as it **fulfils the above criteria**, but must not be used on cats.
 - **Isoxazolines given orally** may also be efficient in this purpose.
 - **Symptomatic anti-inflammatory therapy can be used** to help control pruritus and inflammation (**4-5 days if the patient is severely affected**) but remember it can interfere with the conclusions of the therapeutic trial.
- **Conclusions:**
 - **A positive response (successful therapeutic trial):** if the **clinical signs resolve**, the **diagnosis** may be confirmed since the **positive predictive value (PPV)** is **very high**.
 - **A negative response (unsuccessful therapeutic trial):** the **dog** may **not be affected by FAD**, but the **negative predictive value (NPV)** is **not as high as the PPV**.
 - a negative response may be due to the fact that the patient is still being bitten,
 - increase this NPV using permethrin and following an adequate protocol (see below) to be able to conclude that actually the dog is not suffering from FAD.
- The **therapeutic trial** may have been **effective**, but leading to a **partial response**:
 - pursue (or reinforce) the treatment if specific clinical signs of FAD remain,
 - the dog may have concomitant **atopic dermatitis** (and/or an adverse food reaction) if non specific signs remain, control of the FAD is then still necessary, and the necessity of initiating a control of the atopic dermatitis should be evaluated afterwards.

- The recommended protocol is summarised below:
 - **1, 2 and 3 are mandatory.**
 - 4 is highly recommended.
 - 5 considerably increases the NPV.
 - The long term treatment may be adapted in each case (depending on the occurrence of clinical signs in the affected animal and of the environmental parasitic infestation).

Days of treatment and/or consultation	D ₀	D ₇	D ₁₄	D ₁₅ to D ₂₁	Long term
1. Taking the history and clinical examination	+	-	-	+	+
2. Treatment of the affected dog with an efficient product (adulticide + IGR)	+ by the vet	+ by the owner	+ by the owner	-	+
3. Treatment of the in-contact pets with IGRs	+	-	-	-	+
4. Treatment of the in-contact pets with adulticides	+	-	-	-	+/-
5. Perfect environmental treatment	+	-	-	-	-

TREATMENT

General remarks.

- **The only way to avoid the clinical signs** (symptoms and lesions) **of FAD** in affected dogs **is to**
- eliminate the source of allergenic challenge i.e. **prevent all flea bites by eliminating the fleas.**
- **Resolution** will then occur **within 15 days.**
- **Prevention of access of allergen** to the animal is the **best way to control any allergy.** And, if most of the time, this is unfortunately not possible in atopy, it **is possible in FAD**, so it should be the goal.
- FAD can be perfectly controlled with the correct use of parasiticides.
- **See “flea control” and “therapeutic trial”** sections.

Symptomatic and anti-inflammatory.

General remarks.

- **Symptomatic anti-pruritic and anti-inflammatory therapy** should be **used with caution**, remembering that it **can interfere** with the assessment of the **efficacy** of the **anti-parasite strategy.**
- If they are required, it is preferable to use **short-term oral corticosteroids and/or oclacitinib.**
- Reassure the owner that **pruritus will also decrease with a successful parasiticidal therapy.**

Topical therapy:

- Topical therapy is not generally employed in the therapy of FAD, except in relation to flea control (see below).
- The use of shampoos and/or lotions may be appropriate in some cases.

- **Systemic therapy:**

- **Corticosteroids:**

- » Effectively control the inflammatory response.
 - » Preferably, oral products rather than long-acting injectables.
 - » May be sometimes helpful at the beginning, but do not replace an appropriate parasitocidal treatment (which would be rapidly effective alone!).

- **Oclacitinib** can be used to help control pruritus.

- **Other anti-inflammatory agents:**

- » Antihistamines are generally ineffective in FAD.
 - » **Essential Fatty Acids**, in sufficient doses may help, especially if there is concomitant atopic dermatitis.

- **Antibiotics:**

- » Any secondary bacterial infection is usually minimal, and does not require systemic treatment.
 - » Occasionally, however, animals are encountered where the acquisition of a flea infestation initiates a generalised pyoderma. In such cases, a 2 week course of a suitable antibiotic is indicated (see complex approach pyoderma monographs).

- **Additional therapy:**

- Immunotherapy with the currently available products is not effective.

- ▶ **Flea control.**

- **General remarks:**

- Although less rigorous protocols may be adequate to keep flea infestation controlled in non-allergic animals, the **final objective** in a case of FAD is to **avoid any flea from biting the affected animal during its life.**
 - **Total elimination of the flea population within the household is the best way.**
 - **There are three distinct but related means of achieving the final objective:**
 - » **eliminate the flea population from each animal in the household (the affected animal and all the in-contact pets),**
 - » **protect them from continued infestation from adult fleas from the environment,**
 - » **eliminate from the environment the reservoir of eggs, larvae and pupae.**
 - **Three principles** must be considered **when selecting the optimal method** for flea control.
 - » careful **consideration** of the **environmental conditions** and of any **in-contact animals** must precede the formulation of the **treatment regime**,
 - » the **goal** is to **eliminate the flea population as rapidly as possible**, and with **products** that have **repellent** and/or **anti-feeding properties** to treat the **affected animal**,
 - » use of a **combination of products**, so called “integrated flea control”, is likely both to be more effective and also to limit the development of insecticidal resistance.
 - **Informing the owner and constructing the flea control programme:**
 - After the diagnosis is established, **the most cost-effective flea control has to be chosen**, bearing in mind any **special circumstances pertaining to** the **pets**, the **environment** and the **owner**.
 - The most **appropriate programme** must be formulated aiming **at all in-contact pets** and the **environment** (both inside and outside if appropriate) where they spend time.
 - A **major factor** in achieving **success** is **client education, taking the time to explain** essential features of **flea biology**, as they affect the selected strategy, and of the **properties of the products** selected and the **rationale behind their use**.

- The owners must be convinced that the most effective control programme is not likely to be the cheapest, but that time and money will be saved in the long run by adopting an effective strategy:
 - **the least treatment acceptable is the use of efficient and quick acting parasiticidals on the affected animal at appropriate intervals**
 - the efficacy will be greatly increased by an efficient environmental treatment, even if done only once at the beginning.
- After this discussion, **explain** that the **animal's treatment might be reduced later** (especially in winter...) and that **if clinical signs of FAD reappear**, this is because of ineffective parasite control, which will then have **to be reinforced**, first by **re-initiating treatment of the affected animal** and second by re-evaluating the treatment of the in-contact pets and of the environment.

ENVIRONMENTAL TREATMENT

- Adulcicides and IGRs applied in each habitat where the affected dog goes (even once a year), in each room, using foggers, sprays or pump-sprays to treat where foggers do not.
- In warmer climates contamination of the outside environment may be a significant source of reinfestation, and an adulticide and an IGR should be applied to shady areas where there is plenty of organic debris. The IGR chosen should be resistant to ultraviolet light (e.g. pyriproxyfen—as opposed to methoprene which may be inactivated by ultraviolet light).
- Do not forget all the areas frequented less commonly by the affected animal, including **the car**, the garage...
- Affected animals and all in-contact pets may be “used” to assist in the environmental treatment, giving them topical or systemic IGR (pyriproxyfen and lufenuron for example). Then, if a flea “accidentally” takes a blood meal on such treated animals, it will not reproduce thus preventing environmental contamination.

TREATMENT OF IN-CONTACT PETS

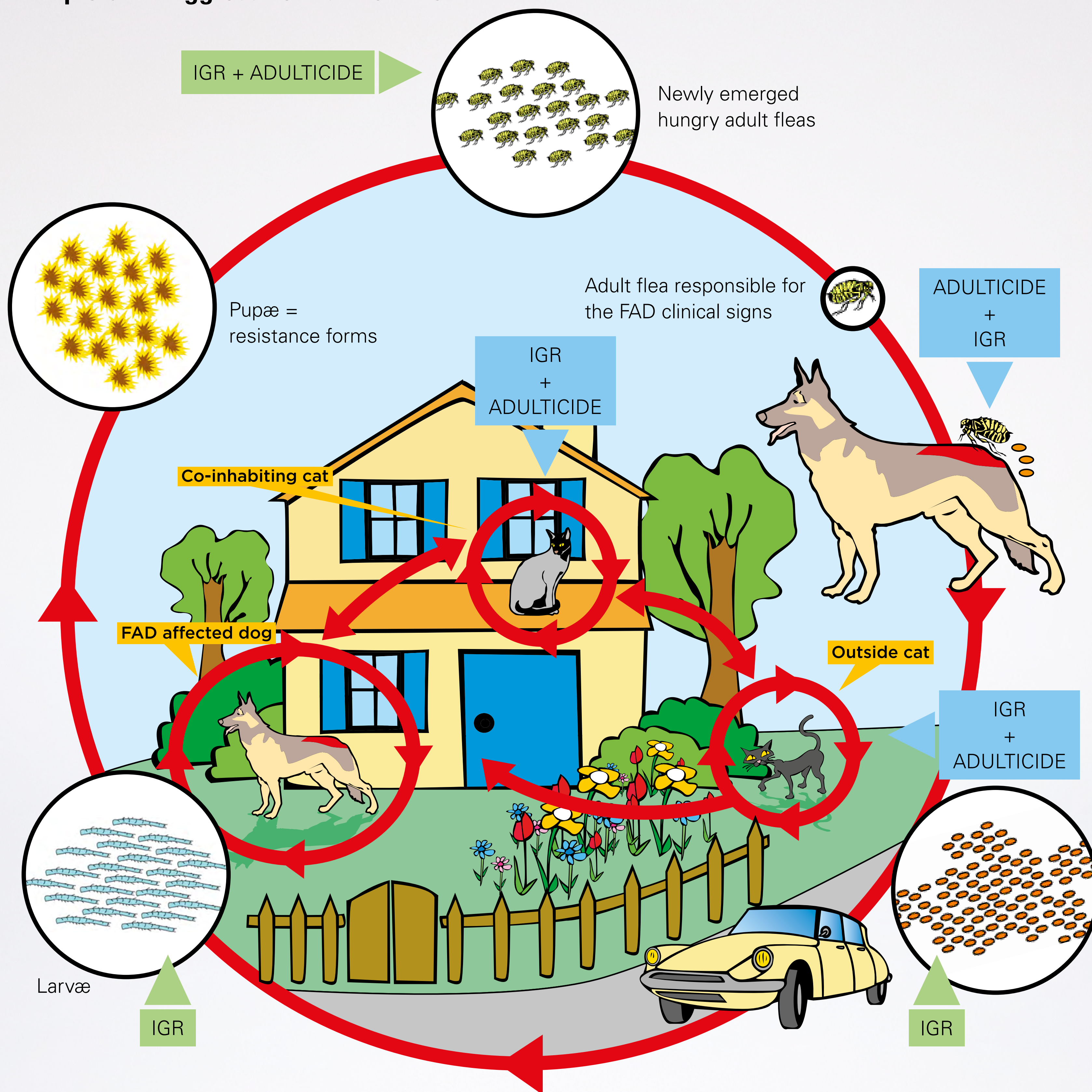
- Treatment with IGRs and/or adulticides.
- Topical or oral products.
- IGRs may be sufficient in long-term control.

TREATMENT OF AFFECTED ANIMALS

- The best way to protect an affected dog from FAD is the use of quick acting products containing adulticides preferably in association with an IGR.
- Maintenance of continual and effective anti-parasite pressure is recommended.

ADULTICIDES AND IGRS IN FLEA CONTROL

Example of an aggressive first treatment



ANIMAL TREATMENT:
TOPICAL or ORAL for Adulticide & IGRs

ENVIRONMENTAL TREATMENT:
SPRAYS & FOGGERS

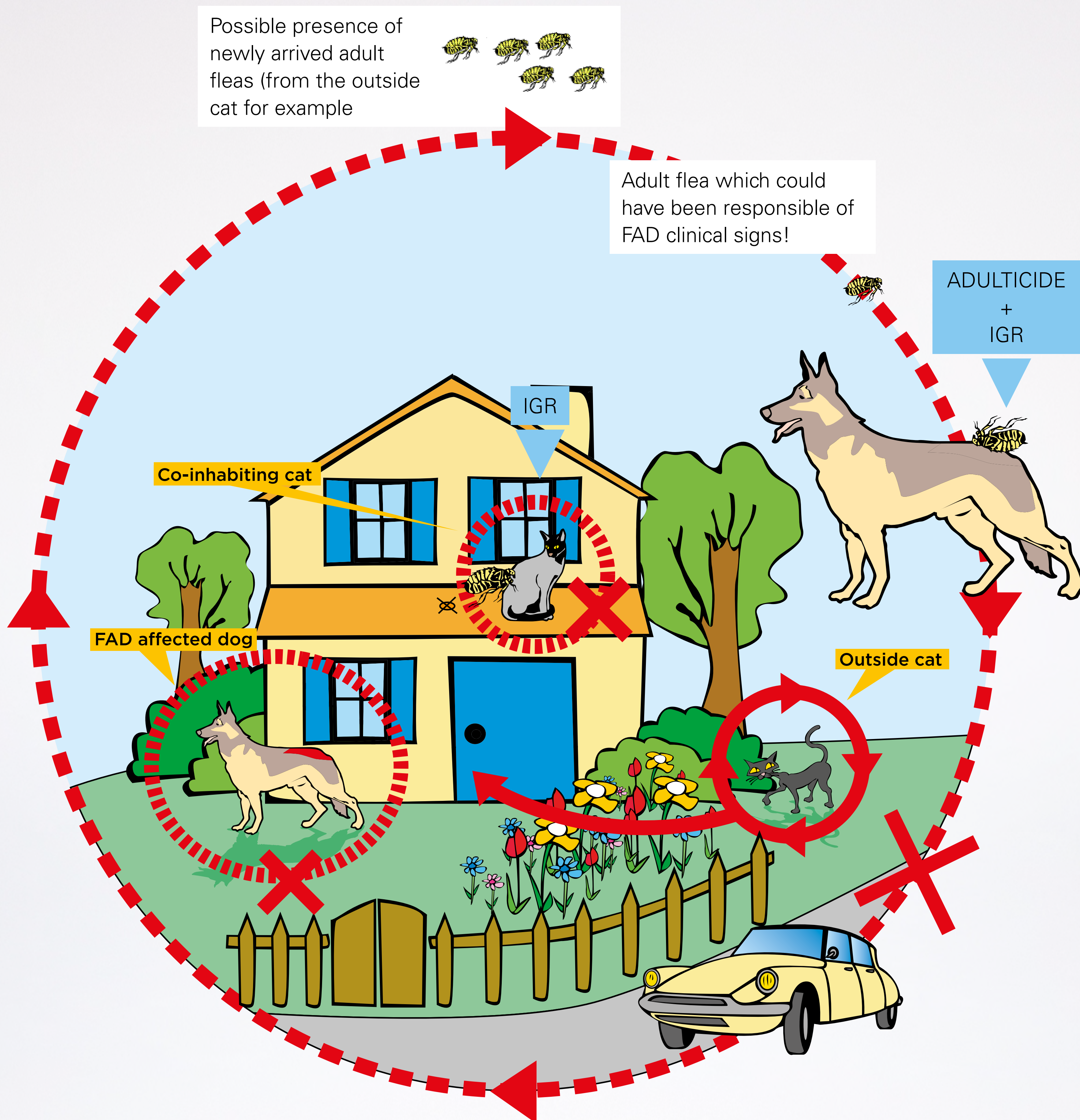
Note: IGRs given to animals contribute to the environmental treatment

Reservoirs of fleas (host-environment life cycle)

Sources of infestation

ADULTICIDE AND IGRS IN FLEA CONTROL

Example of maintenance treatment



ANIMAL TREATMENT:
TOPICAL or ORAL for Adulticide & IGRs

Note: IGRs given to animals contribute to the environmental treatment



Reservoirs of fleas (host-environment life cycle)



Sources of infestation

► **Types of molecules available.**

- Products used can be divided into **two types**, namely the **insecticides**, which kill the flea, and **insect growth regulators (IGRs)** which act on other stages of the life-cycle. The latter can be applied to the environment or to animals.
- **Insecticides:** amongst the topical molecules, pyrethroids, such as **permethrin**, are still potent insecticides and have been shown to have an **anti-feeding as well as a quick killing action**. A number of other molecules topically applied are available, including **fipronil, imidacloprid, selamectin and isoxazolines**.
- **Insect growth regulators (IGRs):** these consist of the chitin synthesis inhibitors (lufenuron) and the juvenile hormone analogues which are ovicidal and larvicidal. Methoprene and fenoxycarb were the early products, but **pyriproxyfen** is far more potent than either.
- **Effective flea control may involve the use of a combination of insecticidal and growth regulating products.**

► **Topical parasiticial therapy.**

- **Shampoos:**
 - Shampoos are generally only effective in mild infestations and where there is little environmental contamination.
- **Sprays:**
 - These are still popular ways by which to apply quick acting pyrethroids and also fipronil.
- **Collars:**
 - Although collars are often used for controlling flea infestation, more aggressive therapy is usually required for the treatment of FAD.
- **Spot-ons:**
 - This is a **very popular way** in which to apply insecticides. Following application the products quickly disperse throughout the skin surface.

► **Oral parasiticial therapy.**

- The older oral products were of limited efficacy in FAD, as the flea has to bite before it gains access to the product.
- Isoxazolines (fluralaner, afoxolaner, lotilaner, sarolaner and similar drugs) every 1 to 3 months (fluralaner), have a quicker onset of action (which may vary from one molecule to another), and can ease up owners' compliance when a year round treatment is required.
- Two other products may be effective in this formulation, namely nitenpyram (but very short acting) and spinosad.

PROGNOSIS

- ▶ The prognosis for FAD is good so long as a complete therapeutic strategy is involved which takes into account all in-contact animals that could provide a reservoir, as well as the environment.

FOLLOW-UP

- ▶ After the initial treatment, it is important to evaluate the clinical situation 2-3 weeks later. If the treatment is only partially successful, a reassessment of all aspects, and especially the environmental situation, is important.
- ▶ It must be remembered that once the animal is allergic, it is likely to remain so indefinitely.
- ▶ Therefore it is imperative that a long-term prevention strategy is developed for the future and regularly reassessed.

CONCLUSIONS

- ▶ FAD is still a **very common skin disease** in temperate climates.
- ▶ The only effective means of curing and **preventing FAD** remains the **protection of the affected animal from flea bites**.
- ▶ Newer products and the use of an **integrated approach** employing both an **insecticide and an insect growth regulator** have now made what used to be a very **difficult problem, readily controllable**.
- ▶ However, the key to success is still to develop a programme tailored to the individual situation and including all in-contact animals.
- ▶ **Combination therapy** using an **insecticide and an insect growth regulator** tremendously **enhances** the **speed of success** and the **efficacy of long term prevention**.
- ▶ **Management of FAD** is **not really complex** in itself, but it has to be remembered that it may be **associated** with secondary cutaneous infections and/or other allergic dermatitis, especially with **atopic dermatitis** (increasing the risk of cutaneous infections).



Photomicrograph of *Ctenocephalides felis* egg.
Courtesy of: P. Bourdeau



Photomicrograph of *Ctenocephalides felis* larva.
Courtesy of: P. Bourdeau

FOOD ALLERGY (FA)

INTRODUCTION / DEFINITION

- ▶ Food allergy involves immunologic mechanisms.
- ▶ We are discussing in this chapter the skin manifestations of food allergy, also called "cutaneous adverse food reactions" (CAFRs).
- ▶ Typically, FA leads to a **non seasonal pruritus**.
- ▶ FA may manifest as Atopic Dermatitis (AD), and Flea Allergy Dermatitis (FAD) can, of course, be superimposed.
- ▶ **FA is one of the three major allergic skin diseases** that have to be considered in the differential diagnosis of pruritic dermatoses, the others being FAD and AD, clinical signs of FA being similar to the latter in a certain number of cases.
- ▶ During this **differential diagnosis of allergies, FA** takes a particular place: especially in case of non seasonal sings, after exclusion of FAD, and even though FA is not so common, it **should always be investigated and excluded (or controlled) before initiating any treatment of AD** (even if the dog showed a positive intradermal test).



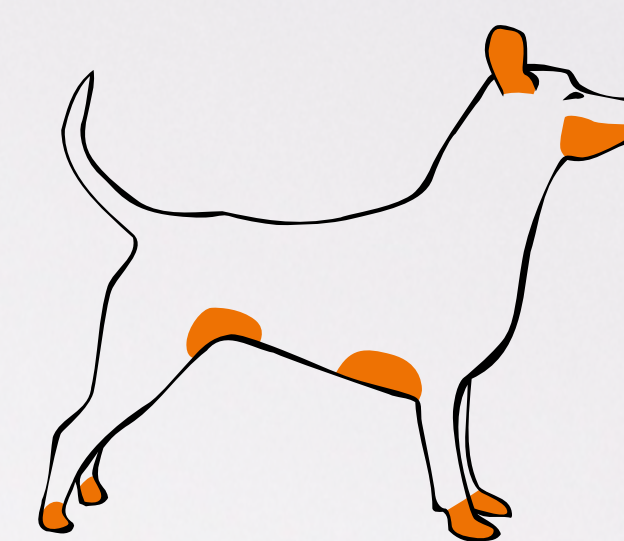
Major food products incriminated. Courtesy of: P. Jasmin

AETIOLOGY / PATHOGENESIS

- ▶ **The allergens.**
 - Most dog owners believe that their dog cannot be affected by FA because the dog has been on the same diet for years!
 - **The offending antigen is usually a basic food ingredient** of the diet, containing proteins.
 - Sensitisation to an antigen often **follows a long refractory period**, up to two years or more, **before clinical manifestations** become evident.
 - **Major food ingredients** involved in allergic reactions include meat (beef mainly, pork, lamb, chicken... in a less extent), milk and dairy products (particularly involved), fish, egg, wheat, rice, soybean, maize and other cereals, potentially all kinds of proteins, and even starches contain proteins.
 - In most cases, **pruritus is due to one allergen** or possibly two, but some dogs are multisensitive.
 - It has also been shown that some food antigens cross-react. Thus most animals reacting to beef (probably the major food allergen in dogs) will also react to lamb and milk.
 - **Commercial canned or dry pet food** (which may contain some or many of these ingredients) can as readily cause FA as do home prepared diets.
 - Even though raw food might be more allergenic than cooked food, some food processing can lead to new allergens.
 - Involvement of these ingredients varies between regions of the world.
 - Several studies on dogs affected by AFR showed that 3/4 of cases were **due to beef, dairy products and wheat**.
 - Adverse reactions in dogs to corn, rice, pork and fish are rarely reported.
- ▶ **Pathogenesis.**
 - The specific immunological mechanisms involved in food allergy are **not well understood**.
 - The mechanisms of FA are most likely to involve a combination of IgE-mediated immediate reactions (minutes to hours) and lymphocyte-mediated delayed reactions (hours to days).
 - It is likely that animals that respond quickly to a diet trial and relapse upon challenge within hours of a challenge are IgE-mediated.
 - Dogs affected by FA may be predisposed to secondary staphylococcal and/or *Malassezia* infections and/or proliferation. They are also likely to vary over time as dogs are fed.

EPIDEMIOLOGY

- ▶ **FA is not an uncommon** skin disease.
- ▶ After a major bibliographic research on cutaneous adverse food reactions, Thierry Olivry and Ralf S. Mueller (2017) found that:
 - Among dogs presented to their veterinarian for any diagnosis, the **prevalence was 1 to 2%**.
 - Among those with skin diseases, it ranged between 0 and 24%, **in dogs with pruritus (9 to 40%)**, in those with any type of allergic skin disease (8 to 62%) and in dogs diagnosed with atopic dermatitis (9 to 50%).
- ▶ Another major bibliographic research of Thierry Olivry and Ralf S. Mueller (2017) reported that:
 - Age of onset varied from less than 1 to 13 years of age; a beginning of signs by 6 or 12 months of age was noted in 22 to 38% of dogs, respectively.
 - Four breeds (German shepherd dogs, West Highland white terriers, Labrador and golden retrievers) accounted for about 40% of affected dogs.



Silhouette of food-induced AD



Dog affected by food allergy. Courtesy of: D.N. Carlotti

CLINICAL SIGNS

- ▶ **Perennial pruritus** is the most common manifestation of FA most often in a generalised pattern.
- ▶ The degree of **pruritus** is variable but often **intense** and relatively **constant from the time of onset**.
- ▶ Pruritus and lesions can be generalised but the **distribution** can be predominantly **the ears, feet, and abdomen**.
- ▶ **Erythema** and a **papular eruption** may occur and are the most common primary lesions.
- ▶ In most cases secondary lesions develop and include **excoriations, crusts, lichenification, hyperpigmentation and keratoseborrhoeic changes**.
- ▶ **Secondary dermatoses** may occur, such as **bacterial overgrowth, folliculitis, Malassezia dermatitis, bacterial overgrowth**, pyotraumatic dermatitis (**hotspot**) and bacterial pododermatitis.
- ▶ A primarily erythematous **bilateral otitis externa may be observed**, with a rapid occurrence of a **secondary infection** involving **bacteria** and/or the **yeast Malassezia** (see the monograph on otitis).
- ▶ **Other signs** such as **gastrointestinal signs**, symmetrical lupoid onychitis, conjunctivitis, sneezing, and anaphylaxis were reported. **Diarrhoea** and **frequent defecation** were most frequently reported.
- ▶ Thus concomitant gastrointestinal and dermatological signs are highly suggestive of a FA.
- ▶ As indicated by Thierry Olivry and Ralf S. Mueller (2017), cutaneous manifestations of FA presented mainly as **recurrent bacterial skin infections, otitis externa** and **atopic dermatitis**.
- ▶ It is **important** to re-emphasise that **similar clinical signs** can result from **other diseases (AD, FAD, Malassezia dermatitis, idiopathic bacterial folliculitis, Sarcoptic mange...)**. These **must** therefore **be excluded** and the **secondary complications treated before FA can be implicated in the disease process**.



Dog affected by food allergy. Courtesy of: D.N. Carlotti Clinical signs



Dog affected by food allergy. Courtesy of: D.N. Carlotti

DIAGNOSIS

General history.

- **Sudden or progressive onset** of a mild to severe **pruritus**, sometimes late in the animal's life.
- Onset of pruritic disease at <6 months of age, with or without urticaria.
- **Perennial pruritus** with no seasonal influence.
- The delay between ingestion of the offending food and onset of signs may depend on which type of hypersensitivity response predominates and on the particular antigens involved. However most affected dogs have a constant pruritus with no obvious relationship to the diet.

Dietary history.

- The dietary history **should be carefully reviewed with the owner** with two main objectives:
 - **first, to identify ingredients commonly associated with AFR,**
 - **second, to determine what ingredients that have never been eaten by the dog should be used for the elimination diet.**
- This history **should include commercial foods, treats, biscuits, supplements, chewable medication, chew toys and also access to other sources of food:** e.g. various leftovers from human meals, commercial cat food...

Clinical elements.

- **Food induced atopic dermatitis** is one of the **most common FA manifestations**, with similar clinical signs and **ears, feet** and **abdomen** preferentially affected.
- **Generalised** non seasonal **pruritus**.
- Bilateral **pododermatitis**.
- **Otitis externa**.
- **Secondary pyoderma and/or bacterial overgrowth and/or Malassezia dermatitis.**

HISTORY SHEET

Owner: Date:

Dog's name: Age:

Breed: Sex: Weight:

GENERAL HISTORY

1/ Age when acquired and origin (breeder, pet store, ..):

2/ Geographical area of home, present and past (trips, kennels, ..):

4/ **Diet (current and previous):** and in-contact pets:

6/ Reproduction (frequency of oestrus, pregnancy, behaviour of males, ..):

6/ Previous diseases and surgery:

8/ **Current non skin-related problems:**

• Behavioural changes:

DERMATOLOGICAL HISTORY

1/ Chief complaint:

2/ Date of onset:

3/ **Pruritus, importance and time of onset (before and after lesions):**

• Itching of feet (licking, chewing):

4/ **Specific clinical signs and related behaviour:**

• Otitis, itching of ear pinnae (scratching, shaking):

• Itching of anogenital area (rubbing, licking and chewing):

• Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretion):

• Upper respiratory signs, nasal discharge and/or sneezing:

• Lower respiratory signs, asthmatic problems:

• First cutaneous lesions observed and their development:

6/ Seasonal influences:

7/ Other affected animals (cohabiting, lineage) or human beings in contact:

8/ Presence of fleas and anti-parasitic treatments given:

11/ **Previous treatments (date, products, dosage, duration) and responses:**



Dog affected by food allergy. Courtesy of: D.N. Carlotti



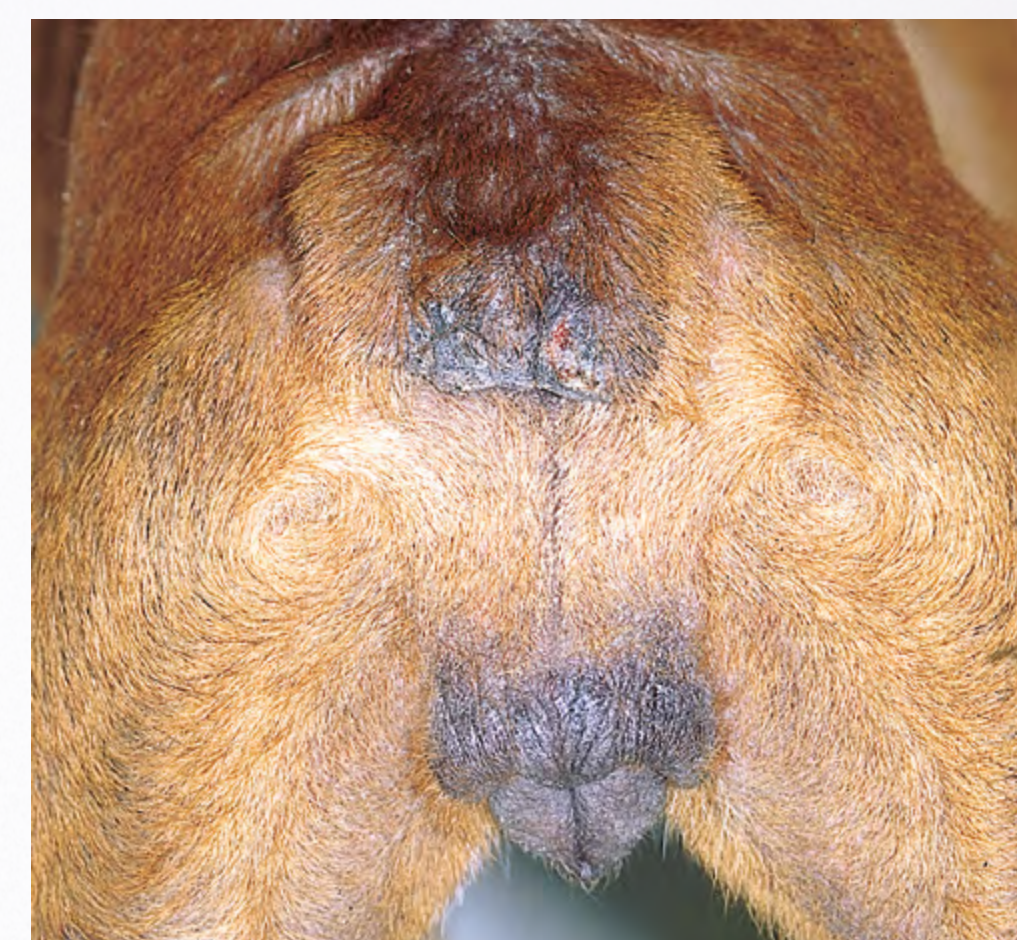
Dog affected by food allergy. Courtesy of: D.N. Carlotti



The above dog after 7 weeks of an elimination diet. Courtesy of: D.N. Carlotti



The above dog after 7 weeks of an elimination diet. Courtesy of: D.N. Carlotti



The above dog after 7 weeks of an elimination diet. Courtesy of: D.N. Carlotti

► **Major differentials.**

• **FAD (Flea Allergy Dermatitis):**

- The major differential in flea-endemic areas is FAD.
- The two diseases may co-exist in the same patient but **FAD is more frequently associated with atopic dermatitis.**

• Key distinguishing features of FAD are (see monograph on FAD):

- There is always a primary eruption, which is papular and crusting.
- The **distribution** involves the **lower back** and posterior and inner thighs.
- There is **no obvious association with otitis externa.**

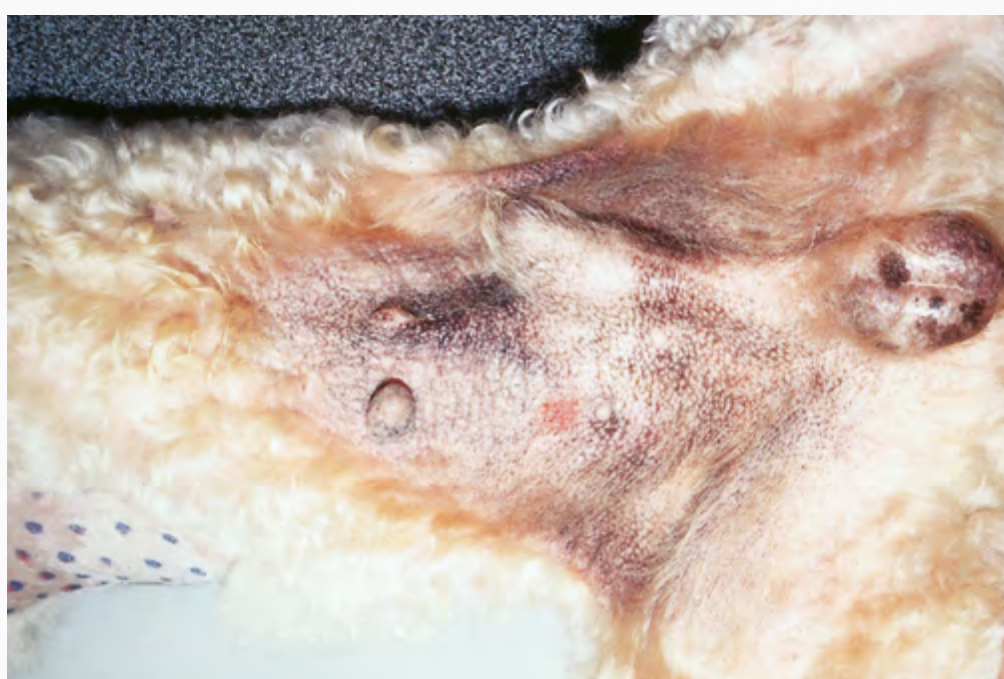
• **AD (Atopic Dermatitis):**

- It should be emphasised that in many dogs, FA manifests as AD, and in many dogs with AD, signs are exacerbated by food, like in humans, thus, **clinical features of AD** can be **identical** to those of FA (food-induced atopic dermatitis).
- Thus most dermatologists prefer to **look for FA prior to exploring further a diagnosis of AD** (see monograph on atopic dermatitis), so every dog with nonseasonal AD must have a food trial.

• **Is the following case a dog affected by FA or atopic dermatitis?**



Generalised ventral erythema in a dog. Courtesy of: D. Pin



Closer view showing the IDT done due to a suspicion of atopic dermatitis. Courtesy of: D. Pin



Close view of the IDT showing hypersensitivity to Graminaceae, Df, Dp and flea extracts. Courtesy of: D. Pin



Close view of the abdominal erythema. Courtesy of: D. Pin



Close view of the axillary erythema. Courtesy of: D. Pin



Close view of the periorbital erythema. Courtesy of: D. Pin

- **The above pictures show a dog affected with a food allergy** (diagnosed by elimination diet and provocation tests) **which expressed as atopic dermatitis**, this dog is affected with a **"food-induced atopic dermatitis"**.
- At that time, clinical signs were not due to aeroallergen hypersensitivity revealed by the IDT.
- **This emphasises first that a positive IDT is not diagnostic for atopic dermatitis, and second that it is necessary to perform an elimination diet test before trying to control any atopic dermatitis potentially due to other allergens, even in the face of a positive IDT.**

• **Parasitic Dermatoses:**

- As is the case in FAD, **care must also be taken to exclude the pruritic parasitic dermatoses.**
- These include **Sarcoptic mange** (see monograph on Sarcoptic mange) and infestation with *Cheyletiella*, *Trombicula* and lice (see monograph on dermatoses associated with infestations by other parasites).

• **Allergic Contact Dermatitis (ACD):**

- Food allergy may also be confused with allergic contact dermatitis, which is **very rare in dogs.**
- Key features of allergic contact dermatitis are:
 - » There is always a primary eruption which is macular (erythema) and papular.
 - » The eruption is restricted to contact areas where the hair is absent or thin.

► **Diagnostic tests.**

• **General remarks:**

- **Histopathology** is not diagnostic but may be **suggestive of cutaneous hypersensitivity**.
- As reviewed by Ralf S. Mueller and Thierry Olivry (2017):
 - » In dogs, testing for serum food-specific IgE and IgG still currently show low repeatability and a highly variable accuracy.
 - » Negative patch test reactions have a very high negative predictability in dogs and could enable a choice of ingredients for the elimination diet in selected patients.
 - » **So, currently, the best diagnostic procedure to identify FA remains an elimination diet with subsequent provocation trials.**
- **The purpose of this trial is to evaluate the improvement of clinical signs and especially pruritus.**
 - » In order to appreciate the effect of the trial diet, **no other therapy should be permitted.**
 - » However if the dog is severely pruritic, a short course of short-acting corticosteroids may be used for symptomatic relief early in the dietary trial.
 - » Furthermore **all other primary dermatoses** (including FAD) **and secondary dermatoses** (especially cutaneous infections) **have to be excluded or treated before and during the diet trial.**
 - » In a dog affected by FA, clinical signs will gradually decrease, over 3-8 weeks once the offending allergen has been eliminated from the diet.

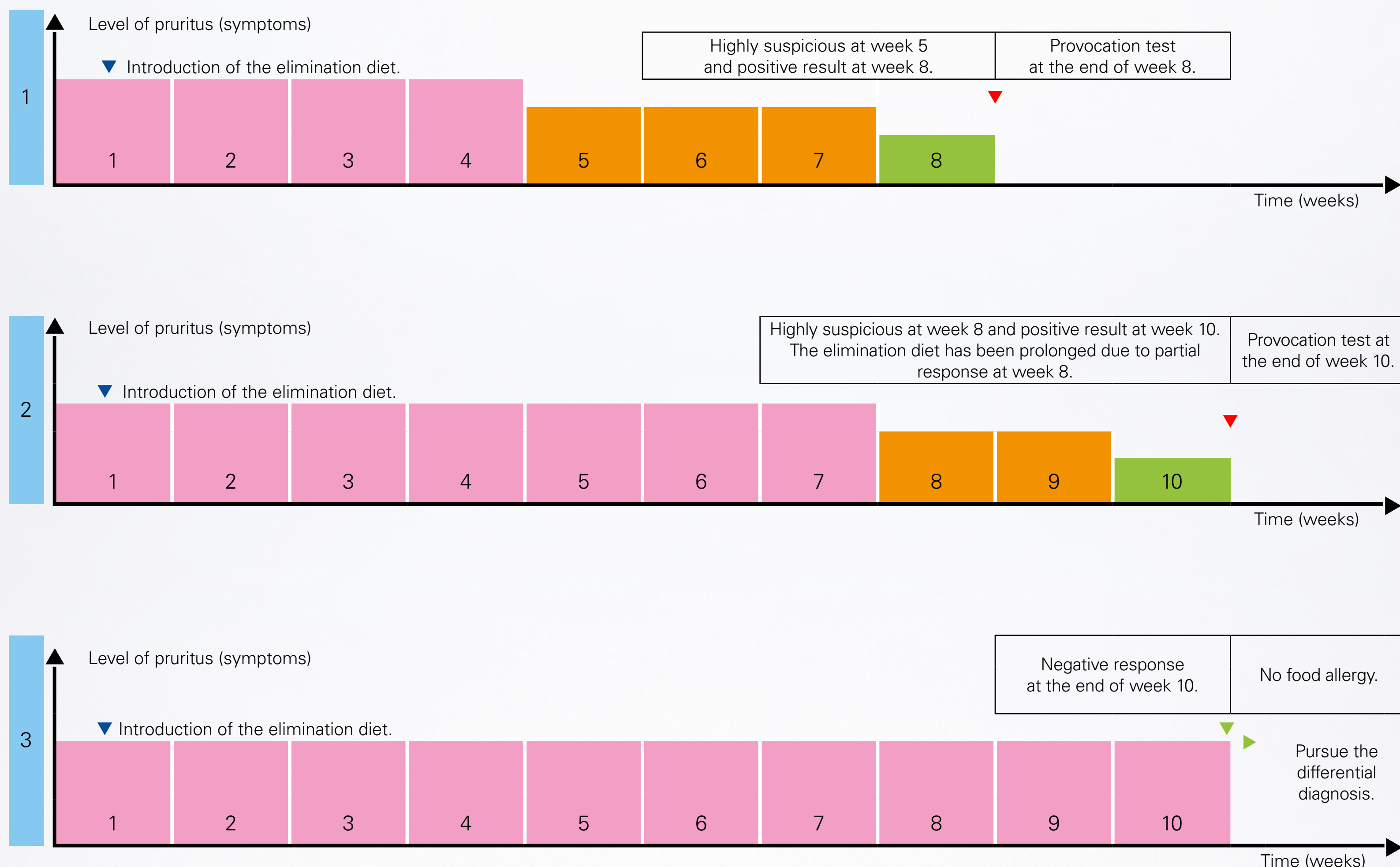
• **Practical guideline for the elimination diet test:**

• **Constraints and contents of the diet:**

- » Commercial **hyper-hydrolysed** or "**hypoallergenic**" petfood should be preferred.
- » Alternatively, a **homemade diet** can be prepared, even though more complex, maybe more expensive, and potentially more allergenic as less cooked. Such a diet should contain a single protein source and a single carbohydrate source, a meat and a vegetable, that the dog should not have previously eaten.
- » Note that **cross-reaction between** potentially **any mammalian meat** may occur, and between related or distant plants due to the presence of evolutionary-conserved proteins belonging to several families, that are "pan-allergens".

- **Absolutely no other food is permitted during this period:**
 - **Be careful that the dog has no access to another pet food, e.g. cat food or tidbits.**
 - **All people who might be in contact with the affected dog (even once!),** e.g. all members of the family (especially **children**), friends, guests... **have to be aware of the “treatment” of the dog and clearly advised that they must not give anything to the dog.**
 - The animal should be controlled during the trial, to **avoid any incidental ingestion** of foods other than the permitted ones. On the other hand, if there is an "accident" and no reaction (e.g. no pruritus re-increase), this is very informative that it is not an offending food ingredient, and inversingly.
- **Duration:**
 - **Improvement of clinical signs** is usually **gradual** and may take **a long time to become evident.**
 - **At least 50% of amelioration** should be seen to conclude on the elimination trial success.
 - Some dogs (50%) **respond within 3-4 weeks**, but if not, the diet must be **given for a minimum of 8 weeks** (95% responders), and prolonged beyond (**up to 12-13 weeks** if necessary for the remaining 5%), in case of no or partial amelioration after 8 weeks.
 - The prescription of a **short course of oral corticosteroids** at the start of the elimination diet, **may shorten the duration** of the trial.
 - Conducting an elimination diet is not easy, **the basic condition is that the owner has to be convinced of its importance.** But when the owner agrees to perform it, **do not hesitate to prolong it for as long as necessary.**

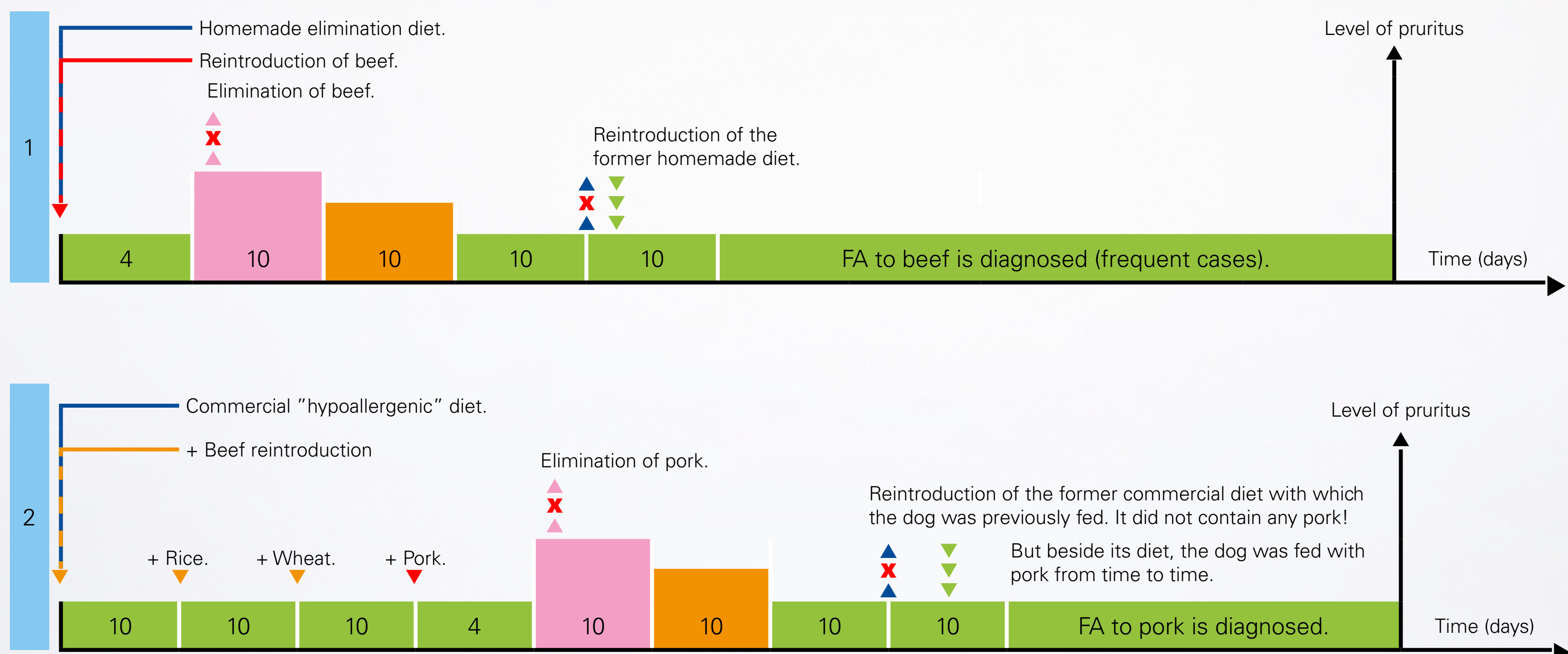
• **Examples of three different elimination diet results:**



• **Provocation test:**

- In case of positive response to the elimination diet, the diagnosis must be confirmed by an oral food challenge (OFC) consisting in reintroduction of the former diet components, one by one at around 2 weeks intervals.
- Recrudescence of the clinical signs may occur within 1-3 days, but sometimes is delayed up to 14 days.
- As shown by Thierry Olivry and Ralf S. Mueller (2019) in their bibliographic analysis: about 9% of dogs exhibited a flare of clinical signs in the first day after an OFC, 21% by the end of the second day, 50% by 5 days and 90% after 14 days.
- **This allows the determination of the specific allergenic agent but also confirms the diagnosis.**
- Previous foods may be reintroduced:
 - » in addition to the elimination diet,
 - » or instead of one of the components of a homemade elimination diet.
- When a food component causes the recurrence of clinical signs, stop it immediately, and feed the dog again with the previous foods that caused no signs. This should resolve the clinical signs induced by the food challenge (within a few days to a few weeks).

• **Examples of two different provocation test results:**



Legends

- ▼ Dog fed with the elimination diet.
- ▼ Reintroduction of one of the components which were included in the former diet of the dog.
- ▼ Reintroduction of the offending component, previously given to the dog in its diet.
- ▼ Reintroduction of all the other components which were included in the former diet of the dog.
- ▲ Definitive elimination of the offending component.
- ▲ Discontinue the elimination diet.

• **Conclusions:**

- When the offending component has been found, it must never be given to the dog again (although some dogs may tolerate a new exposure later in life, after a long and strict avoidance).
- In the future, oral immunotherapy may be used (works well in people).
- FA often occurs in association with AD, and in some regions also with FAD.
- **Dogs affected by concomitant FA and AD may show a significant but not total improvement of their clinical signs during a dietary elimination trial. These patients must then be worked up for concomitant AD.**
- One of the most **important sources of errors** is **owner compliance. To increase compliance**, it may be pertinent to **ask the owner to precisely notice the date, foods given and clinical signs modifications during the whole dietary elimination trial and provocation test.**

CLINICAL MANAGEMENT

General remarks.

- **Contrary to atopic dermatitis, food allergy can usually be perfectly controlled.**
- **Avoidance of the allergen(s) by omitting the offending food(s)** identified during the test diet is the **key** to a **successful "treatment"**.
- **Diagnosis and clinical recovery are then concomitant.**
- An accurate identification of the offending allergen is necessary.
- Once the diagnosis has been made, feeding a commercial hypoallergenic diet – either limited antigen or a hydrolysed protein diet, is preferable to feeding a home prepared diet for maintenance. Although the hydrolysed protein diets should be the ultimate limited antigen diet, unfortunately not every animal is satisfactorily controlled by such diets.
- A tolerable home-prepared diet is an alternative, and can usually be achieved, but must be balanced with vitamin, mineral and essential fatty acid supplements.
- **Secondary complications** such as **bacterial and/or Malassezia infection** (including **otitis externa**) have to be **treated before** and during the **elimination diet**, but **should not recur since food hypersensitivity is controlled.**
- Any **associated FAD** has to be managed by **flea control.**

Topical treatment.

- **Shampoos** and **lotions** formulated **to help control allergic skin diseases** are useful (see Atopic Dermatitis Monograph).
- **Otitis externa** should be treated with an antibiotic, anti-yeast and anti-inflammatory **otic preparation.**
- **An antiseptic ear cleanser** may be useful for regular ear cleaning.

Systemic treatment.

- **Systemic treatments** and **especially corticosteroids are usually unnecessary**, bearing in mind that food allergy may not respond well to corticosteroid therapy.
- However, **essential fatty acids** may improve the skin and haircoat quality.
- Also, maybe in the future, oral immunotherapy could be used.



Dog affected by FA.
Courtesy of: D.N. Carlotti

PROGNOSIS

- The **prognosis for food allergy is good** because the offending allergen can be eliminated.
- Rarely, dogs will become sensitised to the new diet, necessitating further investigations and dietary manipulations.
- Very rarely, dogs may become sensitised to new diets so quickly that they have to be maintained on anti-inflammatory or immunosuppressive therapy.

FOLLOW-UP

- All dogs with confirmed FA should be checked periodically to ensure that they are still asymptomatic.

CONCLUSIONS

- **Food allergy is not a very common** skin disease but is **not rare.**
- **An elimination diet should be instituted when appropriate, i.e. where there is suspicion of a FA, and also in cases of AD to ensure that there is not also a contribution from a FA.**
- Even if the understanding of this skin disease is not complete at the present time, **diagnosis and long term management of dogs with FA is achievable.**
- In case of **worsening of signs** after a period of stability, consider that the dog might have developed new **food hypersensitivities.**

ATOPIC DERMATITIS (AD)

INTRODUCTION / DEFINITION

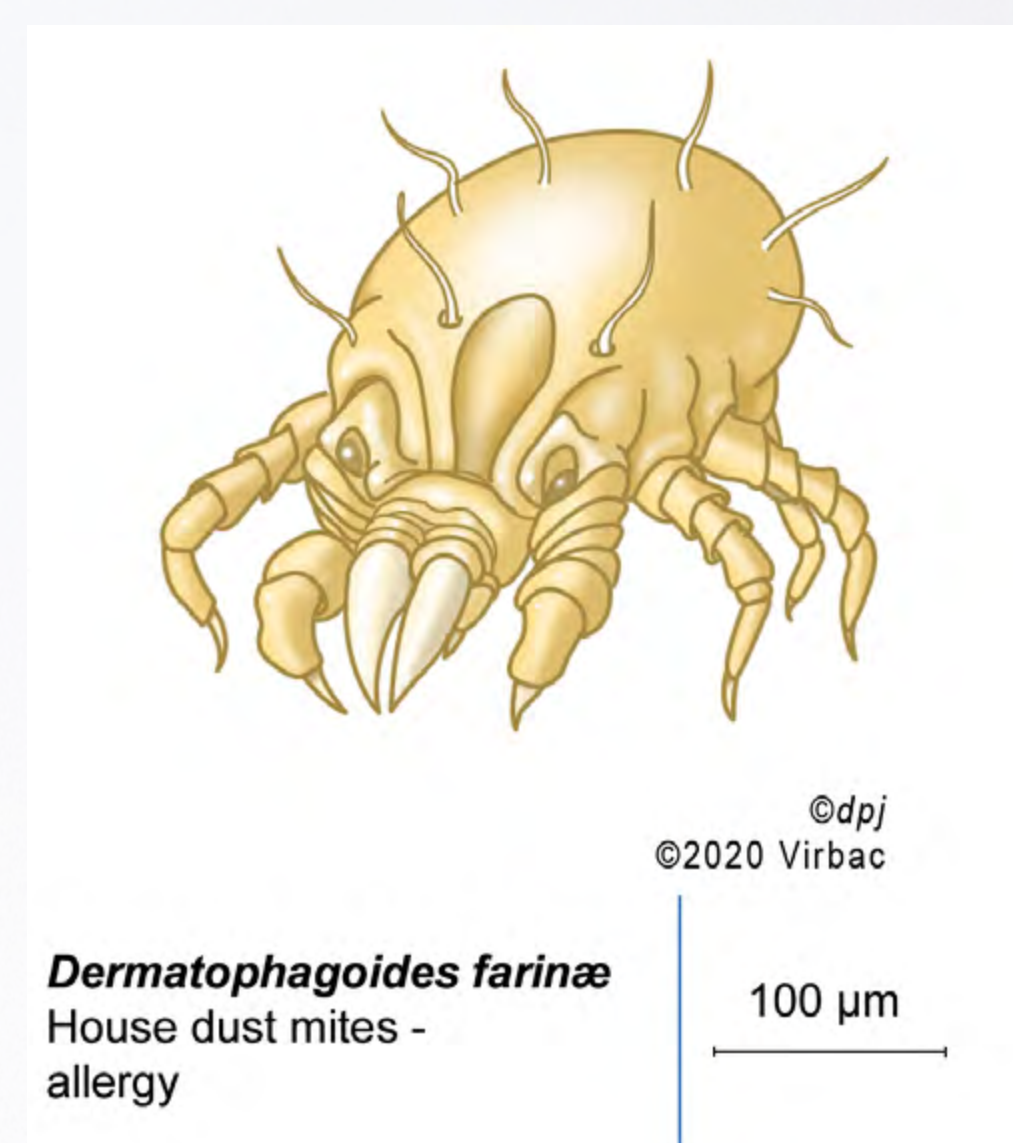
- ▶ **Atopic dermatitis (AD)** in dogs is defined as: “**A genetically-predisposed, inflammatory and pruritic skin disease with characteristic clinical features associated with IgE antibodies most commonly to environmental allergens.**”
- ▶ Canine AD is **one of the most common skin disease** of dogs, and pruritus represents **one of the first reasons for consultation**.
- ▶ The predisposition to IgE development makes the dogs highly likely to develop a **concurrent flea allergy dermatitis**, if infested with fleas.
- ▶ **Atopic dermatitis and food allergy are inter-related**: between 13 and 100% of dogs with food allergy manifest it as AD; conversely, 10-50% (median: 30%) of dogs with AD are food allergic. This relationship implies that, in some but not all atopic dogs, **food allergens can cause a flare of signs of AD**.
- ▶ Due to its **surface skin barrier dysfunction**, AD is associated with a **dysbiosis of the surface microbiome**, which is one of the likely causes for the **predisposition of atopic dogs to develop superficial pyoderma variants and *Malassezia* dermatitis**.
- ▶ In dogs, the diagnosis of AD is made first by **ruling out or treating primary or secondary parasitic or infectious skin diseases**. For example, resembling pruritic diseases, such as scabies must be ruled-out before the diagnosis be made.
- ▶ One can proceed then to the differential diagnosis of allergies, with AD being diagnosed principally based on a compatible signalment, suggestive history, and characteristic pruritus and clinical distribution.



Atopic dog.
Courtesy of: T. Olivry

AETIOLOGY / PATHOGENESIS

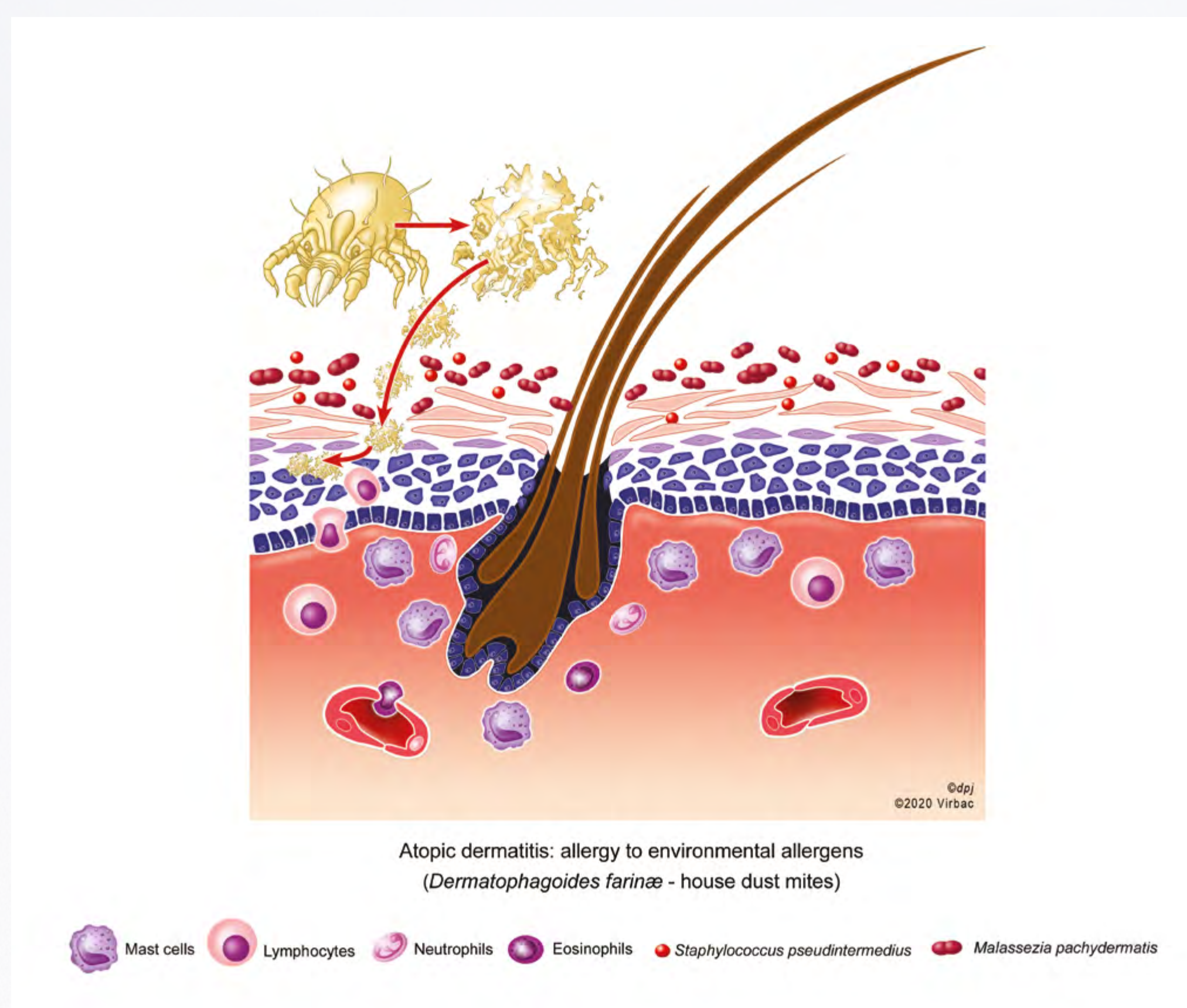
- ▶ **Allergens:**
 - Dogs with AD have been shown to have detectable IgE that target a **combination of environmental, food, flea and microbial allergens**.
 - There is a variation in the type of environmental allergens recognised by IgE. **Nonseasonal (perennial) clinical signs have been attributed mostly to the *Dermatophagoides* house dust (and storage) mites**, while seasonal signs can occur in tree, grass or weed pollination seasons in dogs hypersensitive to such pollens. The prevalence of pollen allergy varies depending upon the geographical location.
 - Recent data suggest the existence of a profound cross-reactivity between mite species, as well as between pollens of the same category. There is evidence that the ubiquitous IgE against *Dermatophagoides farinae* might only reflect, in a substantial fraction of dogs, a cross-reactivity to a previous *Toxocara canis* infestation. As such *Dermatophagoides farinae*-specific IgE are also detectable in normal dogs, there is then some doubt about their pathogenicity.



Courtesy of: P. Jasmin

Pathogenesis:

- **The pathogenesis of canine AD involves the complex interplay of genetic and environmental factors with an immunologic dysregulation.**
- **Canine AD is likely a complex, genetically-heterogeneous syndrome** with each breed (or groups of related breeds) likely having its unique genetic basis. Specific AD-causing mutations have not yet been identified, and genetic tests are not currently available in dogs. **In humans** with AD, mutations in genes coding for epidermal proteins induce a “primary” **skin barrier defect**, but, as of 2020, a similar genetic epidermal defect has not yet been confirmed in atopic dogs.
- It is currently believed that environmental—and perhaps even some food—allergens contact immune cells and keratinocytes in the epidermis to initiate an IgE-mediated inflammatory cascade that involves, at least, mast cells, T helper 2 lymphocytes, antigen-presenting cells, eosinophils, macrophages and skin sensory neurons.
- A myriad of pro-inflammatory mediators is released in the skin of atopic dogs. These include—among others— histamine, cytokines (e.g., interleukin-[IL]4, -13, -31), lipid mediators (e.g. prostaglandins and leukotrienes) and neuropeptides (e.g., substance P).
- **There is likely a vicious circle of inflammation** in which cells keep activating each other, perhaps even without the involvement of IgE in later stages.
- **The dermal inflammation results in a change in epidermal proliferation and differentiation that leads to a secondary epidermal barrier defect** that includes the reduced production of *stratum corneum* epidermal lipids and expression of important upper epidermal proteins and adhesion molecules. **These anomalies likely facilitate the penetration of allergens** through the *stratum corneum* and the increased contact with immune cells and living keratinocytes.
- **The epidermal barrier dysfunction results in a surface microbial dysbiosis with a proliferation of *Staphylococcus pseudintermedius* and *Malassezia pachydermatis*, which can also worsen, in turn, the cutaneous inflammation.**
- The current dogma for AD pathogenesis, in dogs like in humans, is that of an “*outside-inside-outside*” model in which the **skin microbes and allergens penetrate the skin** from the outside to trigger a **local and systemic immune dysregulation** that further **exacerbates any existing skin barrier defects**.



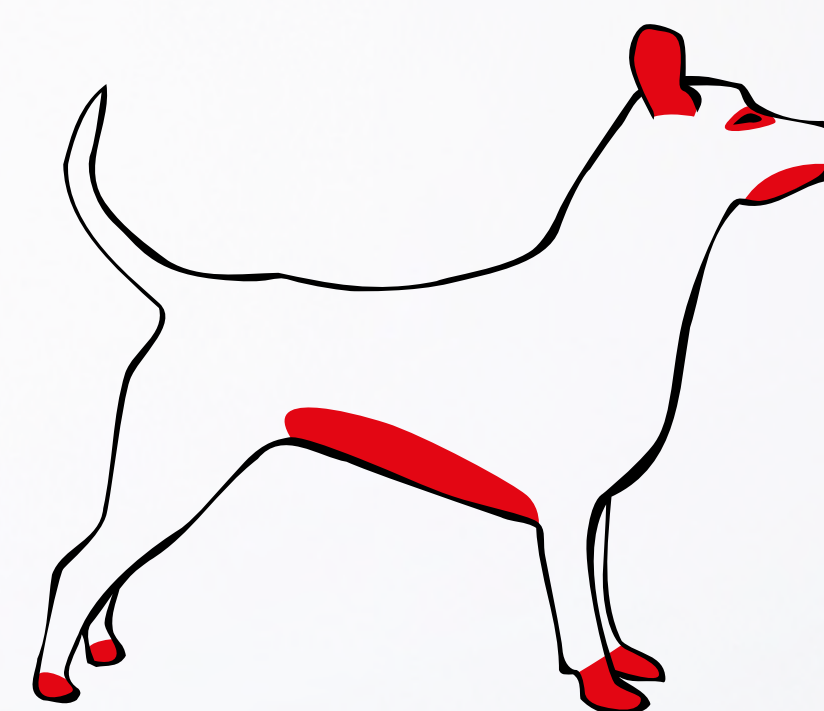
Courtesy of: P. Jasmin

EPIDEMIOLOGY

- Atopic dermatitis is one of the most common skin diseases of dogs.** Where flea control is widespread, AD might even surpass the prevalence of the otherwise-ubiquitous flea allergy dermatitis. In a series of more than 1,500 dogs with chronic pruritus, AD was the diagnosis given to over two-thirds of dogs (Favrot, 2010).
- In a study of over 800 dogs with AD (Wilhelm, 2011), the **mean age of onset was about 2 years.** About 9%, 29%, 52%, 79% of dogs developed their first signs before 6 months, 1, 2 and 3 years, respectively; **only 7% had a diagnosis made after 5 years** of age. **A younger age of onset is seen more often in dogs with food-induced AD.**
- The breed predisposition to develop AD has varied with time and geographical locations, likely reflecting the local spread of AD-causing mutations in some breeds. In a worldwide survey (Favrot, 2010), the following breeds were most commonly reported: West Highland white terriers, Labrador and golden retrievers, German shepherd dogs, boxers, and French and English bulldogs. This list does not exclude that other breeds may be locally more predisposed to develop the disease.
- Males and females appear equally at risk to suffer from AD.
- In the largest series of cases (Favrot, 2010), one-fourth of dogs had a seasonal worsening of signs, while the others were perennially-affected. **Many dogs will exhibit nonseasonal signs with a seasonal exacerbation** during a particular pollination season.

CLINICAL SIGNS

- In dogs with AD, the **pruritus** ranges from **mild to severe.**
- While, for decades, the skin lesions of canine AD were believed to follow scratching, biting etc... (i.e., secondary lesions), studies from experimental allergen challenges in laboratory dogs have confirmed that **erythematous macules, patches and micropapules (1-2 mm) consist the primary lesions** of this disease. Edema might also be seen at the site of erythematous lesions.
- Excoriations, self-induced alopecia, lichenification** (increased thickening), and **scaling** are lesions that **reflect chronic inflammation and self-trauma**; dogs of some breeds are prone to also develop an **hyperpigmented skin.**
- As **dogs with AD are predisposed to develop both superficial pyoderma and *Malassezia* dermatitis**, lesions of bacterial folliculitis, exfoliative superficial pyoderma (epidermal collarettes) or seborrheic dermatitis can be present in addition to typical atopic skin lesions. In general, **the appropriate treatment of these infections resolves their respective lesions without having caused a complete resolution of the pruritus and lesions at the typical AD sites.**



Micropapules,
Courtesy of: T. Olivry



Severe secondary alopecia.
Courtesy of: T. Olivry



Severe chronic lichenification on the ventral area.
Courtesy of: T. Olivry

- ▶ In most dogs with AD, the lesions are present in a characteristic distribution, and they are often bilaterally-symmetrical.
 - On the face, the lesions are visible on the **concave (inner) pinnae**—sometimes only at the **auditory canal opening**—and the **lips** (cheilitis). The presence of **periocular erythema**, **alopecia** and **lichenification** likely reflects the presence of an associated allergic **blepharo-conjunctivitis**, a common occurrence.



Periocular lesions.
Courtesy of: T. Olivry



Periocular lesions and blepharo-conjunctivitis.
Courtesy of: T. Olivry

- On the trunk, lesions tend to affect **areas of friction with poor hair coverage**, such as the **axillae**, **flanks**, **inguinal fold** and **lower abdomen**. On the cranio-ventro-lateral thorax and flanks, lesions will often match the range of motion of the limbs, likely reflecting rubbing. The ventral neck, perineum, perianal and ventral aspect of the tail are also commonly involved.



Chronic lesions on frictions areas.
Courtesy of: T. Olivry



Chronic inflammation, lichenification and hyperpigmentation on frictions areas.
Courtesy of: T. Olivry

- **On the limbs**, lesions clearly affect **flexural aspects of the joints**, such as those of the **elbows, carpi, knees** and **hocks**, like in humans. Elbow fold inflammation might be a specific, albeit not very sensitive, sign for canine and human AD. Outside of the joints, limb lesions are more medially- than laterally distributed.



*Preferential distribution of lesions on the limbs.
Courtesy of: T. Olivry*

- **The feet most commonly harbour lesions**, either in the **dorsal interdigital space**, or on the **ventral or dorsal metacarpi** and **metatarsi**. Between the footpads, lesions are often very edematous. Acral lick dermatitis can be present on the extremities, but are an uncommon complication of canine AD.



*Bilateral pododermatitis.
Courtesy of: T. Olivry*

- **An otitis externa accompanies some 80% of cases (!)**, and occasionally **can be the main presenting sign**. Characteristically, the otitis commences by affecting the inner surface of the pinnae, auditory orifices and the vertical ear canals, but in longstanding cases the horizontal ear canals also become involved **with a secondary infection involving bacteria and/or the yeast *Malassezia*** (refer to the Otitis Monograph).



*Bilateral otitis externa affecting the concave pinnae.
Courtesy of: T. Olivry*

- **Subsequent flares of the disease tend to affect previously-inflamed areas**, likely due to the presence of **residual subclinical inflammation** at these sites.
- Some dogs can be seen **biting/scratching or chewing typically-affected areas without any lesions being seen**. This alesiional pruritus likely reflects **subclinical inflammation** at these sites.

- ▶ In one study, 60% of dogs with cutaneous signs of AD were diagnosed as having a **concurrent conjunctivitis**, after being seen by an ophthalmologist.
- ▶ **Sneezing**, reverse sneezing and rhinorrhoea in conjunction with cutaneous lesions likely herald the presence of **associated allergic rhinitis**. This can lead to **profound facial pruritus in some dogs**.
- ▶ In contrary to the human atopic diseases, concurrent **allergic asthma is a rare diagnosis made in dogs with AD**.



Ventral distribution of lesions.
Courtesy of: T. Olivry



Closer view of the abdominal lesions.
Courtesy of: T. Olivry



Closer view of the facial lesions.
Courtesy of: T. Olivry

DIAGNOSIS

As mentioned above, the **diagnosis of AD** is made principally from a **compatible signalment, suggestive history, and characteristic pruritus and clinical distribution.**

In 2010, Favrot and colleagues reviewed records of more than 1,500 dogs with chronic pruritus. After separating those diagnosed with AD from others, a **list of criteria** was selected (box), **the satisfaction of five of which had a 80% sensitivity and 80% specificity to diagnose the disease.** Such performance means that such criteria are of **limited value in general practice, as their strict application would leave one of each five dogs with the wrong diagnosis.** These criteria are still useful to harmonize enrollment criteria for clinical trials, however.

Favrot's criteria – 2010 (Set 1)

1. Age at onset <3 years
2. Mostly indoor
3. Corticosteroid-responsive pruritus
4. Chronic or recurrent yeast infections
5. Affected front feet
6. Affected ear pinnae
7. Non-affected ear margins
8. Non-affected dorso-lumbar area



Atopic dog, chewing the extremity of one of his front feet.
Observe the left front foot turned around, resting on the right limbs, and **the wet traces** left by the animal on the ground, indicating an intense chewing.
Courtesy of: P. Jasmin



Atopic dog, chewing the extremity of one of his front feet.
Observe both front feet turned around allowing the animal to chew here the palmar aspect of the left one.
Courtesy of: P. Jasmin



Atopic dog, scratching his ear.
Courtesy of: P. Jasmin

HISTORY SHEET

Owner: Date:
 Dog's name: Breed: Age: Sex: Weight:

GENERAL HISTORY

1/ Age when acquired and origin (breeder, pet store, ..):
 2/ Date of onset:
 3/ Key events (microclimate, temperature, humidity, garden, flat, ..) and in-contact pets:
 4/ Diet (current and previous):
 5/ Reproduction (frequency of oestrus, pregnancy, behaviour of males...):
 6/ Previous diseases and surgery:
 7/ Unrelated previous dermatoses:
 8/ Current non-skin-related problems:
 9/ Behavioural changes:

DERMATOLOGICAL HISTORY

1/ Chief complaint:
 2/ Date of onset:

4/ Specific clinical signs and related behaviour:

- Itching of feet (licking, chewing):
- Itching of head, lips, chin, periorbital area (scratching, rubbing):
- Otitis, itching of ear pinnae (scratching, shaking):
- Itching of anogenital area (rubbing, licking, chewing):
- Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretion):
- Upper respiratory signs, nasal discharge and/or sneezing:
- Lower respiratory signs, asthmatic problems:

5/ First cutaneous lesions observed and their development:
 6/ Seasonal influences:
 7/ Other affected animals (cohabiting, lineage) or human beings in contact:
 8/ Presence of fleas and anti-parasitic treatments given:
 9/ Shampoos and grooming:
 10/ Owner's view (personal opinion, remarks) on the dermatosis of his dog:
 11/ Previous treatments (date, products, dosage and duration) and responses:

- ▶ In the dog, **there are several diseases whose signs mirror some those of AD.**
- ▶ As a result, and in addition to the low diagnosis value of the strict application of Favrot's criteria mentioned above, **a careful rule-out of these resembling diseases must be done before the diagnosis of AD is made. These resembling dermatoses are principally of parasitic, infectious and other allergic origin.**
 - **Ectoparasitoses**
 - A **simple flea infestation** (and its **commonly-associated flea allergy dermatitis**) can affect the dorso-lumbo-sacral area, ventral abdomen and perineum, the latter two being also seen in dogs with AD.
 - **Scabies** caused by *Sarcoptes scabiei* is **the perfect AD mimic** due to its involvement of the head, limbs and a ventral-predominant distribution. In contrary to AD, however, lesions affect the external (convex) pinnae (AD = concave), the extensor surface of the joints (AD = flexor), the lateral aspect of the limbs (AD = medial) and sternum (AD = abdomen).
 - In some dogs (especially the small terriers, shih Tzu etc.), **demodicosis**, a usually mildly- or non-pruritic disease, can be very erythematous and pruritic mirroring AD with its involvement of the face and feet.
 - Other ectoparasitoses such as **trombiculosis** and **cheyletiellosis** similarly must be ruled-out, if prevalent in the local geographical area.
 - **Infections:**
 - **AD predisposes dogs to develop recurrent (usually superficial) pyoderma and Malassezia dermatitis. These diseases can occur also in non-atopic dogs.** In this case, an appropriate treatment should resolve all signs, especially pruritus. See the respective monographs on these diseases.
 - **Allergies:**
 - **Flea allergy dermatitis** can exist in conjunction with AD, but is also present in non-atopic dogs. In the latter case, **flea control** would completely resolve lesions. See the separate monograph on this disease.
 - **Food allergies** can manifest not only as AD, but also as **other pruritic conditions such as recurrent pyoderma, alesional pruritus, otitis** etc... When the distribution of signs is that of AD, the diagnosis of **food-induced AD** can be made. See the monograph on food allergy.
 - **Contact allergy** can manifest with **signs mirroring those of AD**, but it is a **very rare condition in the dog.**

PLACE OF IgE SENSITISATION TESTS

- ▶ **For a long time, the diagnosis of AD could not be made in dogs without a supporting positive intradermal or IgE serological test to environmental allergens. This necessity is no longer recommended due to the high prevalence of IgE, especially to the *Dermatophagoides farinae* house dust mite, in healthy dogs without signs of AD.** The use of such test for the diagnosis of AD would thus have a **remarkably low specificity**.
- ▶ At this time, the IgE sensitization tests (intradermal, prick or serological tests) are best **used for the following situations:**
 - to **implement allergen avoidance measures**, if feasible, and/or
 - to **choose allergens to include in allergen-specific immunotherapy (AIT)**.
- ▶ At first, the intradermal test was believed to represent the “gold standard” to measure IgE sensitisation. Both serological and skin (intradermal or prick) tests are now thought to assess different aspects of the sensitisation to allergens, from a highly sensitive yet labile test (serology) due to the very short half-life of circulating IgE (about 2 days), to a “reservoir” in the skin (IDT) that, in experimental sensitization studies in dogs, was shown to be slow to become positive and slow to negativise after the disappearance of IgE from the blood.
- ▶ Intradermal and serological test results are often, but not always concordant. There are advantages and disadvantages for each of these two tests, as well as among the different types IgE serological test (monoclonal, oligoclonal and receptor-based assays), the specifics of which are beyond the purpose of this chapter.
- ▶ Due to the specialisation of allergen-immunotherapy, IgE sensitisation testing is probably best reserved to specialists and veterinarians with experience in AIT.

TREATMENT

► **Forewords:**

- Because AD is likely a **genetically-heterogeneous syndrome** in which dogs live in different environments and can harbour a **variety of skin lesions**—often at **different-stages, there is no “one size fits all” treatment strategy**. For optimal results, the **treatment should be tailored to the patient’s needs at that time: the treatment of canine AD is the ultimate “individualised medicine”!**

- Some anti-allergic drugs that were effective at some points may stop being so, perhaps because of **infection development** or *de novo* production of **pro-inflammatory mediators not blocked by the current treatment**.

In those cases, a **“reset” with a short course of oral ± topical glucocorticoids should be done** before resuming the previously-successful treatments.

- This **“dynamic sequential therapy (DST)”** thus involves the **rotation of anti-allergic drugs** to best benefit the patient’s needs at that particular time.
- For an optimal result, veterinarians should become familiar with the breadth of action, speed of action, side-effects, frequency of use and cost of the various drugs in their respective countries to be able to best advise pet owners.

► **Allergen avoidance:**

- **If an allergen is known to trigger a flare**, it is in the patient’s best interest to **prevent further contact with such allergen**. While this is the easiest to achieve in the case of **flea, food and microbial allergens** with **flea control, diet restriction and antimicrobials**, respectively, the prevention of contact with environmental allergens is difficult to impossible.

- There is some evidence of using **house dust mite control measures** to limit signs of AD in dogs. Special pillow cases, and **acaricides with or without growth regulators** should, at least theoretically, reduce the number of house dust mites in the dog’s environment.

► **Hygiene of the skin and hair:**

- **Regular bathing** with emollient shampoos help **moisturize the skin** and **remove allergens potentially present on the skin**; additional moisturizers could be of interest in case of dry skin. If shampoos were to induce inflammation and pruritus, they should be changed to less irritating ones. If scaling and seborrhoea are present, antiseborrhoeic shampoos could be of interest, but any post-bathing drying and inflammation should be monitored. In case of recurrent infections, the use of antiseptic formulations could be relevant.



Lichenification - Hyperpigmentation.
Courtesy of: T. Olivry

► **Reactive anti-allergic therapy:**

- **Reactive therapy is the treatment of dogs with (i.e., in reaction to) active skin lesions.**
- **It is best to continue the reactive therapy until a full and stable (e.g., two to four weeks) remission of signs before moving on to proactive therapy (see below).**
- **For reactive therapy, several drugs have been shown to have a rapid or slower effect:**
 - **Rapid effect (by decreasing order):**
 - » **Glucocorticoids:**
 - **This is likely the broadest and one of the fastest class of anti-allergic drugs.**
 - A **lack of response** to glucocorticoids should prompt the veterinarian to **reconsider the diagnosis of AD, or look for complicating factors such as infections.**
 - **Orally:** prednisolone, prednisone or methylprednisolone should be initiated at the dosage of 0.5 mg/kg once to twice daily. Once signs are controlled, the dosage or frequency of administration can be reduced. The dose-tapering will result in a plateauing of the benefit, however. **A short course of glucocorticoids is especially useful to “reset” the inflammation control in case of failure of management of signs with drugs with a more restricted spectrum of action.**
 - **Topically: topical glucocorticoid sprays, such as those containing triamcinolone or hydrocortisone aceponate diester, can be used alone or in conjunction with oral glucocorticoids,** while focusing especially onto highly-inflamed or lichenified areas. Their prolonged use at the same site can lead to local skin atrophy, which needs to be monitored; otherwise, topical glucocorticoids should have no clinically-significant systemic adverse effects.
 - » **Janus kinase inhibitors (JAKinibs):**
 - **JAKinibs, like oclacitinib,** act very rapidly.
 - Oclacitinib is licensed at 0.4-0.6 mg/kg twice daily for 14 days and once daily thereafter. There is a common rebound, albeit temporary, in itch when reducing the frequency to a once-daily administration.
 - Their effect is **fastest on itch than on skin lesions.** They can be used **with,** or immediately after, **glucocorticoids (including topical ones) to speed up or potentiate their anti-inflammatory effect on skin lesions and limit pruritus re-increase when the dose of oclacitinib is tapered after 2 weeks.**
 - Oclacitinib is remarkably safe when given at the approved regimen. Regular blood counts should probably be done if given long-term (off-label) at the twice-daily dosage. In some patients, oclacitinib can lead to a reduction in immune-competency with the development of, for example, demodicosis or viral papillomas. A “short drug vacation”, with or without specific treatments for these infections, should resolve these issues.
 - » **Monoclonal antibodies:**
 - **Lokivetmab** is a caninised anti-IL-31 monoclonal antibody that has a **rapid action to reduce itch and a slower one to decrease inflammatory skin lesions.** It is approved at 1 mg/kg once monthly (EU) or 2 mg/kg every 6 to 8 weeks (USA). It is very effective in most dogs, but poorly active in others if the IL-31 does not contribute to signs of AD in that dog at that time. Side effects are almost nonexistent.



Atopic dog BEFORE “RESET” with corticosteroids.
Courtesy of: T. Olivry



Atopic dog AFTER “RESET” with corticosteroids.
Courtesy of: T. Olivry

- **Slower effect:**

- » **Calcineurin inhibitors:**

- **Cyclosporine** is a broad-spectrum **oral immunosuppressant**, which, at the initial dosage of **5 mg/kg/day**, exhibits **widespread anti-allergic properties**.
- Note: cyclosporin A is the chemical name, cyclosporine the US approved name and ciclosporin the international nonproprietary name.
- It is **relatively slow** to act on itch and skin lesions with significant **reductions in signs occurring in the second month of treatment**. After satisfactory control, the frequency of administration can be slowly reduced to once every two to three days. **A previous, or better concurrent short course of oral or topical glucocorticoids, can help speed the remission in the first month of treatment and potentialise its use on the long-term as proactive therapy** (see hereafter).
- Cyclosporine is safe in the long term, but vomiting and diarrhoea are commonly seen when starting treatment. Cyclosporine can induce and prolong hair cycling leading to increase shedding or hirsutism. It can also induce gingival hyperplasia. Like oclacitinib, cyclosporine is an immunosuppressant, but at the dosage used for allergies, the immunosuppression appears minimal. If an immunosuppression-associated disease occurs, a short vacation or dose reduction should resolve the matter.
- **Tacrolimus** is a **topical** calcineurin inhibitor. At the 0.1% concentration, it can help reduce skin lesions. In humans, the initial application of tacrolimus causes a burning sensation.

- **Proactive therapy**

- **Proactive (i.e., preventive, prophylactic) therapy is that of a dog whose AD signs are in remission to prevent their relapse.**
- Due to its wide breadth of anti-inflammatory effect and low rate of side effects, especially if not given every day, it could be argued that **cyclosporine is one of the best drugs to use proactively in the long-term.**
- **Proactive topical glucocorticoid therapy (PTGT)** is the application of a topical glucocorticoid (such as the currently-approved triamcinolone and hydrocortisone aceponate), **twice weekly, at the site of previously-affected lesions to prevent their recurrence**. The application is generally done twice weekly, either on each week-end day, or every three days. **There is little risk of skin atrophy** due to the normal collagen production in between applications. **This PTGT has been shown to considerably delay relapses of AD in dogs.**
- **Allergen-specific immunotherapy (ASIT, AIT)** is the administration of increasing amounts of extracts of allergens to which the patient is hypersensitive to prevent or reduce flares of allergic diseases upon further contacts with the offending allergens. Allergens can be chosen from results of either skin or IgE serological tests, and the efficacy of AIT does not appear to depend upon the selection method. In the dog, AIT can be administered by several routes: subcutaneous, sublingual or intra-lymphatic. There is initially an induction phase with a slow increase in allergen dosing followed by a maintenance phase with less frequent injections of a higher concentration of extract. Due to the complexity of this intervention, specific methodology details are beyond the scope of this chapter. In dogs, AIT is considered fairly safe and to, in average, result in a 60-70% of dogs having good-to-excellent results, shown by either the disappearance or reduction in the severity of signs or of anti-allergic drugs needed to maintain control. Of importance is that, with the currently-available "classic" regimens, the time to maximal **benefit might not occur before months of treatment.**
- **Antihistamines:** type 1 histamine receptor antagonists should be ideally given before the allergic reaction occurs so that to block the H1 receptor before histamine is released. As such they are probably best used in a proactive rather than a reactive manner, especially as histamine may not be an important mediator of chronic allergic reactions. **As a group, antihistamines appear to have a limited benefit to control signs of AD**, and they are probably more useful as antipruritics (or sedative) rather than to reduce skin lesions. There are important pharmacogenetic differences in the metabolism of H1R antihistamines in dogs compared to humans, so not all antihistamines will be reliably absorbed in dogs. Hydroxyzine (2 mg/kg twice daily) or cetirizine (1-4 mg/kg once daily) are the antihistamines with proven pharmacodynamic effect in dogs. Clemastine and diphenhydramine are not, or poorly, absorbed in the dogs and should not be used in this species.

PROGNOSIS

- ▶ The **prognosis for the long-term** control of signs of AD is **rather good**.
- ▶ However, the **percentage of cases that are “cured”** and will not require prolonged therapy **is low**.
- ▶ **Most cases will require many years of anti-allergic drugs** with or without AIT. Of importance is that AIT is the only current intervention known to alter the natural course of the disease, and which could result in a prolonged partial or full remission or a reduction in the need for anti-allergic drugs.

FOLLOW-UP

- ▶ **Dogs with AD should be seen regularly by their veterinarians to verify the satisfactory control of inflammation and clinical signs, the lack of infections**, the adherence to the previous prescription and to alter the treatment regimen, if needed. Anti-allergic drugs might be changed from time to time to optimise their benefit. The AIT regimen might need some optimisation.
- ▶ **In case of a flare of signs**, veterinarian should first **verify the presence of a skin infection**, or **consider if a contact with an offending allergen has occurred** recently or **new sensitisations** (including to **foods**) might have developed.
- ▶ **In case of a flare of signs**, and **in the absence of verified infection**, dogs will often benefit of a **short course of oral glucocorticoids (and/or topical glucocorticoids) to “reset” the inflammation control before resuming the treatment that was shown to be previously effective**.

CONCLUSIONS

- ▶ AD is **one of the most common dermatoses of dogs**, and is the leading cause of chronic pruritus in this species.
- ▶ AD results from the complex interplay of a **genetic predisposition, environmental factors** and **immune dysregulation** that cause a **secondary skin barrier dysfunction**.
- ▶ **Before a diagnosis of AD is made, resembling pruritic diseases, especially parasitic and infectious dermatoses, must be ruled-out**.
- ▶ **For an optimal result, the treatment of canine AD should be individualised** with the **goal of neutralising the inflammation** and **restore a normal skin barrier and surface dysbiosis**, all the while **attempting to reduce the side effects**.
- ▶ **Frequent monitoring and treatment adjustment are needed to ensure the best quality of life of affected dogs and their pet-parents**.



*Atopic dog, chewing the extremity of one of his front feet. Observe both front feet turned around allowing the animal to chew here the palmar aspect of the left one.
Courtesy of: P. Jasmin*

IATROGENIC AND SPONTANEOUS CUSHING'S SYNDROMES (ICS AND SCS)

INTRODUCTION / DEFINITION

- ▶ **Systemic disease as a result of chronic glucocorticoid excess, often with cutaneous involvement.**
- ▶ **Two spontaneous types of Cushing's syndrome:**
 - pituitary-dependent hyperadrenocorticism,
 - hyperadrenocorticism caused by adrenocortical tumours.
- ▶ **In addition: iatrogenic hypercorticism.**
- ▶ **Cushing's syndrome is a common disorder in dogs.**

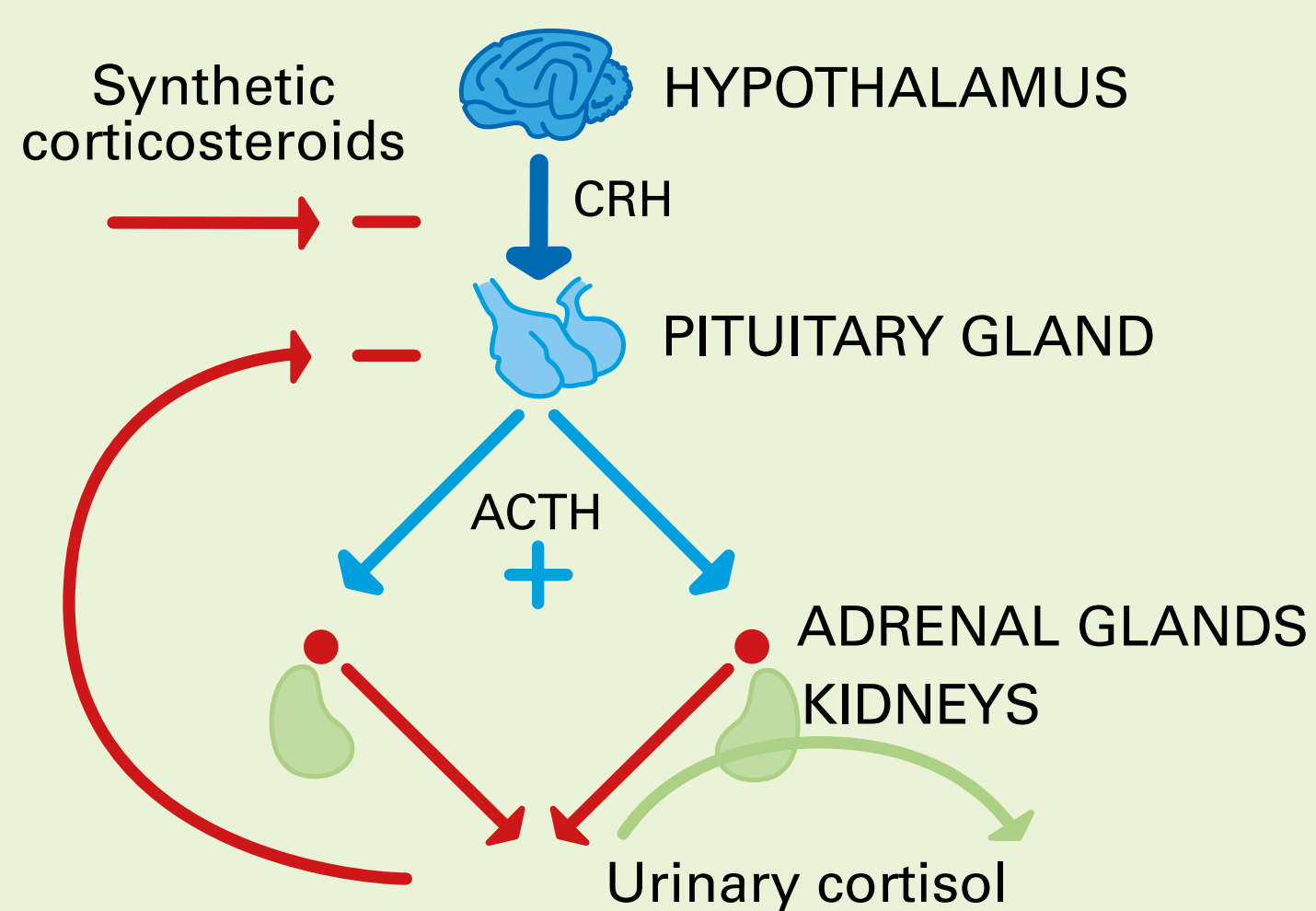


Affected dog by ICS.
Courtesy of: T. Olivry

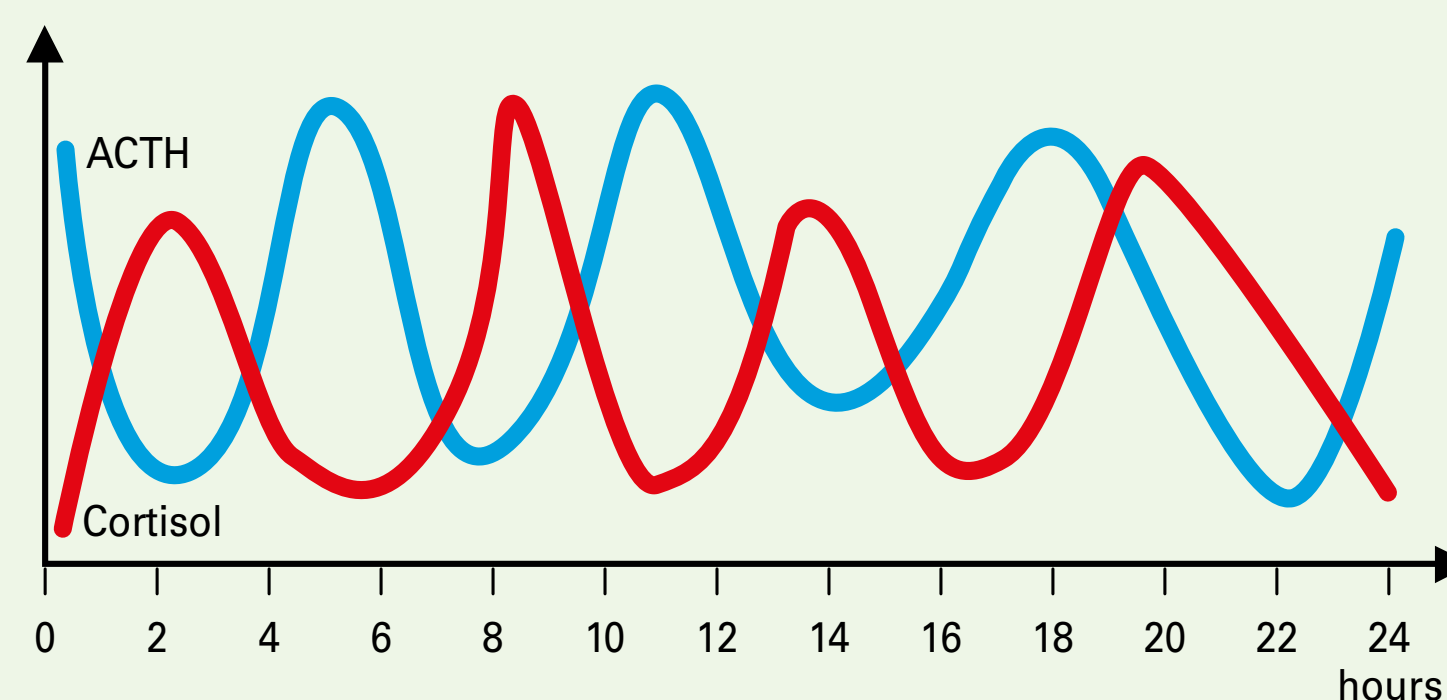
AETIOLOGY / PATHOGENESIS

- ▶ **Regulation of glucocorticoids secretion.**
 - **Cortisol** is **secreted** and **released** by the **adrenal glands**.
 - The amount of **secretion depends directly on** the plasma concentration of adreno-corticocotropic hormone (**ACTH**) which is synthesised in the anterior lobe of the pituitary gland from the precursor molecule pro-opiomelanocortin (POMC).
 - The ACTH synthesis is regulated by the hypothalamus and the central nervous system via neurotransmitters that cause the release of corticotropin releasing hormone (CRH) and arginine vasopressin (AVP).
 - The **ACTH secretion** is also **regulated by stress** factors (increased production) **and exogenous glucocorticoids** (negative feedback leading to the inhibition of ACTH secretion).
 - The blood cortisol levels vary by a factor of 9 to 10 during the day in healthy dogs and normal levels range between 1-6µg/dl (27-165 nmol/l). Thus **a single blood test for cortisol is not diagnostic** for either hyper- or hypoadrenocorticism.

Regulation of glucocorticoid secretion



Cortisol and ACTH in plasma

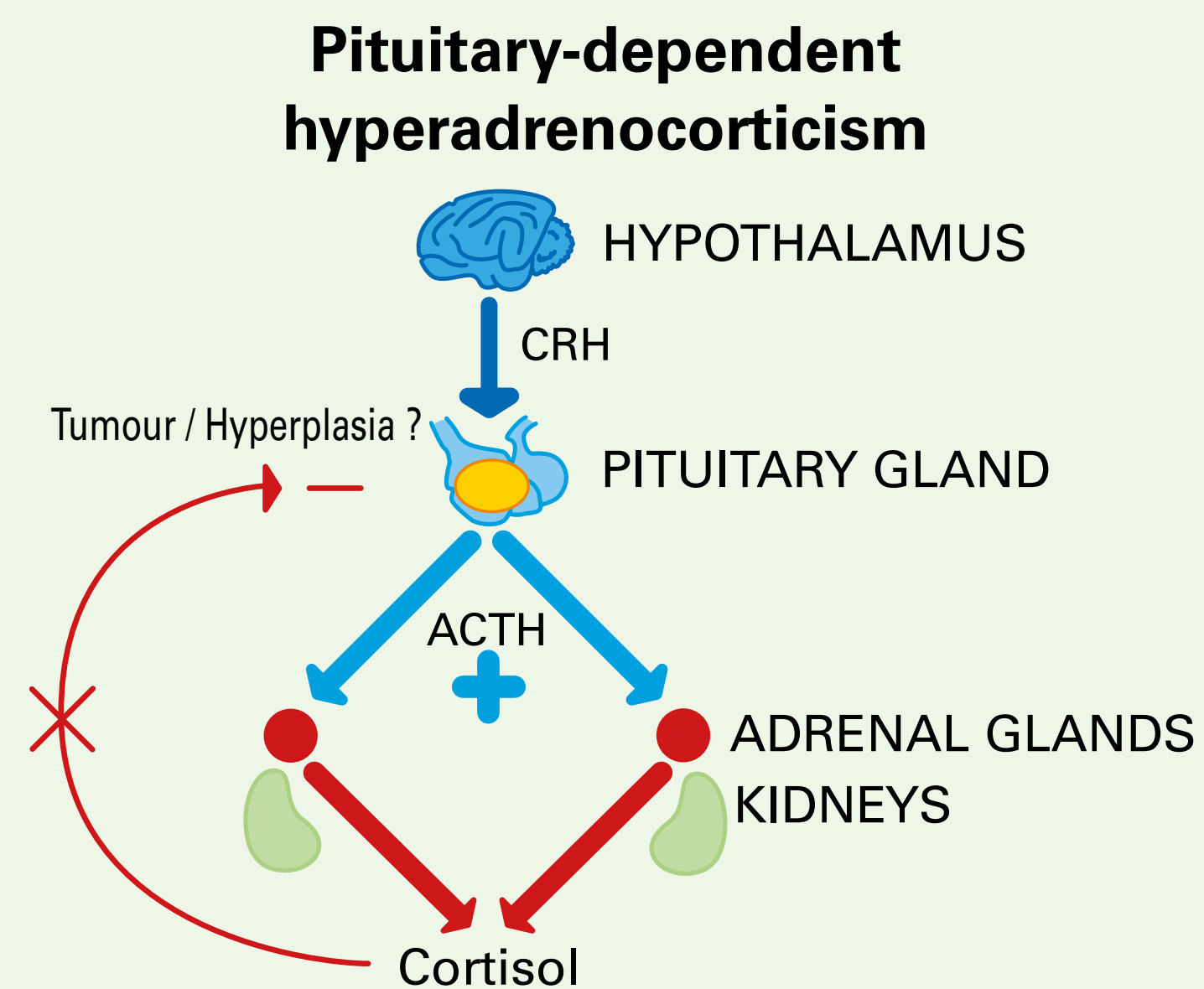


► **Pituitary-dependent hyperadrenocorticism (PDH).**

- **85% of spontaneous Cushing's cases.**
- Caused by changes ranging from hyperplasia to neoplasia of the pituitary gland.
- 70% occurring in the anterior lobe (mainly microadenoma).
- 30% occurring in the pars intermedia (often macroadenoma).
- **Consequences:**
 - **increased ACTH production,**
 - **stimulation of both adrenal glands,**
 - **often bilateral hyperplasia,**
 - **increased cortisol production, decreased endogenous ACTH production**



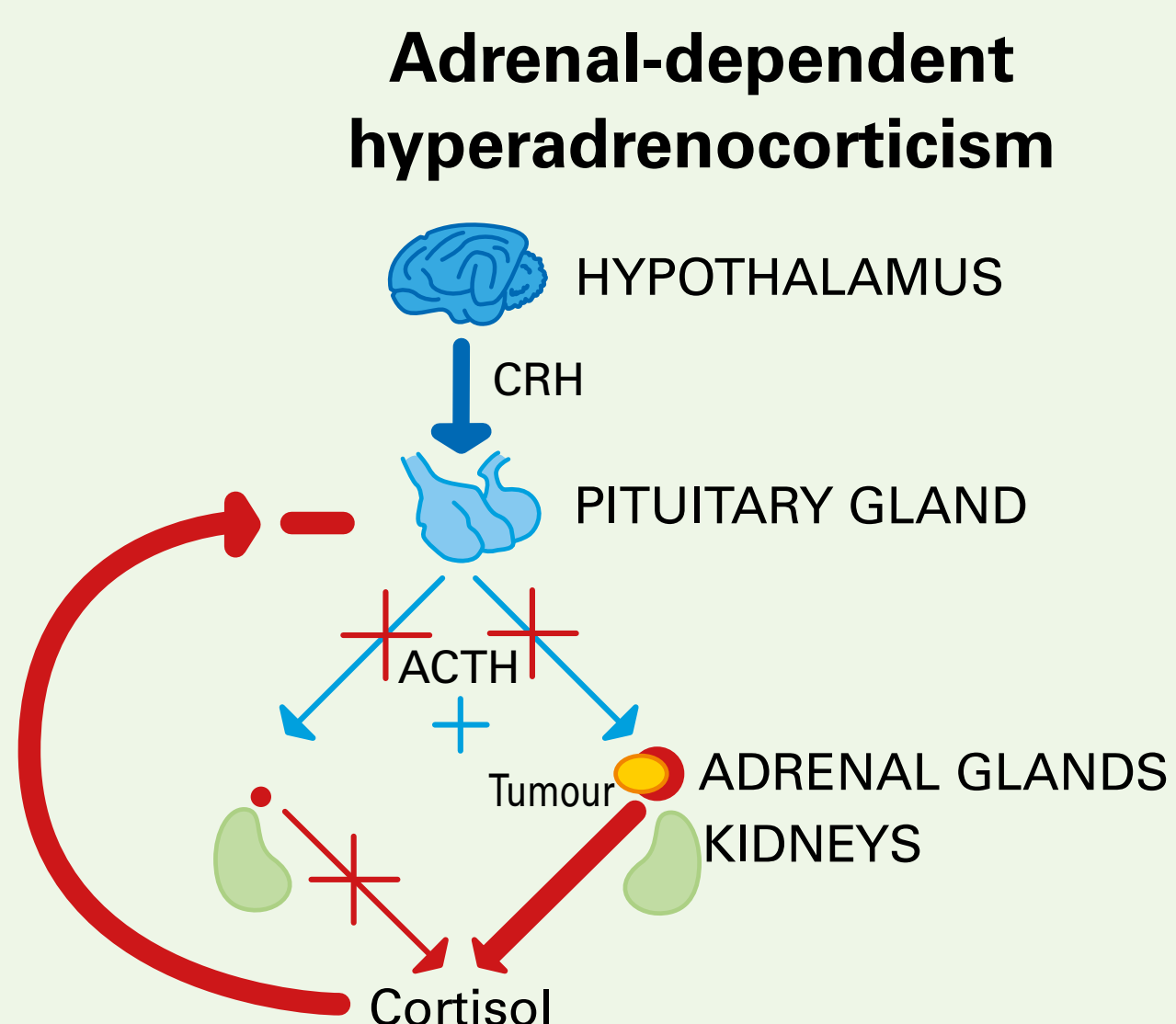
Affected dog by PDH. Courtesy of: D. Pin



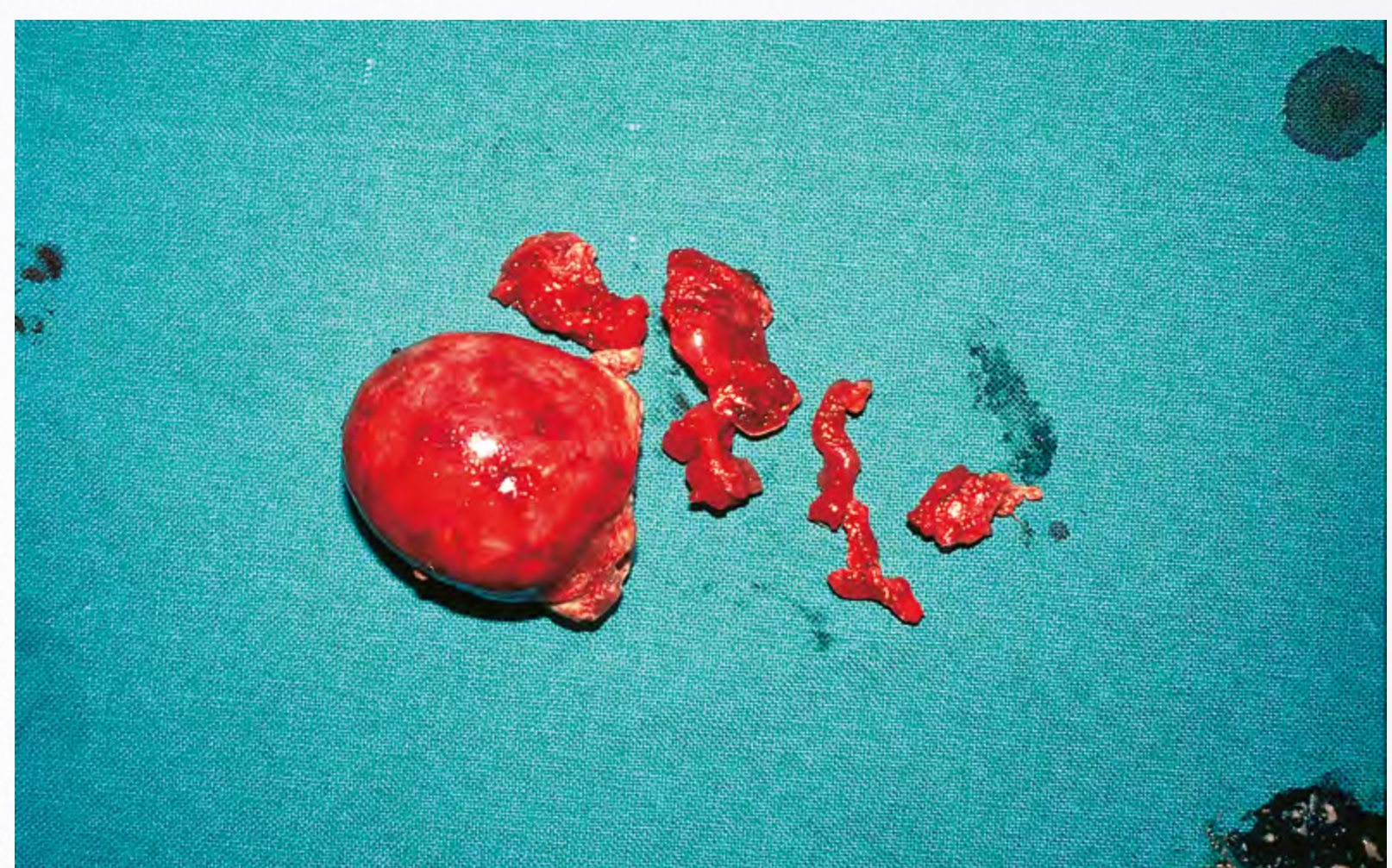
Affected dog by PDH. Courtesy of: D.N. Carlotti

► **Adrenal-dependent hyperadrenocorticism (ADH).**

- **~ 15% of spontaneous Cushing's cases.**
- Caused by a **tumour of one** (rarely both) **adrenocortical glands.**
- Adenoma or adenocarcinoma.
- **Consequences:**
 - **atrophy of contralateral adrenal gland,**
 - **increased cortisol production.**



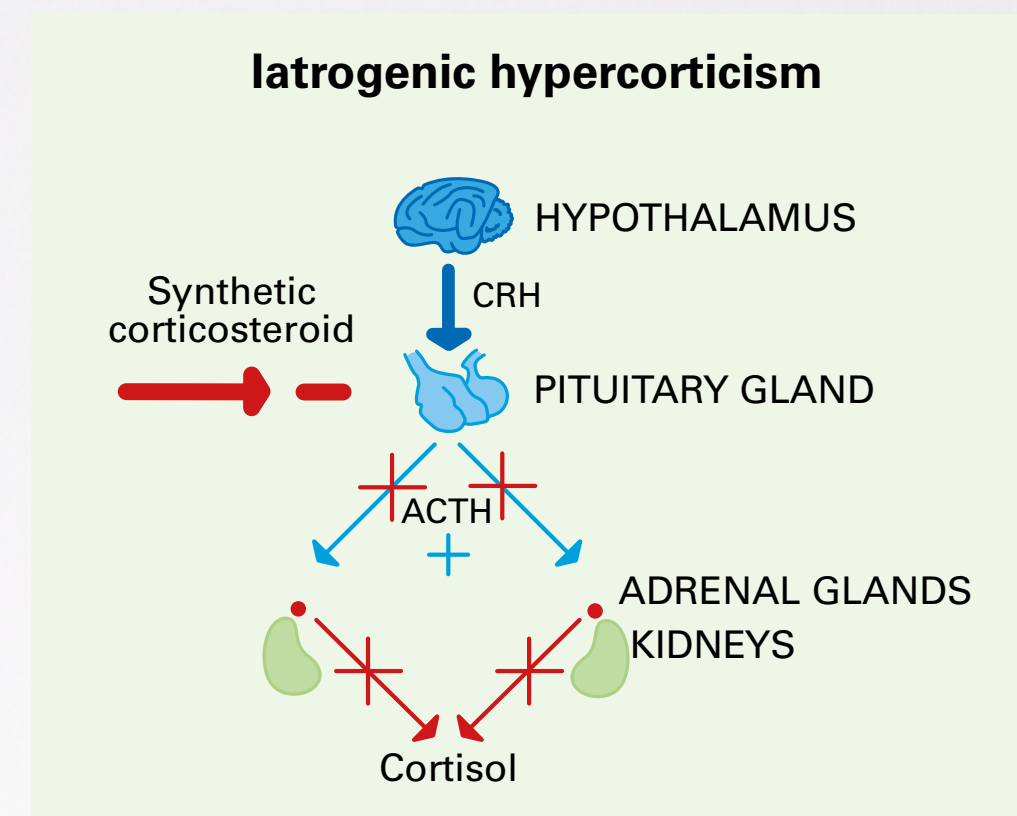
Affected dog by ADH. Courtesy of: D.N. Carlotti



Adrenocortical gland tumor (adenoma). Courtesy of: D.N. Carlotti

► **Iatrogenic hypercorticism.**

- Caused by inappropriate **chronic use of glucocorticoid therapy**, mostly **systemic**
- In some cases, topicals, particularly with the more potent **glucocorticoids**, may trigger skin atrophy.
- **Consequences:**
 - **elevated blood level of circulating glucocorticoids,**
 - **reduction of endogenous corticoid production,**
 - **often atrophy of both adrenal glands,**
 - **secondary adrenocortical insufficiency with reduced production of both glucocorticoids and mineralocorticoids which may lead to a life-threatening Addisonian crisis when the glucocorticoid administration is stopped.**



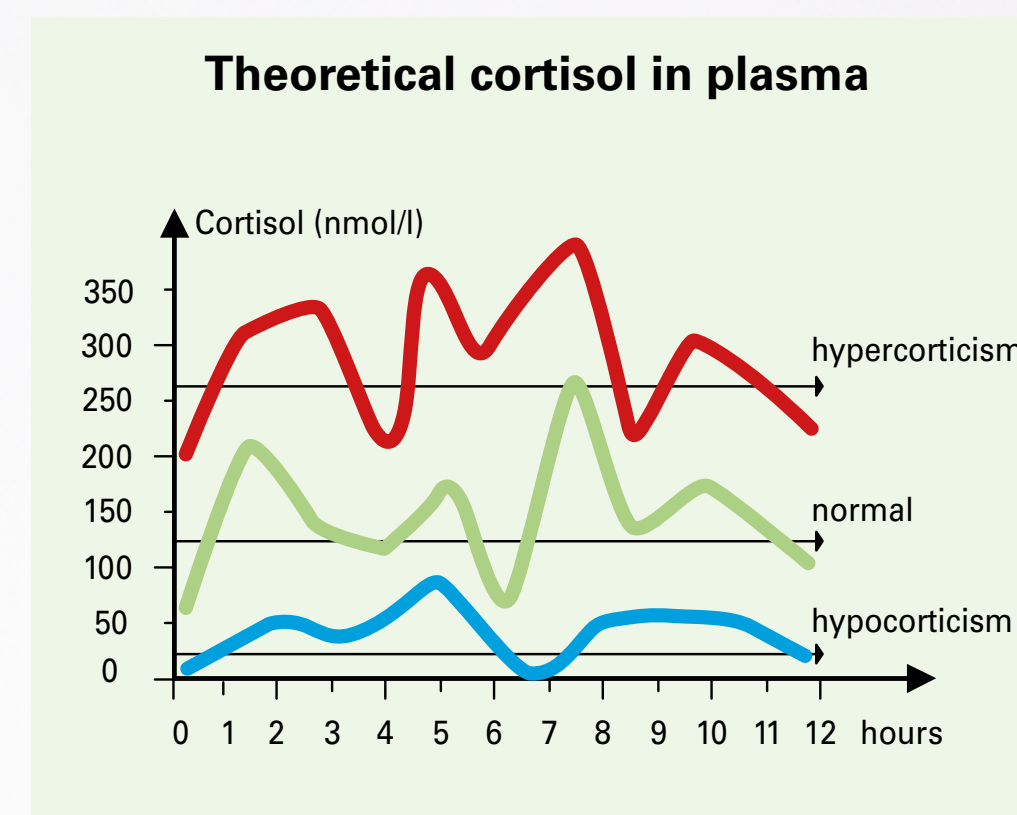
► **Consequences on the cortisol level in plasma.**



ICS with comedones. Courtesy of: T. Olivry



ICS with comedones. Courtesy of: T. Olivry



EPIDEMIOLOGY

► **Breed and age predilections for spontaneous hyperadrenocorticism (SCS).**

- **Poodles, Yorkshire terriers and dachshunds are more commonly affected, but Cushing's syndrome is also seen in many other breeds.**
- The disease is frequently seen **between the ages of 6 to 9 years.**

► **Breed predilections for iatrogenic hypercorticism (ICS).**

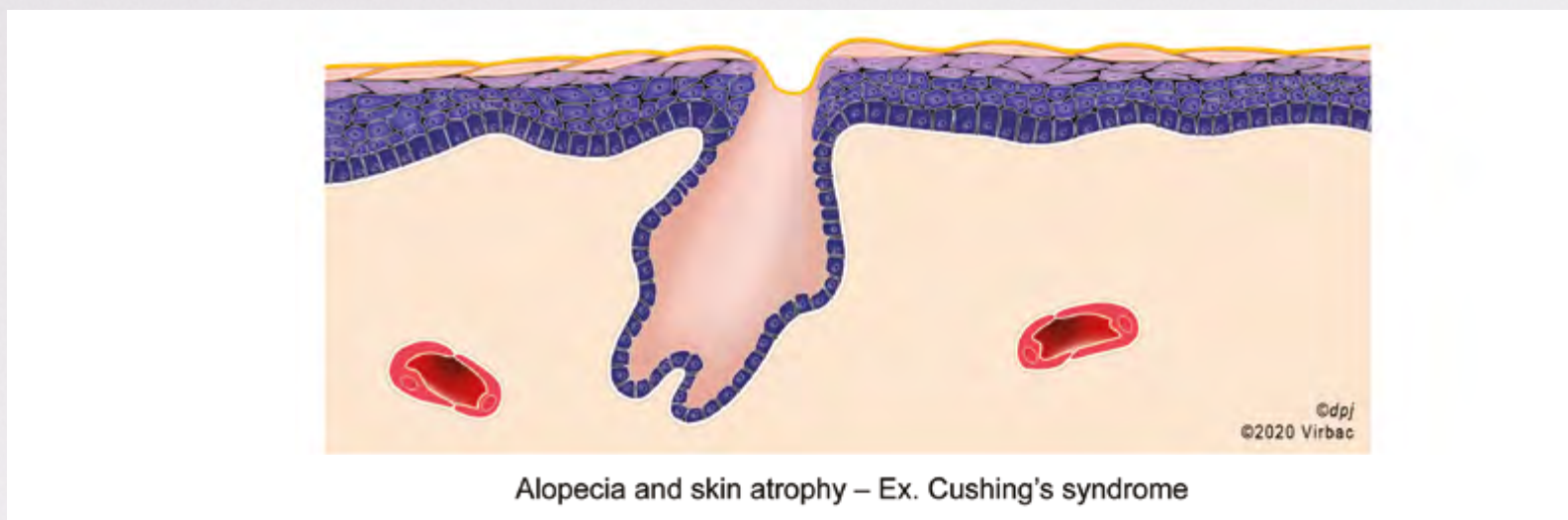
- **Tolerance to glucocorticoid therapy is very variable amongst individuals and breeds, and depends on the duration and level of administration.**
- **Small dogs** and certain breeds (such as Boxers) show a **higher risk of developing iatrogenic hypercorticism.**

CLINICAL SIGNS

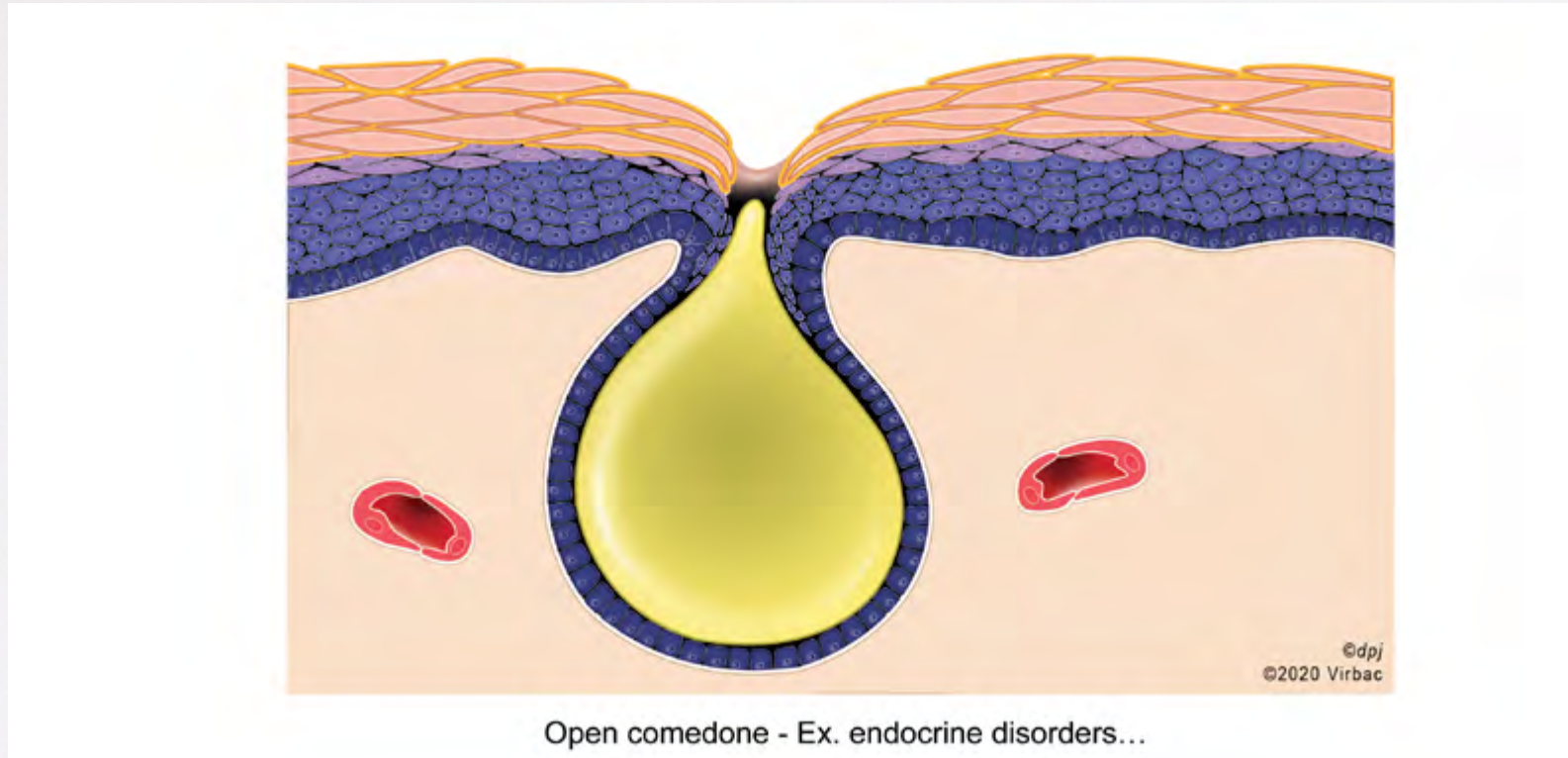
Chronic excessive glucocorticoid blood levels result in a varying spectrum of both cutaneous and systemic signs.

► **Dermatological.**

COMMONLY OBSERVED	LESS COMMONLY OBSERVED
<ul style="list-style-type: none"> • Hair loss (alopecia) mainly affecting the trunk, mostly bilateral. • Head and legs are usually unaffected. • Regrowth of hair reduced or absent following clipping. • Decreased thickness and elasticity of the skin. • Telangiectasis, prominent blood vessels. • Comedones. • Dry skin. 	<ul style="list-style-type: none"> • Easy epilation of hairs. • Secondary infection and/or colonisation of the skin by bacteria and/or <i>Malassezia</i> with or without pruritus. • Demodicosis. • Calcinosis cutis, often with focal inflammation and pruritus more common in iatrogenic Cushing's syndrome (ICS). • Hyperpigmentation.



Courtesy of: P. Jasmin



Closed comedone. Ex. endocrine disorders...
Courtesy of: P. Jasmin



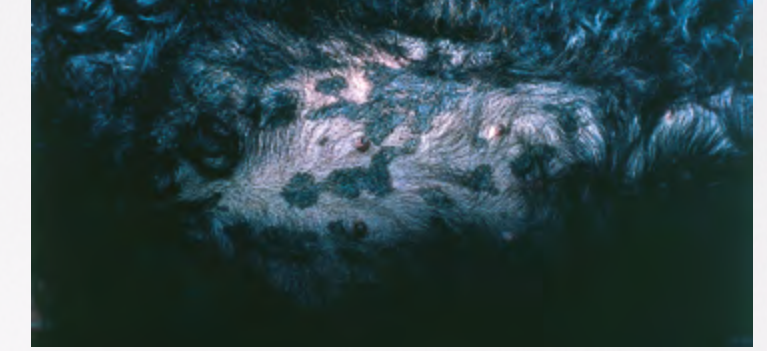
Close view of the skin of a dog affected by SCS with skin atrophy and telangiectasis.
Courtesy of: D.N. Carlotti



Close view of the skin of a dog affected by ICS with skin atrophy.
Courtesy of: T. Olivry



Close view of the skin of a dog affected by SCS with hyperpigmentation, comedones and pustules (secondary pyoderma).
Courtesy of: H. Koch



Close view of the skin of a dog affected by SCS with hyperpigmentation and calcinosis.
Courtesy of: P. Jasmin

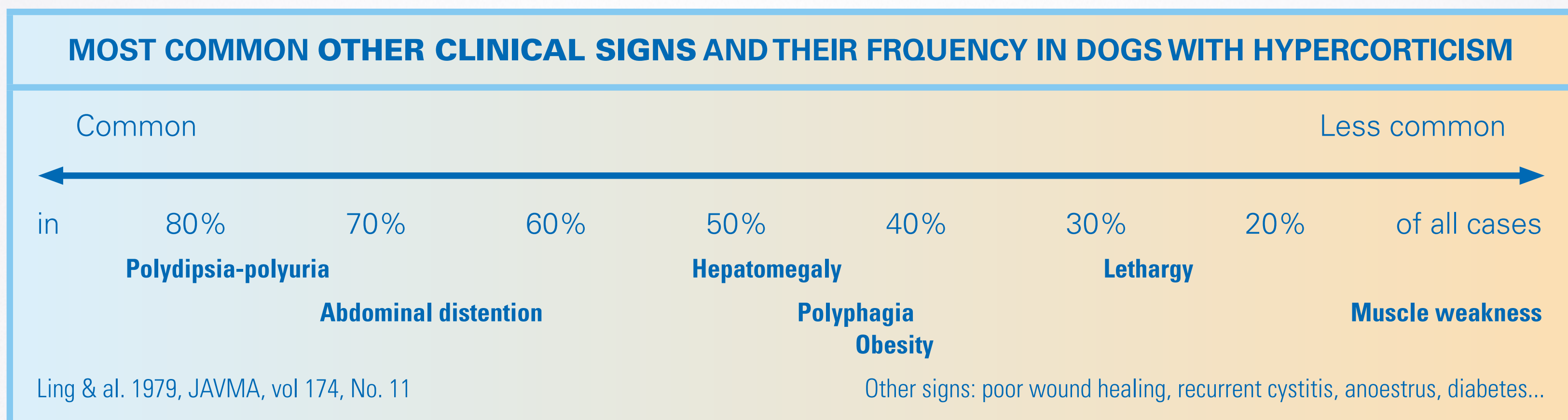
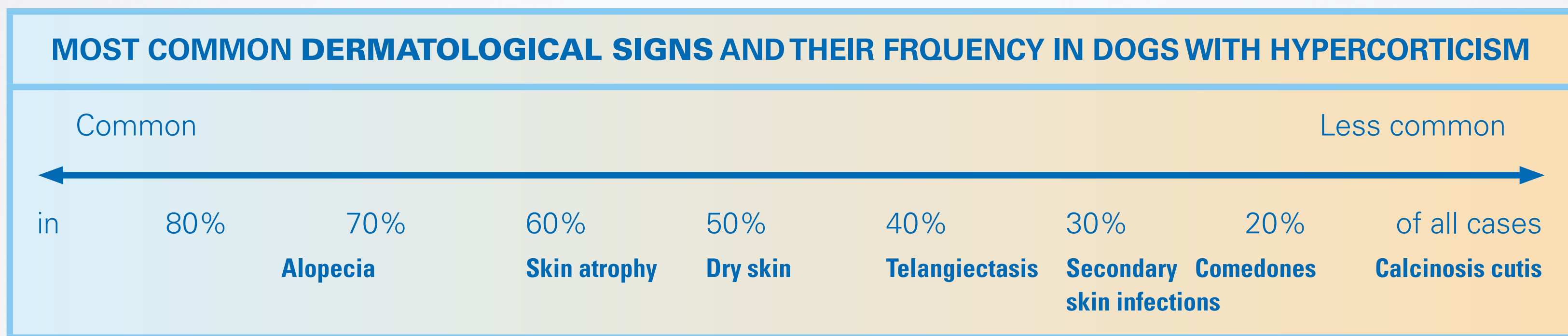


ICS (calcinosis cutis). Courtesy of: T. Olivry.

Non dermatological signs.

COMMONLY OBSERVED	LESS COMMONLY OBSERVED
<ul style="list-style-type: none"> • Polydipsia / polyuria. • Polyphagia • Increased lipogenesis leading to obesity, abdominal enlargement, hepatomegaly. • Panting, exercise intolerance. • Muscle weakness and atrophy (particularly involving the temporal and gastrocnemius muscles). • Anoestrus. • Calcification, particularly of blood vessels, lung and adrenal glands. • Poor wound healing. • Tendency to corneal ulcers. 	<ul style="list-style-type: none"> • (Recurrent) urinary tract infections (cystitis). • Acute pancreatitis. • Pulmonary embolism. • Testicular atrophy, aspermatogenesis. • Prolonged intervals between oestrus cycles. • Congestive heart failure. • Glycosuria, diabetes mellitus ("steroid diabetes"), often insulin resistant.

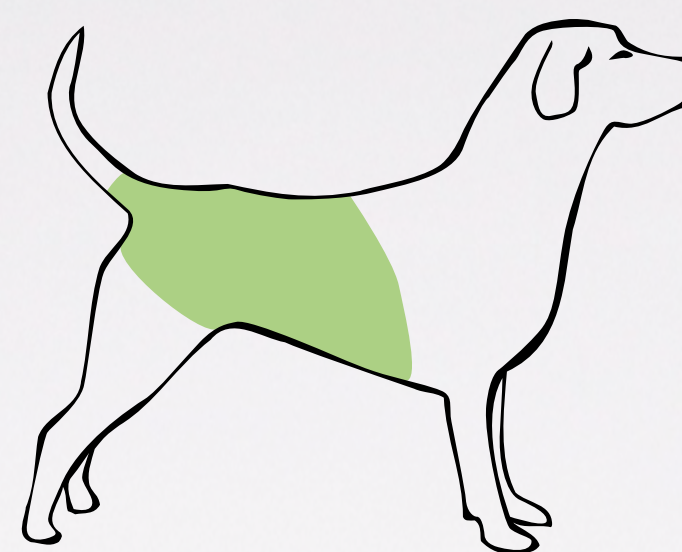
Clinical signs frequency summary.



DIAGNOSIS

History.

It is very important to obtain accurate details of all corticosteroid preparations administered to assist in the distinction between spontaneous and iatrogenic Cushing's syndrome. The diagnosis of the latter may be possible without recourse to exhaustive tests, but just based upon the history and clinical signs.



HISTORY SHEET

Owner: _____ Date: _____
 Dog's name: _____ Sex: _____ Age: _____
 Breed: _____ Weight: _____

GENERAL HISTORY

7/ Unrelated previous dermatoses: _____
 8/ Current non skin-related problems: _____

9/ Chief complaint: _____
 10/ Date of onset: _____
 11/ Previous, severity and time of onset (before or after lesions): _____
 12/ Specific clinical signs and related behaviour: _____
 • Itching of feet (licking, chewing): _____
 • Itching of head, face, ears, periorbital area (scratching, rubbing): _____
 • Otitis, itching of ear pinnae (scratching, shaking): _____
 • Itching of anogenital area (licking, biting and chewing): _____

5/ First cutaneous lesions observed and their development: _____

11/ Previous treatments (date, products, dosage, duration) and responses: _____

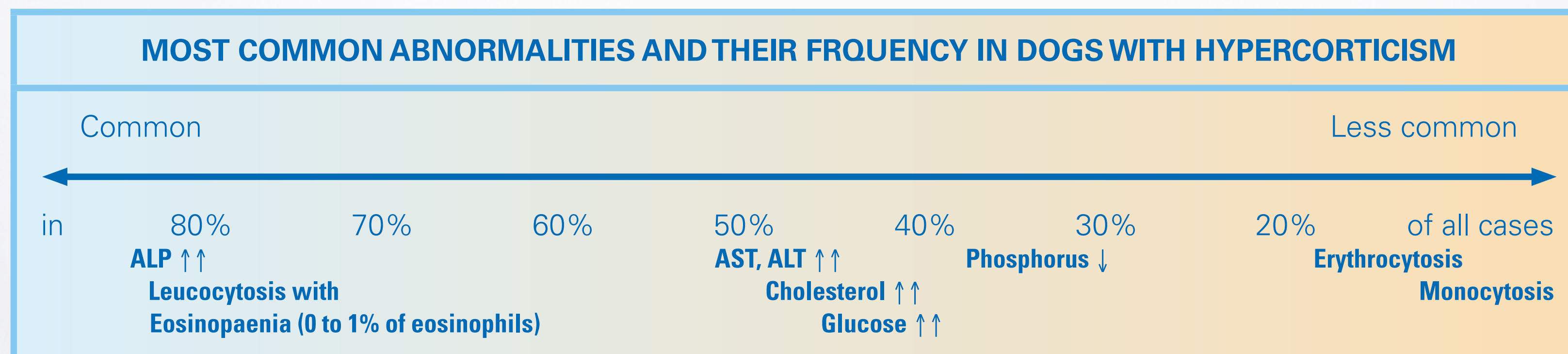
Clinical signs.

Very variable, see previous paragraphs.

Diagnostic tests:

- **Haematology and blood chemistry: may be a useful first indicator in the differential diagnosis of endocrine disorders** alongside differential blood cell counts (especially lymphocytes, **eosinophils**), **cholesterol, ALP (very common), AP, AST, ALT, glucose** and **basal free T4**.
- **Hormone assays and function tests.**
- Also helpful in some cases:
 - **Diagnostic imaging: X ray**, ultrasonography, computertomography, NMR (Nuclear Magnetic Resonance).
 - **Skin biopsies.**

Haematology / Blood chemistry.



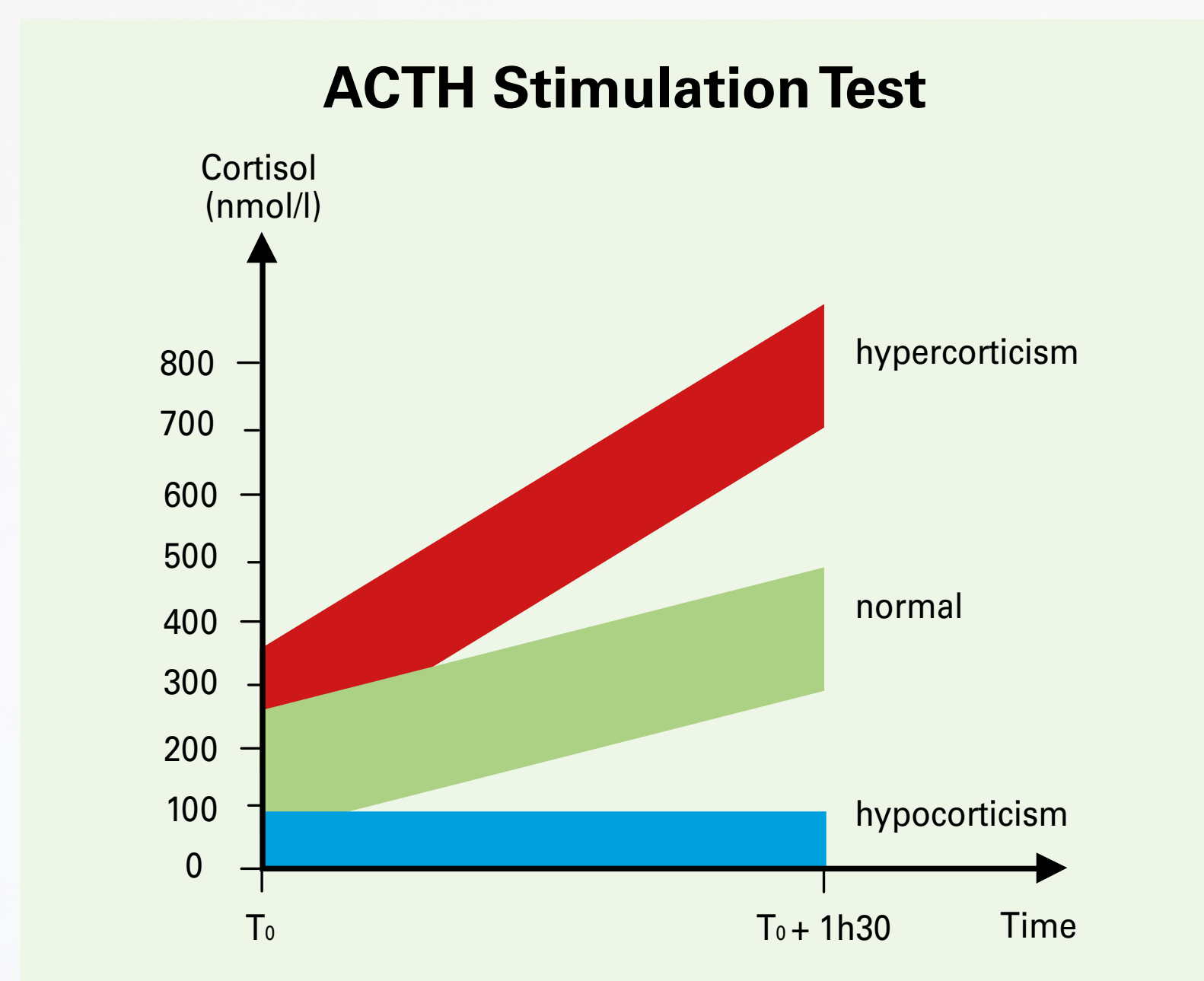
- Classically, dogs with Cushing's syndrome, from whatever cause, show a leucocytosis, lymphopenia, **eosinopenia**, a markedly **elevated ALP**, and **moderately elevated AST, ALT, cholesterol and glucose**.
- Such tests are used for a **first screening although they do not enable a definitive diagnosis**.
- **Low free T4 serum levels do not necessarily indicate hypothyroidism in patients with Cushing's disease. They may just be a secondary effect caused by elevated cortisol levels (euthyroid sick syndrome).**

Hormone assays and function tests.

- **Please note:**
 - For the **evaluation of cortisol** serum or plasma levels the blood needs to be **centrifuged within 30 minutes** after collection.
 - Serum, plasma and urine samples for the evaluation of cortisol levels need to be **kept in the refrigerator** until mailing.
 - Serum samples for the **evaluation of ACTH** need to be **shipped on dry ice to the laboratory immediately after collection**.
- **Procedures are given below but also follow any procedures recommended by your own laboratory.**

ACTH stimulation test.

- First test in case of **high suspicion of ICS** or to eliminate the hypothesis before investigating a SCS.
- **Test principle: cortisol determination** immediately **before and** after stimulation with **ACTH**.
- **Indication:** evaluation of the adrenocortical reserve in cases of suspected iatrogenic hypercorticism (ICS), in cases of suspected spontaneous hyperadrenocorticism (SCS) and also in cases of suspected hypoadrenocorticism.
- **Performance:** a fasting blood sample is taken in the morning, immediately before and 90 minutes after the **intravenous injection** of **0.25 mg synthetic ACTH**.
- **Interpretation:**
 - **ICS and hypoadrenocorticism: cortisol basal level normal or low normal** (1-6 µg/dl / 27-160 nmol/l) only mild or **no increase after stimulation**.
 - **SCS: variable, but sometimes high cortisol basal level** (10 µg/dl / 270 nmol/l) or more than **3 times higher** than basal level **after stimulation and reaching > 20 µg/dl (550 nmol/l)**.



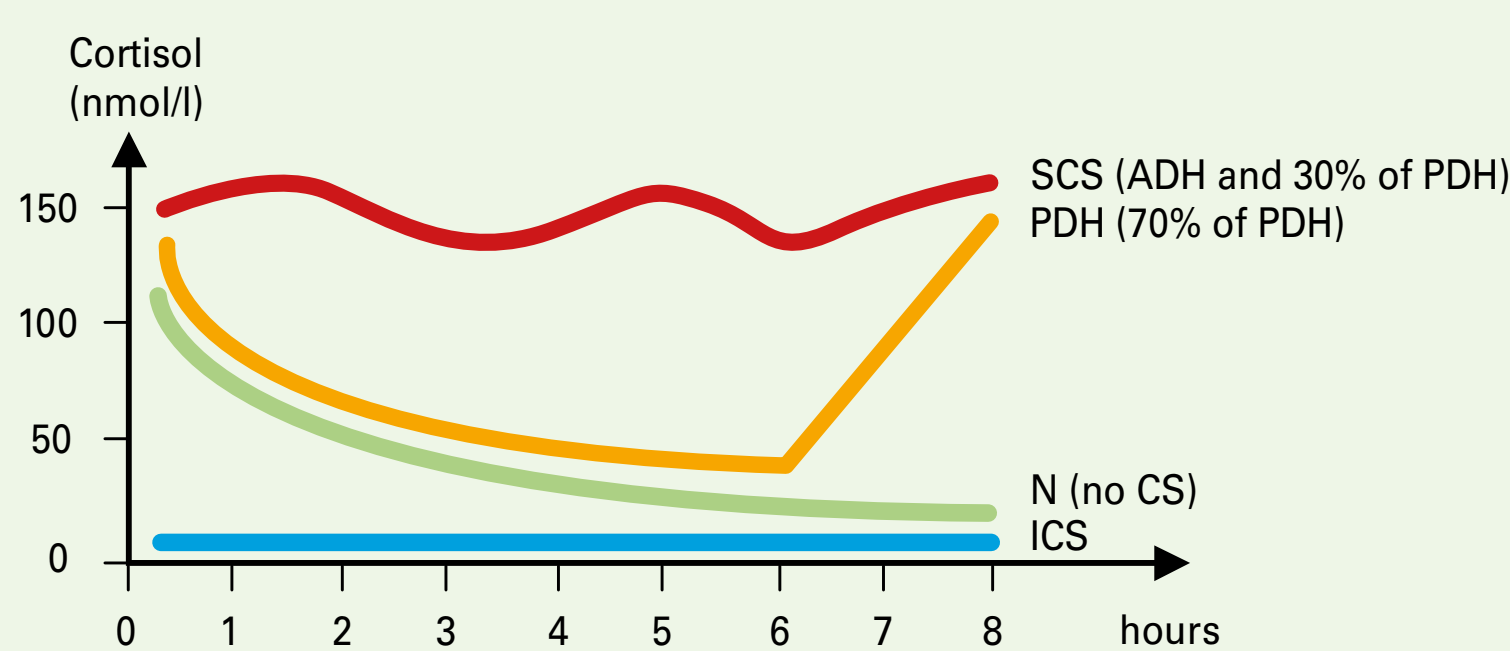
Determination of Urinary Cortisol Creatinine Ratio (UCCR).

- **This test is a good first screening test in case of low suspicion and to eliminate an hypothesis.**
- **It is also easier to conduct, as the samples are taken "at home" by the owner.**
- **UCCR has a high negative predictive value (NPV) for SCS:**
 - If the ratio is low, it is very unlikely that the dog is affected.
 - The hypothesis may then be excluded.
 - The positive predictive value (PPV) is lower (very low in case of ICS). A high UCCR may be due to endogenous cortisol secretion due to stress of the animal. To increase this PPV, tell the owner to try to avoid any stress of the dog.
 - If the ratio is high, to confirm the diagnosis, a dexamethasone suppression test should then be performed.
- **UCCR has also a high negative predictive value (NPV) for ICS:**
 - **If the ratio is high, it is very unlikely that the dog is affected.**
 - The **hypothesis** may then be **excluded**.
 - If the ratio is low, to confirm the diagnosis, the ACTH stimulation test should then be performed.
 - The ratio is derived by dividing the urine cortisol level in nmol/l by the creatinine level in nmol/l. Reported reference ranges vary between laboratories, with a normal value ranging from < 10 x10⁻⁶ to < 60 x10⁻⁶ and so your individual laboratory should be consulted for interpretation.

Low Dose Dexamethasone Suppression Test (LDDST).

- **Test principle:** cortisol determination in the blood before and some time after the administration of a **low dose of exogenous corticosteroids**. In healthy dogs the **negative feedback** mechanism causes a **decrease in ACTH secretion** and thus a **suppression of cortisol production** ($< 1\mu\text{g/dl}$ or 27 nmol/l) after 3 or 4 hours and 8 hours.
- **Indication:** suspicion of **spontaneous hyperadrenocorticism (SCS)**.
- **Procedure:** blood is taken in the morning immediately before and, 3-4 and 8 hours after the i.v. injection of **0.01 mg/kg dexamethasone**.
- **Interpretation:** in dogs with **hyperadrenocorticism, levels either remain high or are suppressed after 4 hours and then increased again after 8 hours**.
 - If the **value at 4 hours** is at least **50% lower** than the basal one **and increases again after 8 hours, PDH is very likely**.
 - If **levels remain high**, it **indicates a SCS** and more likely an adrenal tumour but it may be a dexamethasone-resistant pituitary tumour (often macroadenoma of the pars intermedia which is under dopamine control). Then a HDDST or ACTH measurement will permit differentiation between PDH and ADH.

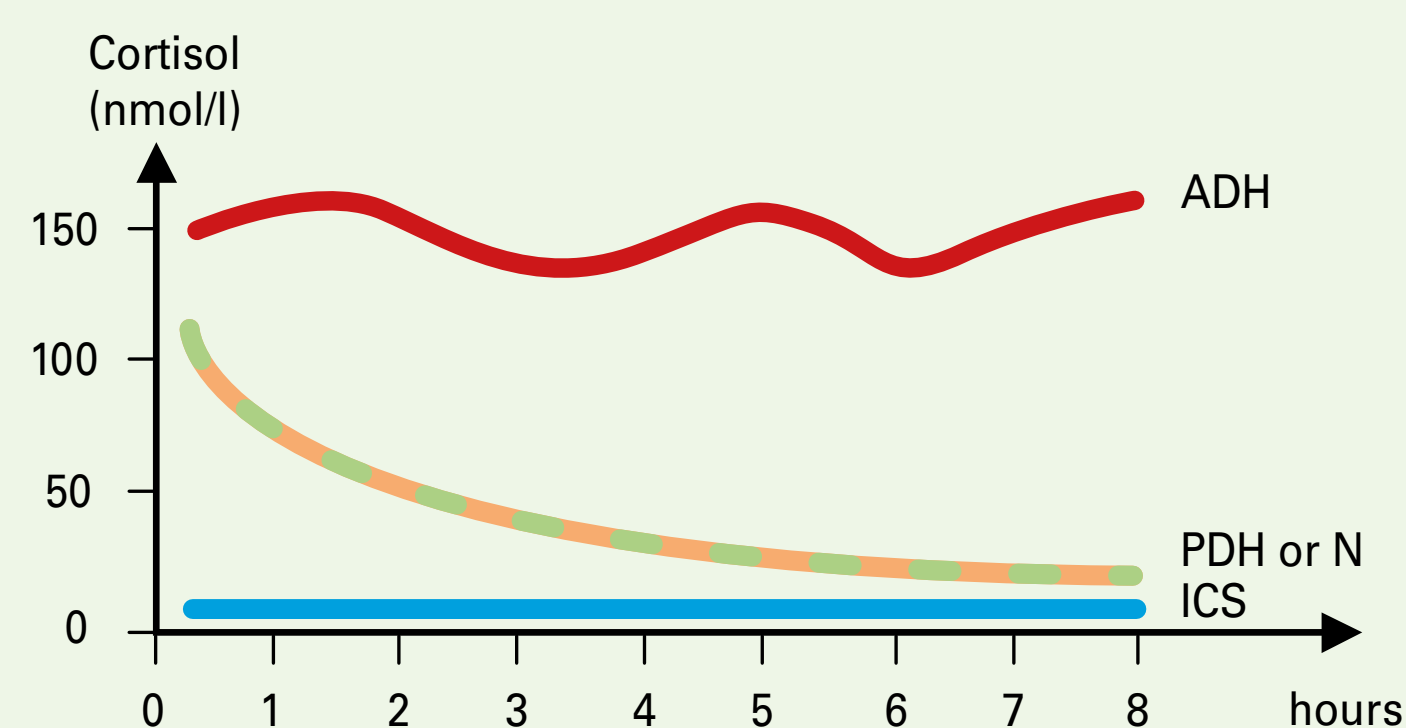
LDDST (dexamethasone I.V. = 0.01 mg/kg)



High Dose Dexamethasone Suppression Test (HDDST).

- **Test principle:** cortisol determination in the blood immediately before and after the administration of a high dose of dexamethasone. The ACTH production in dogs with PDH can be suppressed by high doses of a potent exogenous corticosteroids, leading to a decreased cortisol production. In adrenal adenomas or adenocarcinomas the **autonomous hypersecretion of cortisol** is **not influenced by high doses** of exogenous corticosteroids.
- **Indication:** suspicion of adrenal hyperadrenocorticism (**ADH**).
- **Performance:** blood is taken in the morning immediately before and 4 hours and 8 hours after the **intravenous injection of 0.1 mg/kg dexamethasone**.
- **Interpretation:**
 - If **no suppression, ADH is very likely**.
 - Suppression of 50% or more from basal cortisol at sample 2 and 3 may indicate a pituitary tumour (PDH).
 - Definitive **confirmation of the diagnosis** can be achieved by **ACTH measurement**, which will be **low in adrenal tumors**, or by ultrasonography of the adrenal glands and computed tomography of the pituitary.

HDDST (dexamethasone I.V. = 0.1 mg/kg)



UCCR with HDDST.

- **Indication: suspicion of spontaneous hyperadrenocorticism.**
- This test is done on **3 consecutive days** and should be performed **at home since the stress** of hospitalisation **can influence the results.**
- **Test principle: cortisol determination in urine**, twice before and once after the administration of a **high dose of exogenous corticosteroids.**
- **Performance:** the first (fasting!) **urine in the morning is collected** at day 1 and 2 and kept cool. After the second sample is taken, 0.1 mg/kg dexamethasone is given orally every 8 hours. On day 3 the first morning urine is collected and the samples mailed to the laboratory to determine the **Cortisol/Creatinine (C/C) ratio.**
- **This procedure** also gives information about the origin of hyperadrenocorticism, **pituitary or adrenal (PDH or ADH)** because it combines a test for basal adrenocortical function and a dynamic test for the differentiation between primary and secondary hyperadrenocorticism.
- **Interpretation (the values given below are for illustration – be sure to obtain normal values from your laboratory):**
 - **Day 1 and 2**
 - » Hyperadrenocorticism: C/C ratio $> 25 \times 10^{-6}$
 - » Normadrenocorticism: C/C ratio $< 15 \times 10^{-6}$
 - » Questionable: C/C ratio $15-25 \times 10^{-6}$
 - **Day 3 (in addition to increased C/C ratio on samples 1 and 2)**
 - » **ADH or dexamethasone resistant PDH:** C/C ratio of **sample 3, less than 50% lower** than mean of samples 1 and 2.
 - » **PDH:** C/C ratio of **sample 3, more than 50% lower** than mean of samples 1 and 2.

Measurement of endogenous ACTH.

- **Very useful** but **no routine** laboratory test.
- **Ask a specialist** how and where to perform this test.
- The endogenous ACTH levels allow the differentiation between PDH and ADH:
 - > 120 pg/ml: PDH
 - < 30 pg/ml: ADH

Summary: diagnosis of Cushing's Syndrome (CS) iatrogenic (ICS) and spontaneous (SCS).

HAEMATOLOGY / BLOOD CHEMISTRY

Always consider haematology and blood chemistry tests first, in the differential diagnosis of endocrine disorders.

FIRST SCREENING HORMONAL TESTS

If, high suspicion of ICS due to history, **or**, no precise idea if **ICS or SCS**:

- **ACTH stimulation test**, then diagnosis of ICS or investigation of SCS.

If, no precise idea if **ICS or SCS** and wish of surely eliminating ICS or SCS:

- Determination of UCCR, then investigation of ICS or SCS.

SECOND STEP HORMONAL TESTS

If, hypothesis of **ICS** excluded, **and**, suspicion of **SCS** due to history, clinical signs and first screening laboratory tests:

- **To exclude the hypothesis** (low suspicion), choose a test with a high NPV:
 - Urinary Cortisol Creatinine Ratio (**UCCR**) alone.
- **To confirm the hypothesis** (high suspicion), choose a test with a high PPV:
 - Low Dose Dexamethasone Suppression Test (**LDDST**).
 - Urinary Cortisol Creatinine Ratio (**UCCR**) with High Dose Dexamethasone Suppression Test (**HDDST**) orally.
- **To precisely differentiate between PDH and ADH:**
 - study the results of low dose dexamethasone suppression test (**LDDST**),
 - and/or High Dose Dexamethasone Suppression Test (**HDDST**) I.V.,
 - and/or **measurement** of endogenous **ACTH**,
 - and/or **diagnostic imaging**.

- **Schematic representation of the diagnostic possibilities depending on hypotheses and chosen tests.**

Legends

Affections:

N = Normal dog
 CS = Cushing's Syndrome (hypercorticism)
 ICS = Iatrogenic Cushing's Syndrome
 SCS = Spontaneous Cushing's Syndrome
 PDH = Pituitary Dependant Hyperadrenocorticism
 ADH = Adrenal Dependant Hyperadrenocorticism

Hypotheses

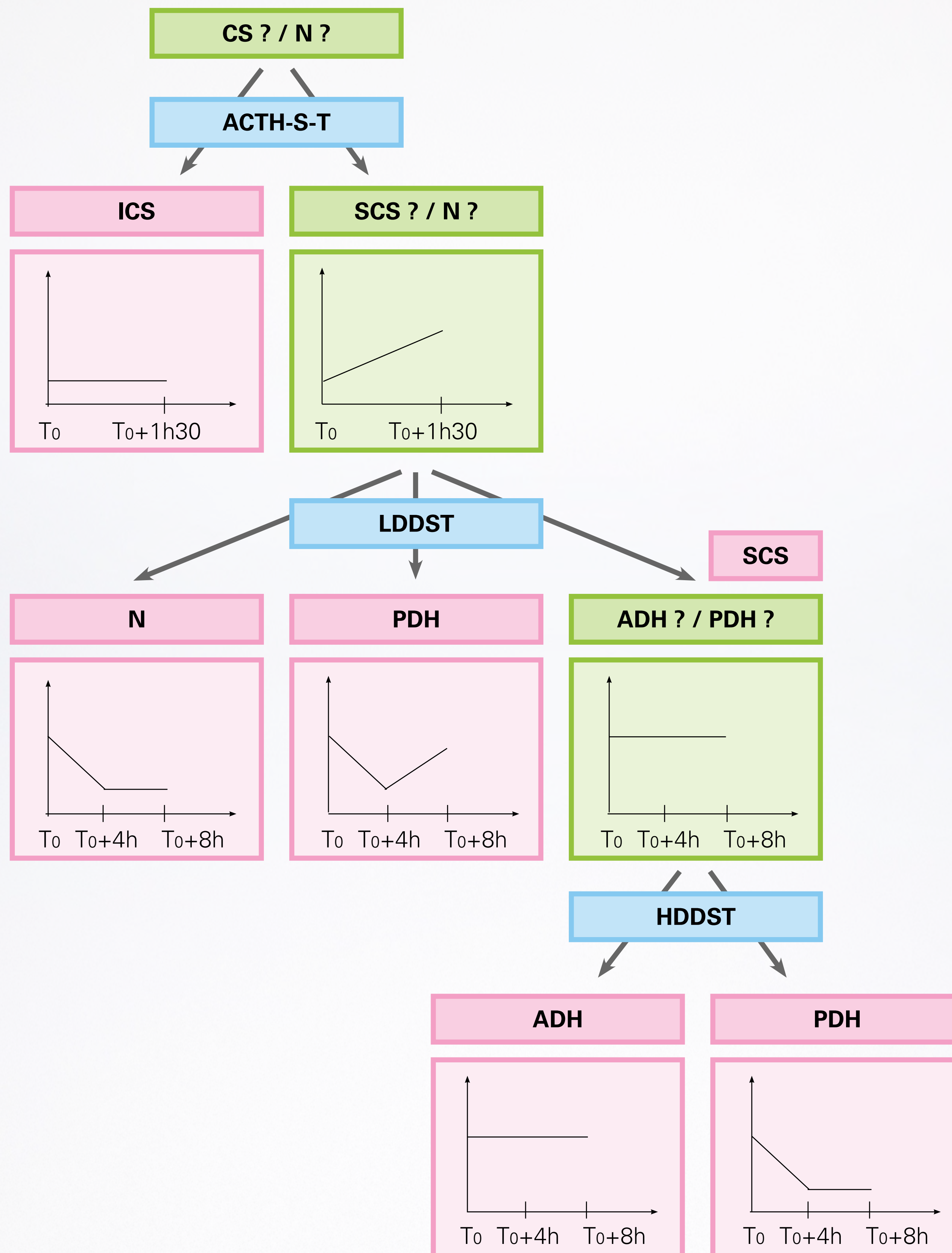
Confirmed hypotheses

Eliminated hypotheses

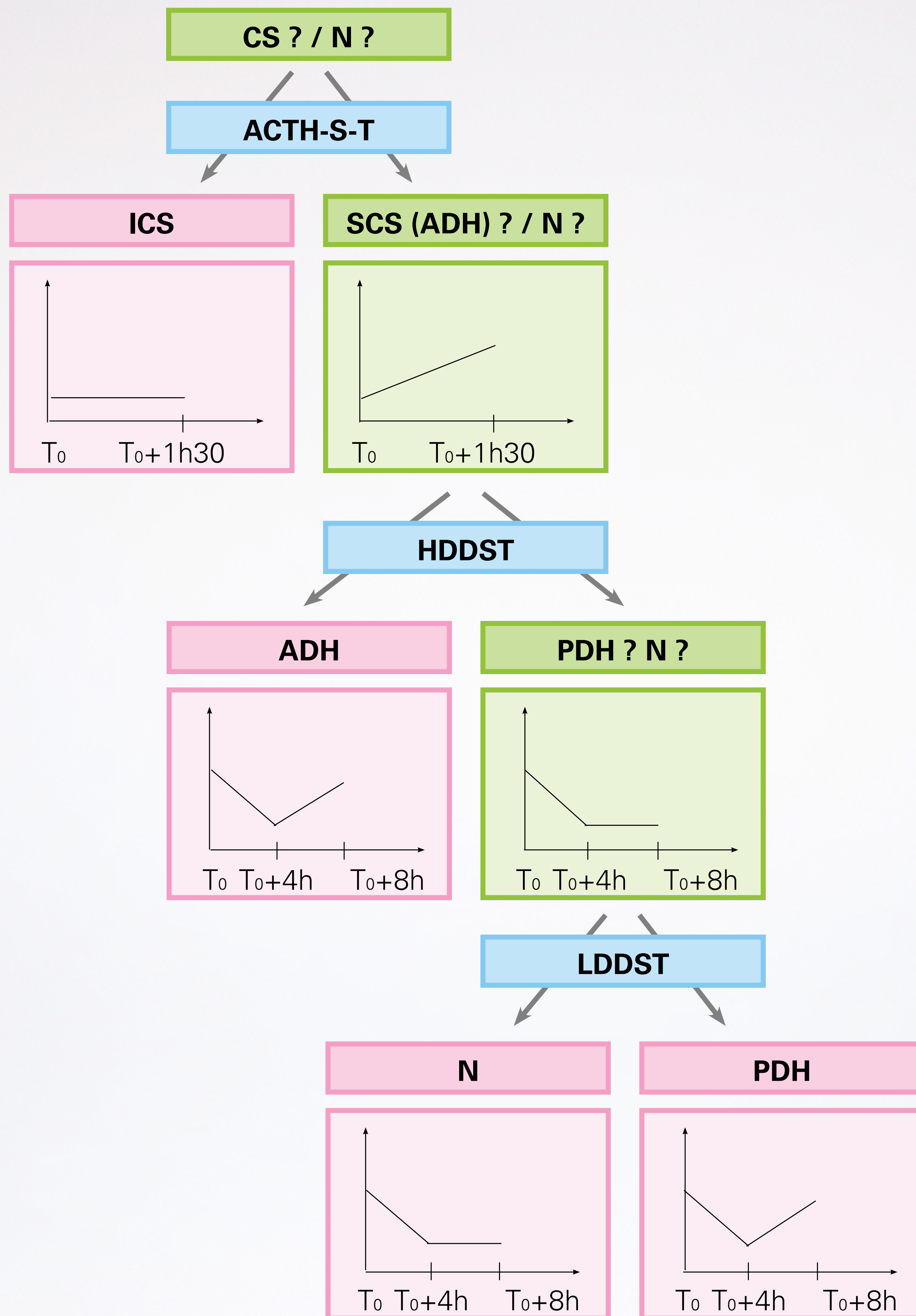
Tests :

LDDST = Low Dose Dexamethasone Suppression Test
 HDDST = High Dose Dexamethasone Suppression Test
 UCCR = Determination of Urinary Cortisol Creatinine Ratio
 ACTH-S-T = ACTH Stimulation Test

ACTH-S-T, LDDST and HDDST



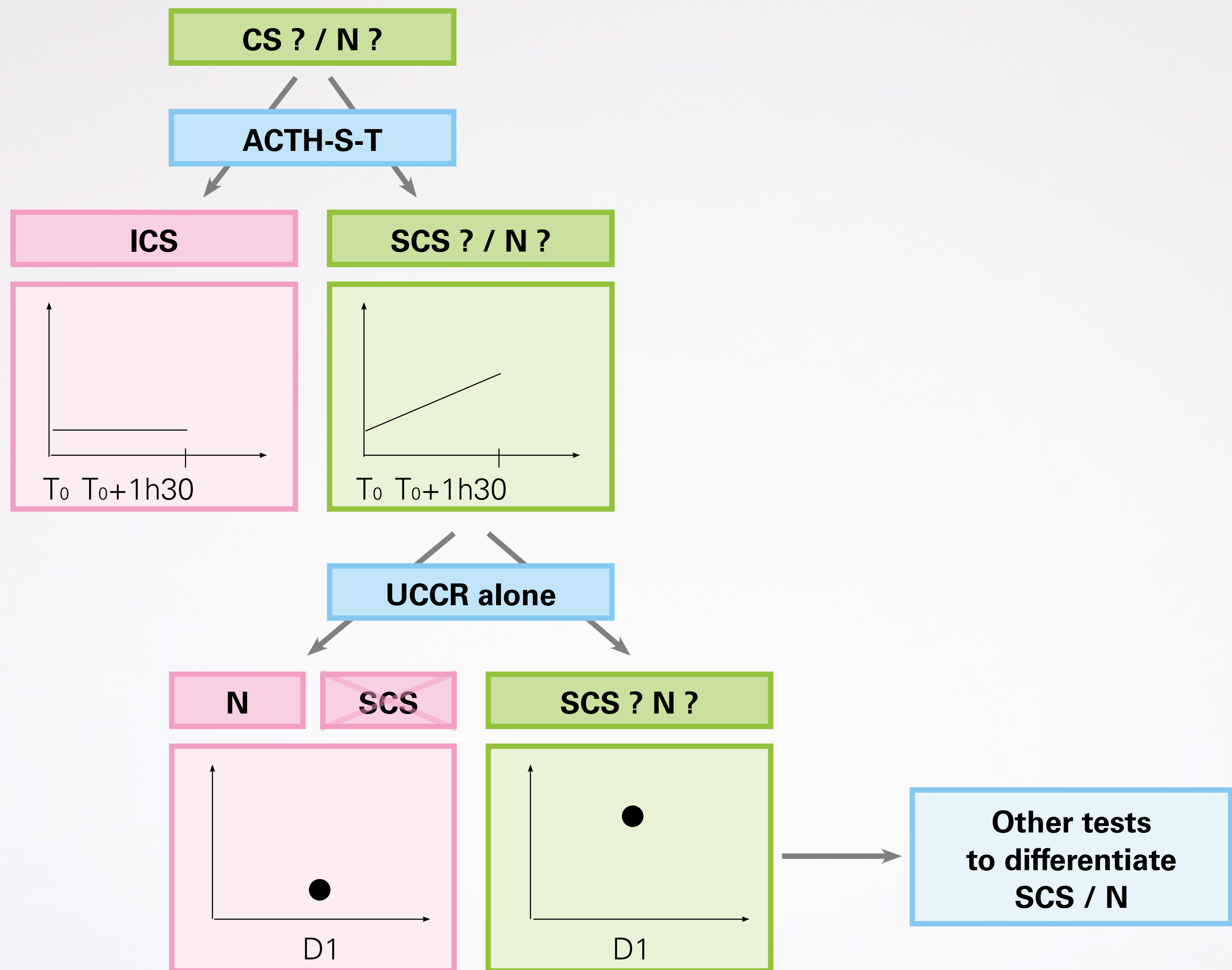
ACTH-S-T, HDDST and LDDST



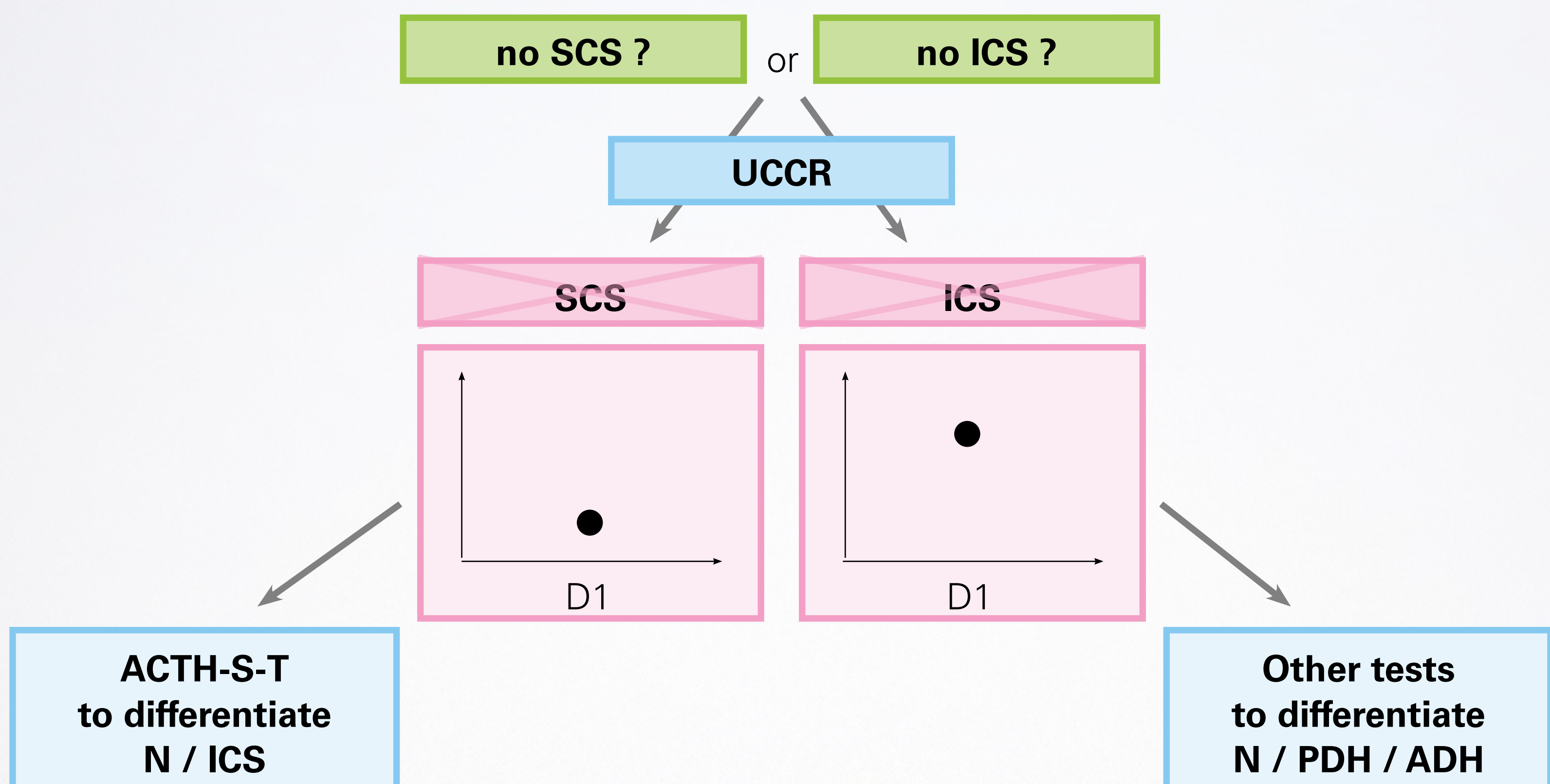
UCCR with HDDST orally

Do not forget the use of UCCR + HDDST orally which provides useful information and is easier to conduct (no need for hospitalisation) compared to other tests using blood samples.

ACTH-S-T, and UCCR alone



UCCR as a first screening test



TREATMENT

▶ PDH

▶ **Hypophysectomy.**

- This therapeutic procedure is **directed against the primary lesion in PDH** and leads to the **complete destruction of the pituitary gland**.
- Today, computer tomography or MRI (Magnetic Resonance Imaging) is recommended before surgery to allow accurate determination of the size and localisation of the gland.
- The trans-sphenoidal microsurgical hypophysectomy technique should only be performed by an **experienced surgeon**.
- In PDH, surgery shows a lower recurrence rate than the conservative (medical) therapy.
- **Diabetes insipidus**, permanent central or secondary **hypothyroidism** and **keratoconjunctivitis sicca** are the most common **sequelae** and **must be controlled periodically**.
- A **lifelong L-thyroxine replacement therapy** is mandatory.

▶ **Chemical destruction of the adrenal cortices with o,p'DDD.**

- **There are two main protocols – one aims to selectively destroy the adrenal cortex whilst sparing the mineralocorticoid-producing zona glomerulosa. Complete destruction of the cortex does not result, and the therapy is maintained using interval dosing. The second seeks to non-selectively destroy the three layers of the cortex, and life-long supplementation is required. In neither case is there any effect on the pituitary pathology, and in fact any pituitary adenoma may actually enlarge due to lack of negative feedback.**
- **Selective destruction:**
 - Induction phase: 25 mg/kg SID for 7-10 days.
 - Maintenance dosage: 25 mg/kg SID once every 7-10 days.
 - The substitution with low doses of prednisolone (0.25 mg/kg) on the days of o,p'DDD application helps to prevent the risk of hypoadrenocorticism with Addisonian crisis which is the most common side effect of this therapy.
 - **ACTH stimulation tests are recommended** at the end of the induction phase and periodically during the maintenance phase. Ideally, the resting level should be between 1.0 and 3 µg/dl (27-80 nmol/l), and the stimulated level should be between 3.0 and 5.0 µg/dl (80-135 nmol/l).
 - **The treatment regime needs to be adapted individually** due to variations in the response to therapy. For this purpose **the owner needs to observe abnormalities** in his dog's normal behaviour, particularly during the first two or three weeks of therapy.
 - With any medical treatment, deficiency of glucocorticoids (lethargy, anorexia) or mineralocorticoids (Addisonian crisis) are possible complications.
 - If PU/PD is observed and persists after more than 10 days of therapy the daily dosage of o,p'DDD may still be too low to achieve a therapeutic effect. Normal consumption of water is about 20 ml/kg/d.
 - Signs of an Addisonian crisis include apathy, weakness, vomiting, trembling, diarrhoea, collapse, elevated numbers of lymphocytes, low glucose and elevated urea, creatinine and total protein serum levels, serum Na:K ratio less than 24:1 (normal 33:1), ECG: spiked T wave, flat P wave and prolonged Q-T interval.
- **Non-selective destruction:**

The following **treatment schedule** is **more aggressive** and aims at the complete quick destruction of both adrenal cortices and lifetime substitution therapy for the iatrogenic adrenocortical insufficiency:

 - 50-75 mg/kg o,p'DDD daily for 25 days, divided in 3-4 doses, with food.
 - On the third day supplementation begins:
 - » Cortisone, 2 mg/kg daily.
 - » Fludrocortisone, 0.0125 mg/kg daily.
 - » Sodium chloride, 0.1 mg/kg daily.
 - » All doses are divided into 2-3 administrations.
 - » After 25-30 days, the cortisone is reduced to 0.5-1 mg/kg daily and fludrocortisone and/or salt are adjusted to the needs depending on the results of measurements of Na and K plasma levels. This regimen has a lower incidence of relapses (30%) compared with the "classic" schedule. For all types of therapy, good owner compliance is mandatory. He/she must be well informed about the pathogenesis of the disease, possible side effects of the treatment, re-examinations and costs. Written instructions are highly recommended.
 - Since the primary lesion in the pituitary gland is not affected by these therapies, the relapse rate is high (more than 50%) and the risk of tumour growth is not reduced.

► **Inhibition of cortisol production.**

• **Trilostane:**

- Trilostane competitively inhibits the enzyme 3-beta-hydroxysteroid-dehydrogenase which processes the conversion of pregnenolone to progesterone, reducing steroid hormone levels.
- This is the first choice for treatment of PDH and the only licensed drug in Europe and the USA.
- Published data shows that response rates are as good or better than those with o,p'DDD, with mean survival rates of 930 days.
- Unlike o,p'DDD, trilostane is usually given daily for life, although some 5-10% of cases appear to be "cured" after 1-2 years, and therapy can be withdrawn.
- Various treatment protocols with trilostane exist. At the present time a twice daily administration is recommended.
- The dose necessary to effect control varies widely, and on a per/kg basis is much higher in small dogs than large breeds.
- The dosage of 6 mg/kg/day, divided twice daily is a usual starting dose which may result in a resolution of clinical signs and routine laboratory abnormalities.
- Some dogs may need higher dosages to achieve good response.
- Monitoring should consist of: clinical evaluation, assessment of water intake, and ACTH stimulation tests should be undertaken at 7, 28 and 56 days to assess the response. Similarly to treatment with o,p'DDD, well-controlled animals have a basal cortisol of 1-3 µg/dl (< 27-80 nmol/l) which stimulates to around 3-5 µg/dl (80-135 nmol/l). A resting value of < 1 µg/dl and/or lack of adequate stimulation indicates excessive suppression, and the dosage should be reduced. As the duration of effect of trilostane is considerably less than 24 hours, the test should be performed 2-4 hours after administration at which time it will show peak activity.
- Monitoring by measuring urinary cortisol/creatinine ratios is not reliable.

• **Ketoconazole:**

- Ketoconazole inhibits the production of cortisol by the adrenal glands. This effect is reversible. The recommended dose is 10 mg/kg daily per os, divided in 2-3 doses.
- As ketoconazole has multiple side effects, the patients must be re-examined in short intervals, particularly at the beginning of the therapy. Liver parameters need to be monitored closely (every 2-4 weeks) due to the hepatotoxicity of this drug.
- The first ACTH stimulation test for the control of cortisol production by the adrenal glands is recommended after 3-4 weeks of therapy and then depending on the course.
- Ketoconazole is less effective than trilostane or o,p'DDD.

► **ADH**

- The **therapy of choice** for ADH is the **adrenalectomy of the affected gland**. It is imperative to supplement with both glucocorticoids and mineralocorticoids during and immediately post surgery, and for up to 10 days afterwards on a gradually reducing dose.
- **If this is not possible** or the tumour is inoperable, **o,p'DDD may be used** at the same therapeutic schedule as described for PDH (50-75 mg/kg daily for 25 days initially and then for at least 3 months once weekly).
- After this time, ultrasonography and X rays are recommended to **re-evaluate the tumour** size and decide about the continuation of the therapy.
- So long as the tumor is not malignant, and there are no secondaries, this approach leads to a complete and permanent cure.

► **Iatrogenic hypercorticism (ICS)**

► **Gradual corticosteroid withdrawal.**

- If the withdrawal is too brisk, a deficiency of either glucocorticoids and/or mineralocorticoids may result where there has been long-term suppression due to exogenous steroid administration. Short-term supplementation may be necessary, and will certainly be required if the patient is subjected to any stressful situations, such as even minor surgery.

Summary

THERAPY OF CUSHING'S SYNDROME

PDH

- Hypophysectomy
- Radiation therapy of pituitary gland or conservative therapy (o,p'DDD, trilostane or ketoconazole)

ADH

- Unilateral adrenalectomy
- Conservative therapy with o,p'DDD

Iatrogenic hypercorticism (ICS)

- Corticosteroid withdrawal

PROGNOSIS

- **Iatrogenic hypercorticism (ICS).**
 - Good in most cases, so long as they are carefully managed.
- **Pituitary-dependent hyperadrenocorticism (PDH).**
 - Very variable response to therapy.
- **Hyperadrenocorticism caused by adrenocortical tumours (ADH).**
 - Excellent if unilateral tumour was removed and no metastasis have occurred.
 - Guarded to poor in other cases.



Dog affected by SCS. Note abdominal enlargement.
Courtesy of: D.N. Carlotti

FOLLOW-UP

- **ICS.**
 - Side effects of complete withdrawal of corticosteroid therapy such as glucocorticoid insufficiency or an **Addisonian crisis are uncommon, but the owner and clinician must be alert for the warning signs.**
 - **It is still helpful to re-examine the animal and to investigate primary diseases camouflaged by the cortisone-therapy:**
 - usually **allergic skin diseases,**
 - ectoparasites infestations...
 - **A thorough workup will be required after cessation of the corticosteroid therapy:**
 - **secondary cutaneous infections** (bacteria and/or yeast), may be more evident upon withdrawal of the corticosteroids,
 - "steroid diabetes" is uncommon
- **SCS.**
 - **Extensive monitoring** of each case is mandatory.



Close view of the skin of a dog affected by SCS with secondary pyoderma.
Courtesy of: D.N. Carlotti

CONCLUSIONS

- **Iatrogenic hypercorticism is frequently observed** due to **abuse of corticosteroids.** In most cases the diagnosis and treatment are uncomplicated. But the diagnosis of the disease for which the corticosteroid therapy was instituted in the first place, such as **allergic skin disease,** must be taken up.
- The **spontaneous types of Cushing's syndrome** are **less common,** are frequently overlooked particularly in early stages and **need extensive tests** to confirm the diagnosis. Several types of treatment exist depending on the type of disease (pituitary dependent or caused by adrenocortical tumours) and depending on the individual animal.
- The outcome depends often also on an early enough diagnosis as well as on the patience of the owner of the animal and her/his ability to co-operate. Many dogs' lives can be prolonged or saved.

HYPOTHYROIDISM

INTRODUCTION / DEFINITION

- ▶ A disease syndrome caused by **insufficient production of thyroid hormone** and leading to a wide variety of clinical signs. Classically, there is **lethargy, weight gain** and **alopecia**. **Secondary skin infections** often occur.
- ▶ **Hypothyroidism in dogs is not uncommon.**
- ▶ “**False positive**” laboratory test **results** are **common**, especially in case of concurrent chronic and inflammatory diseases, and may reflect **euthyroid sick syndrome**.

AETIOLOGY / PATHOGENESIS

▶ **Aetiology.**

- **Primary hypothyroidism.** Nearly all cases (over 90%) are caused by naturally occurring disease. The principal causes are lymphocytic thyroiditis, an immune-mediated disease associated with infiltration into the thyroid gland of lymphocytes, plasma cells and macrophages, and idiopathic thyroid necrosis and atrophy.
- **Secondary hypothyroidism** is a rare cause of hypothyroidism. It is chiefly associated with pituitary neoplasia and pituitary dwarfism, leading to a deficiency of thyroid stimulating hormone (TSH) and consequent lack of secretion of hormone by the thyroid gland. Suppression of TSH can also be caused by glucocorticoid administration, or other drugs like sulfonamides, or by thyroid supplementation of euthyroid dogs.

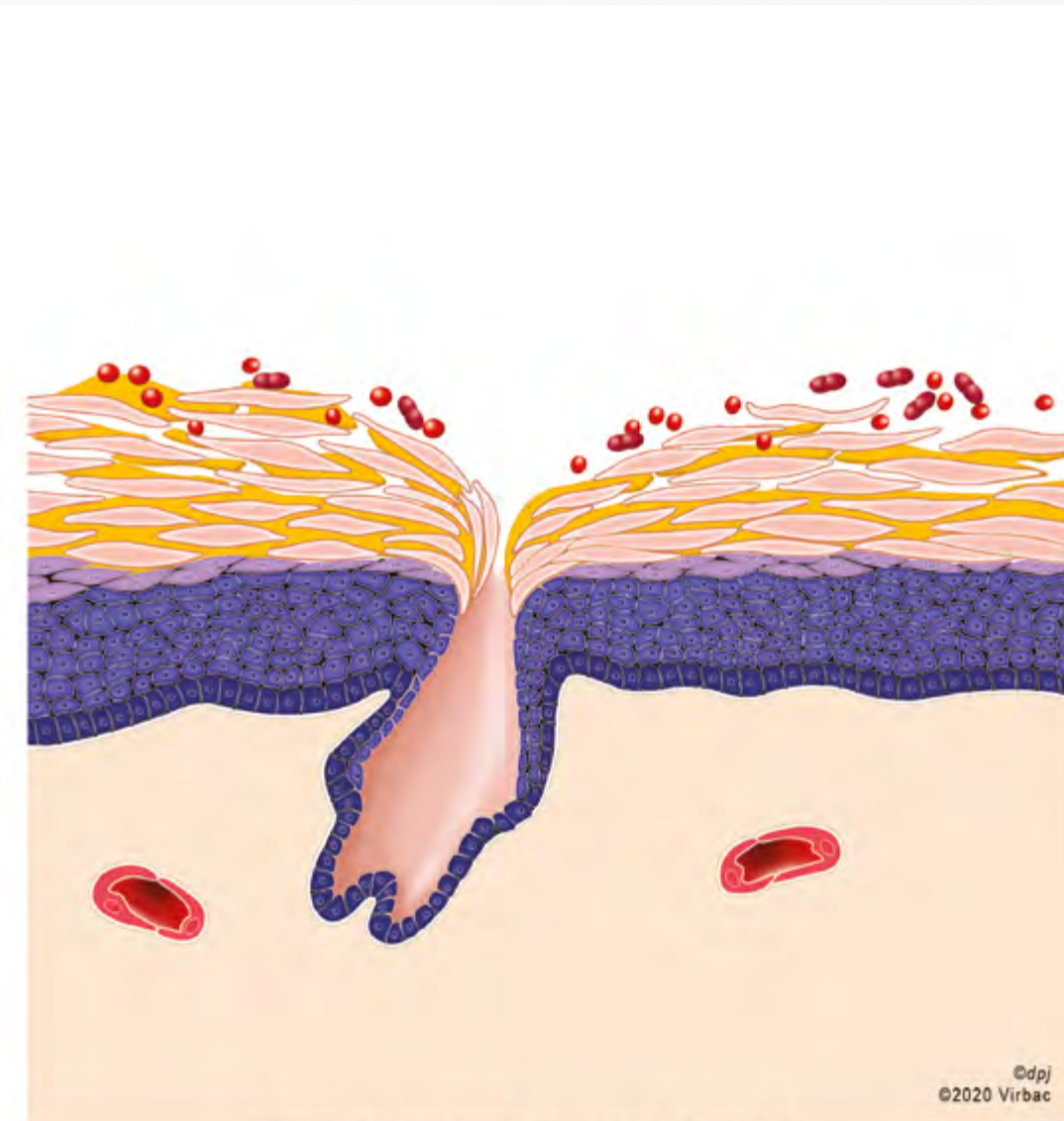
▶ **Pathogenesis.**

- **Overall effects.** The clinical signs of hypothyroidism are a consequence of the lack of circulating thyroid hormones and the effects of this on metabolism in different organs.
- **Effects on the skin.** Thyroid hormone is required for initiation of anagen hair growth. In hypothyroidism, growing hairs proceed to telogen and are shed but lack of replacement by anagen hairs leads to alopecia. In body areas subjected to friction, hair shedding is promoted and hair loss becomes obvious at an earlier stage.
- In contrast to Cushing's disease, there is no hair follicle atrophy, so that there is little spontaneous expulsion of hair shafts. **Alopecia is mostly due to a lack of replacement of hairs and removal by friction.**
- Effects on protein and lipid synthesis commonly lead to dullness of the coat, brittle hairs and severe keratoseborrhoeic disorder (scaling and a dry or greasy skin).



Keratoseborrhoeic disorder - Ex. Hypothyroidism
 ©djp ©2020 Virbac
 ● Staphylococcus pseudintermedius ● Malassezia pachydermatis

Courtesy of: P. Jasmin



Keratoseborrhoeic disorder with alopecia - Ex. Hypothyroidism
 ©djp ©2020 Virbac
 ● Staphylococcus pseudintermedius ● Malassezia pachydermatis

Courtesy of: P. Jasmin

EPIDEMIOLOGY

- **Congenital hypothyroidism** has been reported in several breeds, including German shepherds, giant schnauzers, Scottish deerhounds, bullmastifs and boxers, and can occur in crossbreeds.
- **Acquired hypothyroidism.** Apparently increased incidence has been reported in Afghan hounds, Airedales, beagles, boxers, Brittany spaniels, chow chows, cocker spaniels, dachshunds, dobermann pinschers, English bulldogs, golden retrievers, great Danes, Irish setters, Irish wolfhounds, Malamutes, miniature schnauzers, Newfoundlands, Pomeranians, poodles and Shetland sheepdogs. Crossbred dogs and German shepherds are believed to be at lower risk. The disease is commoner in dogs aged 6 to 10 but may occur at an earlier age in giant and predisposed breeds. Neutered animals may have an increased predisposition.

CLINICAL SIGNS

- Signs of hypothyroidism are diverse and very variable and affect a variety of organ systems. Those associated with organs other than the skin are listed in the table.

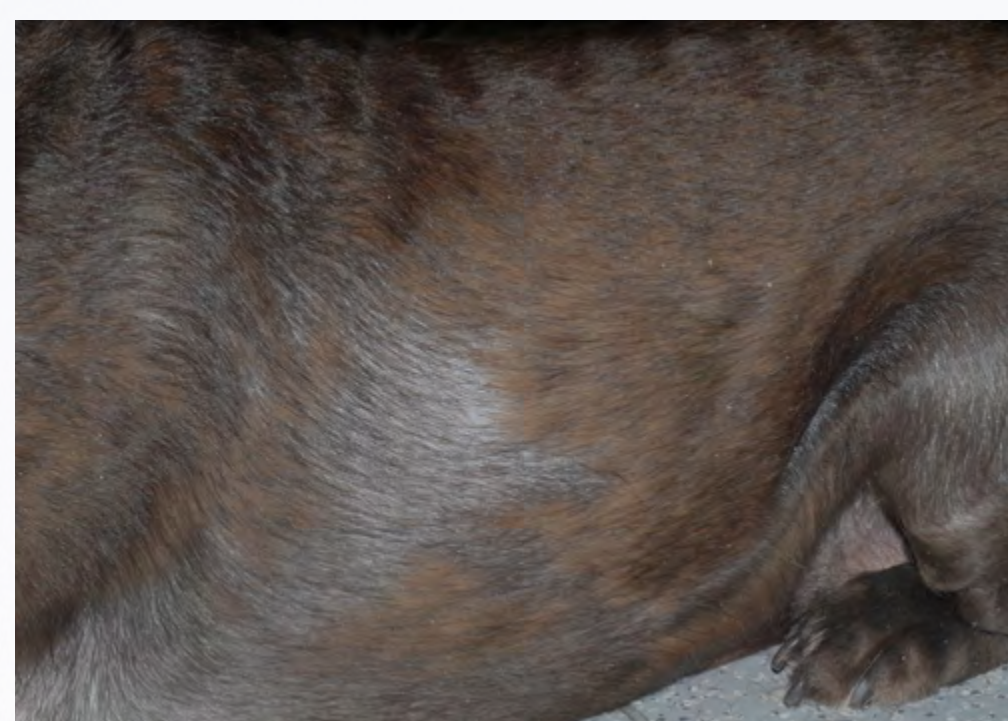
Some clinical signs of hypothyroidism affecting systems other than the skin:

Metabolic	Cardiovascular	Haematological	Ocular	Gastrointestinal	Neuromuscular	Reproductive
Lethargy Mental depression Weight gain Thermophilia	Bradycardia Cardiac arrhythmia	Anæmia Coagulopathy Hyperlipidaemia	Corneal lipid deposition Corneal ulceration Uveitis	Constipation Diarrhoea	Seizure Ataxia Circling Vestibular signs Weakness Facial nerve paralysis	Anoestrus Silent oestrus Prolonged oestral bleeding Testicular atrophy Decreased libido

- **Cutaneous signs of hypothyroidism.** Classically, there is a **bilaterally symmetrical, non-pruritic alopecia** focussed on the **trunk** and tending to first affect **areas subjected to pressure or friction** (flanks, perineum, tail, ventrum etc.) but which may become widespread. **The coat is easily epilated** and tends to be dry and brittle. **Regrowth** either **does not occur or is slow after clipping**. Sometimes lack of hair shedding leads to marked thickening of the coat (**hypertrichosis**) and the retained hairs may become bleached, particularly at the tips of the hairs.
- Commonly there is scaling and the skin surface may be dry or greasy (**seborrhoea**); **hyperpigmentation** may be present. The skin may feel cool and may show myxoedema. Predisposition to bruising, poor healing of skin wounds and excessive scarring may also occur.



Dog affected by hypothyroidism. Courtesy of: T. Olivry



Dog affected by hypothyroidism. Courtesy of: T. Olivry



Dog affected by hypothyroidism. Courtesy of: T. Olivry

- **Cutaneous infection.**
 - Dogs with hypothyroidism are more susceptible to skin infections: regional or generalised superficial or deep pyoderma, bacterial and/or yeast overgrowths (*Staphylococcus pseudintermedius* and/or *Malassezia pachydermatis*) and otitis externa.
 - In the presence of skin infection or seborrhoea, pruritus may be an important sign.

DIAGNOSIS

History.

- Classically there is **lethargy**, dullness, unwillingness to exercise or **poor exercise tolerance** and a tendency to **gain weight** without an increase in calorific intake. **Heat-seeking** during cold weather may also have been observed. These signs are more clearly shown in adult dogs but can be insidious in onset and may only be noticed by observant owners.
- A dull coat, **hair loss** including a "rat tail", **seborrhoea** and **recurrent skin infections** which respond well to antimicrobial therapy may also be reported. Neurological, reproductive or gastrointestinal abnormalities as listed in the table may also be reported.
- Hair loss appears first and is most prominent in areas of skin subjected to traumatic stress**, particularly friction. Such areas include the ventral trunk, the tail and perineal area, and pressure points. Hair loss may be observed on the neck, in friction areas between the skin and the collar. In cases of extensive hair loss, the head and feet are sometimes spared.

Clinical elements.

- Signs can be **very variable**.
- Systemic signs** such as **lethargy**, mental dullness, **thermophilia**, **obesity** and **bradycardia** are important indicators but any of the signs listed in the table may be observed.
- Cutaneous signs. Bilaterally symmetrical alopecia**, possibly including "rat tail" points towards endocrine disease.
- Skin thickening (**myxoedema**), particularly of the **face** and **forehead** and associated with **drooping of the eyelids** and **thickened facial skin folds may be apparent** giving a "tragic facial expression".
- Skin infection, including superficial and deep pyoderma, *Malassezia* dermatitis, and / or otitis externa may be present.

Major elements of history and clinical signs.

- Alopecia, dry and brittle coat.
- Recurrent skin infection.
- Dullness, lethargy, weight gain.

Differential diagnosis.

- This is very wide and should include: other endocrinopathies; follicular dystrophy/dysplasia; superficial and deep pyoderma; bacterial overgrowth; *Malassezia* dermatitis; and otitis externa.

HISTORY SHEET

Owner: _____ Date: _____ **Weight:** _____
 Dog's name: _____ Age: _____
 Breed: _____ Sex: _____

GENERAL HISTORY

5/ **Reproduction (frequency of oestrus, pregnancy, behaviour of males...):** _____

8/ **Current non skin-related problems:** _____

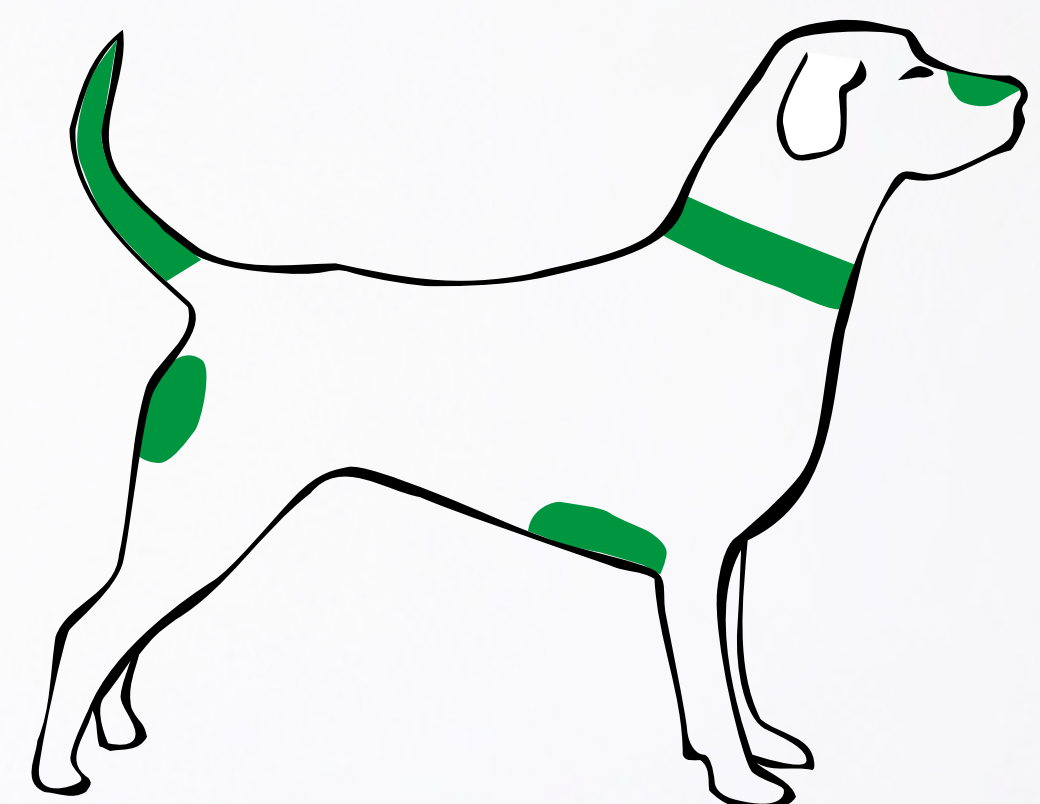
9/ **Behaviour changing:**

1/ Chief complaint: _____
 2/ Date of onset: _____
 3/ Pruritus, severity and time of onset (before or after lesions): _____
 4/ Specific clinical signs and related behaviour: _____

- Itching of feet (licking, chewing): _____
- Itching of head, lips, chin, periorbital area (scratching, rubbing): _____
- Otitis, itching of ear pinnae (scratching, shaking): _____
- Itching of anogenital area (rubbing, licking and chewing): _____

5/ **First cutaneous lesions observed and their development:** _____

6/ Seasonal influences: _____
 7/ Other affected animals (cohabiting, lineage) or human beings in contact: _____
 8/ Presence of fleas and anti-parasitic treatments given: _____
 9/ Shampoos and grooming: _____
 10/ Owner's view (personal opinion, remarks) on the dermatosis of his dog: _____
 11/ Previous treatments (date, products, dosage and duration) and responses: _____



Bilaterally symmetrical alopecia in a Labrit affected by hypothyroidism. Courtesy of: D. Pin



Tragic facial expression in a Labrit affected by hypothyroidism. Courtesy of: D. Pin

► **Complementary examinations.**

- **Trichography.** Examination of hair pluck samples can be helpful. Hairs plucked from areas of hypotrichosis are mounted in liquid paraffin and examined microscopically. Ensure that the hairs are plucked firmly so that anagen hairs, which are less easily removed, are not left behind. The presence exclusively of telogen hairs suggests failure of anagen initiation and may point towards endocrinopathy. Broken hairs are indicative of pruritus, which may be present in hypothyroidism when there is secondary infection or as a consequence of dry or scaly skin.



*Keratoseborrheic disorder in a Labrit affected by hypothyroidism.
Courtesy of: D. Pin*

- **Screening tests** are useful in animals with clinical signs consistent with hypothyroidism. All such tests must be related to normal values and in dynamic hormone tests to expected response values provided by the diagnostic laboratories carrying out the laboratory procedures.
 - **Routine blood tests** in hypothyroid dogs may show mild, non-regenerative anaemia (30 to 50% of cases) and hypercholesterolaemia (70% or more of cases).
 - **Serum total thyroxine** (total T_4) measurement is a useful screening method. Levels are generally below normal in hypothyroidism. TT_4 is a very sensitive test for hypothyroidism,
 - negative predictive value is high, as it would be very rare that a dog might have hypothyroidism and
 - normal TT_4 levels. However, total T_4 levels normally fluctuate in healthy dogs, and are depressed by therapy with a variety of drugs, malnutrition and in non-thyroidal disease. Thus dogs with normal thyroid function may have low T_4 levels.
 - **Serum free thyroxine** (free T_4) is less affected than total T_4 by factors such as non-thyroidal disease, malnutrition and drug therapy and is thus a better screening test of thyroid function but only when levels are measured by the equilibrium dialysis method. Less accurate methods have no advantage over measurement of total T_4 .
 - **Canine TSH assay.** Serum TSH levels are elevated in about 40% of dogs with primary hypothyroidism but may also be present in about 15% of euthyroid dogs. Thus TSH assay alone is not a reliable test. Assessment of both TSH and T_4 levels increases the diagnostic accuracy. Low total or free T_4 together with high TSH is strongly supportive of a diagnosis of hypothyroidism. As with all these assays, specific cut-off levels should be provided by the laboratory carrying out the assay.
 - Total T_3 and free T_3 measurements are of no use to diagnose canine hypothyroidism.
- **Dynamic thyroid function tests.**
 - **TSH response test.** This involves measurement of serum total T_4 prior to and six hours following intravenous administration of TSH or 50-100 μg recombinant human TSH). Post-TSH levels of T_4 below 20 nmol/L are diagnostic for hypothyroidism whilst levels above 30 nmol/L are normal, in assays from most laboratories. This test is generally accepted as the most reliable but as pharmaceutical grade TSH is not available, chemical grade product has to be used and there have been anecdotal reports of adverse reactions to above TSH. Thus authorisation, including owner's consent, should be obtained before it is used. The TSH response test is especially useful in cases where there is non-thyroidal disease or where drugs affecting thyroid function tests are being used. In such cases administration of 150 μg recombinant human TSH is recommended.
 - TRH response test might not be used any more.
- **Sources of errors.** A variety of factors can affect serum thyroid hormone levels and thus complicate diagnosis. These factors should be considered and their effects eliminated, if possible, when performing thyroid function tests.
 - **Breed effects.** Breeds known to have thyroid hormone levels at the bottom end or below generally accepted normal ranges include Alaskan sled dogs, Scottish deerhounds and greyhounds.
 - **Drug effects.** Glucocorticoids and sulphonamides may depress thyroid hormone levels. A variety of other drugs is suspected of having such effects. T_4 administration tends to cause thyroid atrophy

and after prolonged administration may affect thyroid function tests for periods of weeks to months; at least 8 weeks should be allowed after withdrawing T_4 before carrying out such tests.

- **Non-thyroidal illness.** Serum T_3 and T_4 are reduced by illness and severe malnutrition but free T_4 measured by equilibrium dialysis may remain unaffected. Serum TSH levels may also be elevated in up to about 30% of those dogs. Thus tests should be delayed until recovery from the illness is achieved. The TSH response test is less affected by non-thyroidal illness and should be employed to confirm hypothyroidism when the results of other tests are not conclusive.
- **Autoimmune thyroiditis.** This condition may occur in 50% of cases of hypothyroidism. Autoantibodies to thyroid hormone can affect assays and may raise or lower the values given by different assay procedures. However, free T_4 assays using equilibrium dialysis are not affected by autoantibodies to T_4 .

TREATMENT

Topical treatment.

- In cases of pyoderma, bacterial overgrowth and *Malassezia* dermatitis, treatment with **antimicrobial shampoos** should be considered in **conjunction with systemic therapy**, where appropriate (refer to the corresponding monographs). Where there is seborrhoea, the use of antiseborrhoeic shampoos and with dry skin, moisturisers, will be beneficial.

Systemic treatment.

- **Treatment with T_4** will generally be effective; both primary and secondary hypothyroidism are treated in the same way. Doses of 0.01-0.04 mg/kg (10-40 μ g/kg) daily are given once daily or divided at 12-hour intervals. Improved demeanour should occur within 4 weeks but resolution of skin problems may take as long as six months. Treatment should be continued for at least three months to determine whether therapy is likely to be effective. Once a good response has been obtained, consideration should be given to reducing the frequency of administration, from twice to once daily, as well as the dose level. Treatment with T_3 is seldom necessary and is less convenient; doses of 4-6 μ g/kg every 8 hours are used.
- **Post-pill tests.** Testing of the level of T_4 achieved after administration of the therapeutic dose may be necessary in cases which fail to respond to therapy initially or those in which clinical signs recur. Following treatment, blood levels should be within the normal range in 4-6 hours. Higher peak levels will be expected with once daily therapy. In cases with poor responses in which 6-hour levels are adequate, levels should be reassessed at 24 hours. If levels at 24 hours are too low then consideration should be given to dosing twice daily and, where necessary, raising the dose. **Where the post-pill levels of T_4 are substantially above normal and there is a lack of clinical response, the diagnosis of hypothyroidism should be questioned.**
- **Dogs with other diseases** may need special consideration. Where there are other endocrinopathies, these will need to be treated as well. In **hypoadrenocorticism**, the adrenal insufficiency **should be effectively treated before administration of T_4** . In diabetes mellitus, dosage of insulin may need to be adjusted when T_4 therapy is instituted. In heart disease, dosage with T_4 should be started at a low level and gradually increased. A suggested regimen is to begin with 5 μ g/kg every 12 hours and to increase the dose every two weeks by 5 μ g/kg every 12 hours until a therapeutic dose is reached.

Additional treatment.

- **Systemic antibiotics.** Bactericidal antibiotics are advisable to treat any concurrent bacterial infection. Normal dose rates are used (see monographs on pyoderma) and the response is usually very good. Unless thyroid supplementation is instituted, recurrence of the pyoderma will occur. See monograph on complex approach pyoderma.

Comments.

- Concurrent topical therapy is an important aspect of the treatment whilst waiting for skin and coat problems to resolve.

PROGNOSIS

- ▶ In the great majority of cases, supplementation with T_4 is effective and leads to resolution of disease related to the hypothyroidism.
- ▶ Therapy needs to be lifelong.

FOLLOW-UP

- ▶ Post-pill testing and adjustment of the dose of thyroid supplementation may be required should the clinical signs recur.

CONCLUSIONS

- ▶ Hypothyroidism is a disease that may be difficult to diagnose in some cases because of the very wide range of clinical signs and problems with thyroid hormone assessment.
- ▶ Once a diagnosis has been made, recovery is normally complete and the dog can have a good quality of life provided that appropriate supplementation is maintained.

OTITIS EXTERNA

This monograph is not an exhaustive list of clinical signs and causes of otitis externa, but a **chronological and clinical method of investigation** to allow management of otitis externa cases as specific dermatological problems. Even if it is generally not necessary, it is recommended that the patient be sedated to facilitate better examination and sampling quality.

HISTORY SHEET

Owner: _____ Date: _____
 Dog's name: _____ Breed: _____ Age: _____
 Sex: _____ Weight: _____

GENERAL HISTORY

1/ Age when acquired and origin (breeder, pet store, ...)
 2/ Geographical area of home, present and past trips, kennels, ...
 3/ History of life, environment (houses, gardens, flat, ...) and in-contact pets.
 4/ Diet (current and previous):
 5/ Reproduction (frequency of oestrus, pregnancy, behaviour of males, ...)
 6/ Previous diseases and surgery:
 7/ Unrehearsed previous dermatoses:
 8/ Current non skin-related problems:
 9/ Behavioural changes.

DERMATOLOGICAL HISTORY

1/ Chief complaint:

• **Otitis, itching of ear pinnae (scratching, shaking):**

4/ Specific clinical signs and related behaviour:
 • Itching of feet (licking, chewing):
 • Itching of head, lips, chin, periorbital area (scratching, rubbing):
 • Otitis, itching of ear pinnae (scratching, shaking):
 • Itching of anogenital area (rubbing, licking and chewing):
 • Ophthalmological signs, conjunctivitis and/or epiphora (ocular secretions):
 • Upper respiratory signs, nasal discharge and/or sneezing:
 • Lower respiratory signs, asthmatic problems:
 5/ First cutaneous lesions observed and their development:
 6/ Seasonal influences:
 7/ Other affected animals (cohabiting, linnages) or human beings in contact:
 8/ Presence of fleas and anti-parasitic treatments given:

11/ Previous treatments (date, products, dosage, duration) and responses:

HISTORY AND CLINICAL EXAMINATION

Clinical method of investigation

1/ Specific history of otitis

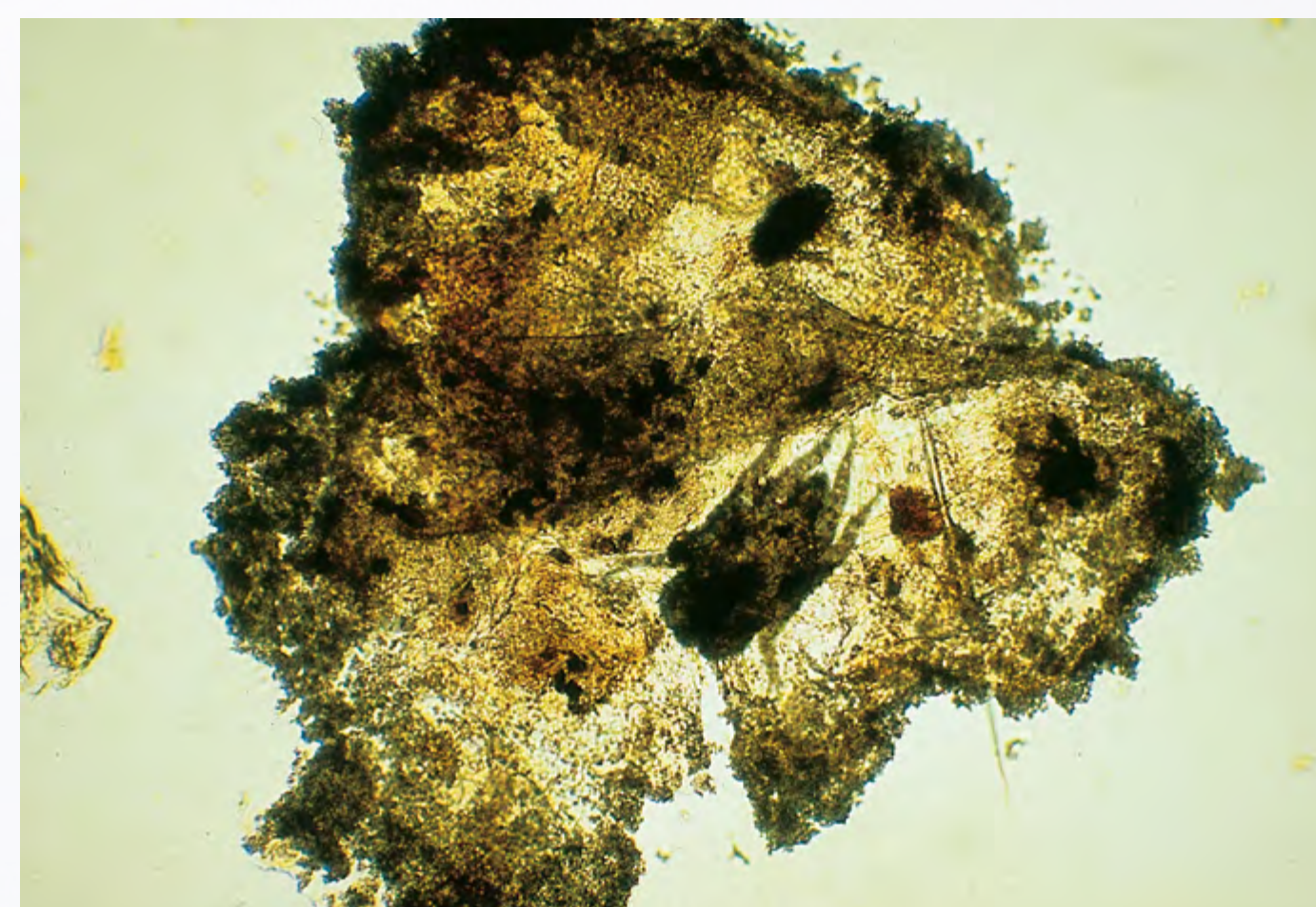
- Must be registered in the sections "otitis" and "response to therapy".
- These elements help to categorize each case in terms of severity.
- Local pathology: degree of pruritus (relief when the ears are massaged...), pain (whining...), neurological involvement.
- Affected pets in contact (in case of ear mites).
- Duration of otitis externa.
- Number of relapses.
- Previous treatments: type of therapy, products used, duration, efficacy / response.
- Grooming and cleaning routine: method, products used.

2/ Preliminary clinical examination

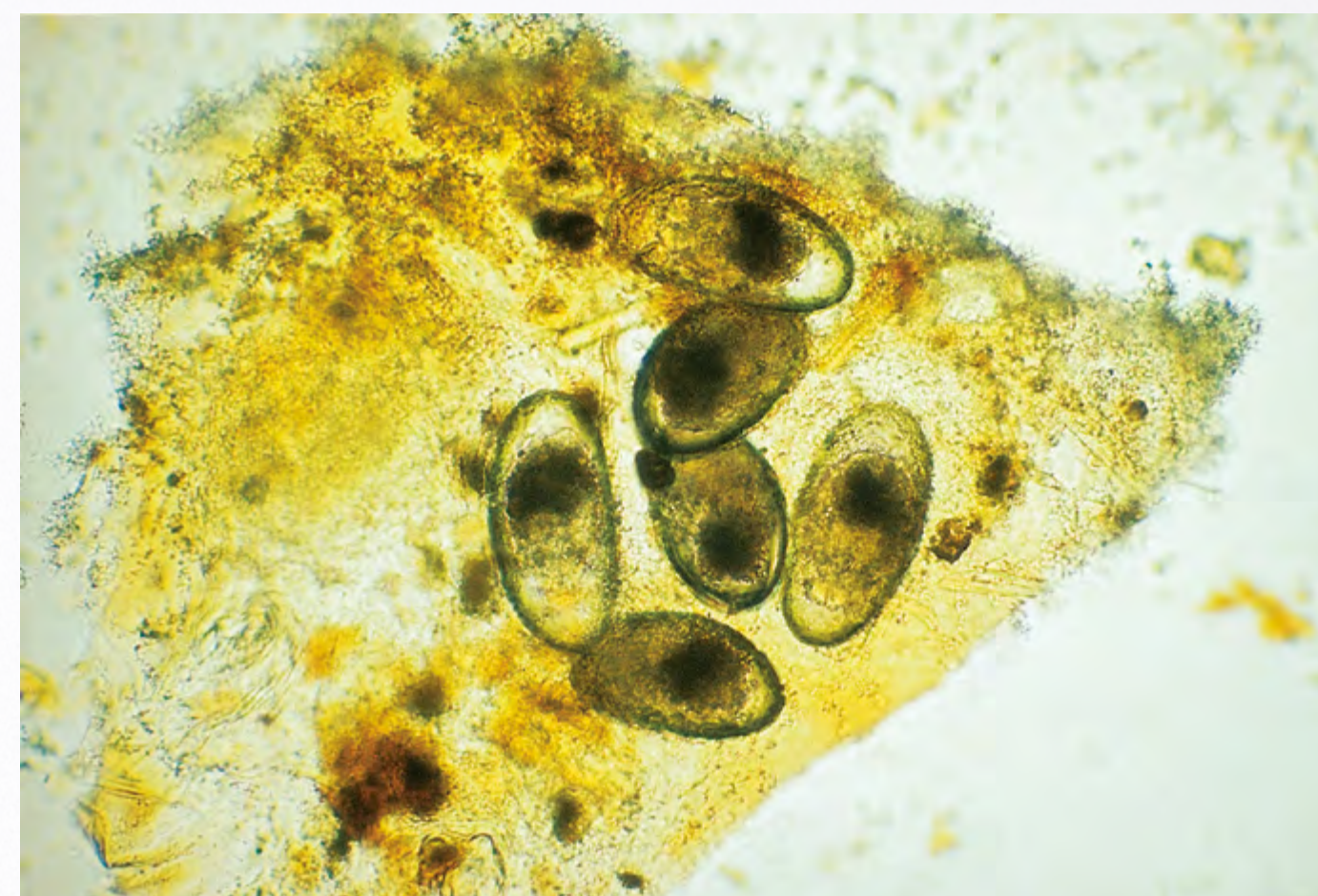
- Head and ear position (head tilt, ear usually held low if painful, or neurological problem if there is an otitis media).
- Gentle palpation of the ear canal (EC), note: level of pruritus, pain, hyperplasia, amount of discharge, hardness (sign of calcification).
- Pinnae and EC examination, note:
 - Primary and secondary lesions, hyperplasia...
 - Discharge or pus - amount and nature.
 - Odour.
- Look for an audio-podal reflex by stimulating the external orifice of the ear canal (suggestive sign of ear mites).
- Assess the hearing.



Clinical examination : ear canal palpation and area to stimulate to trigger an audiotopodal reflex.
 Courtesy of: D. Pin



Ear mite infestation.
 Direct cytological examination of an exudate sampling.
 Adult *Otodectes cynotis* (x40).
 Courtesy of: Royal Veterinary College, London



Ear mite infestation. Direct cytological examination of an exudate sampling. Eggs of *Otodectes cynotis* (x400).
 Courtesy of: Royal Veterinary College, London

OTOSCOPY AND SAMPLING

Clinical method of investigation

3/Sampling for mycology and/or bacteriology

- Must be done with a sterile swab.

4/Exudate sampling for direct microscopic examination

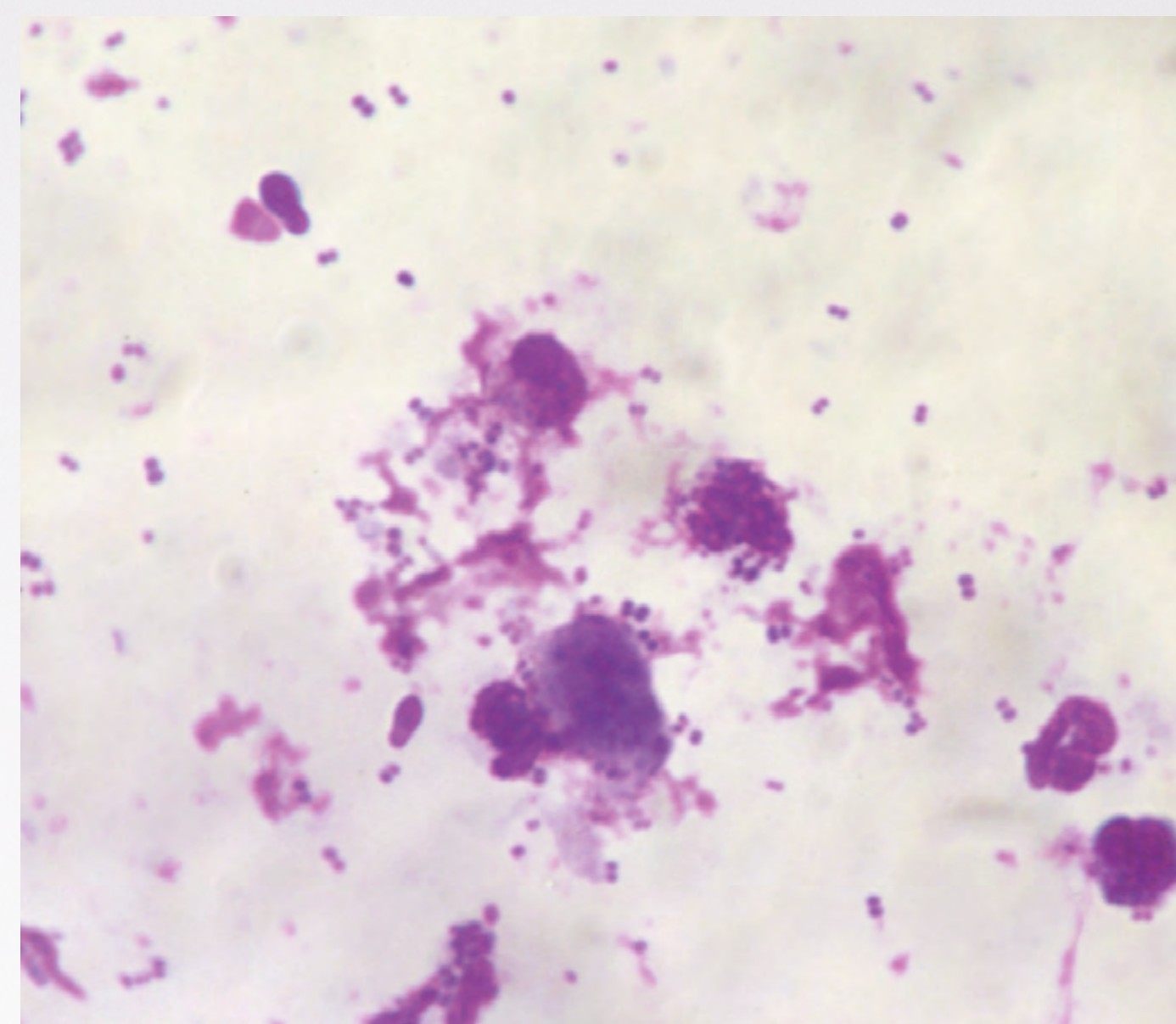
- Must be done with a swab or a curette.
- Parasitic investigation (eggs, larva and adults):
 - *Otodectes cynotis* in ear mite infestation (1/10 of otitis cases),
 - *Demodex canis* or *cati* (rare).
- Refer to the slide preparation and examination in the "sarcoptic mange" monograph.

5/Exudate or pus sampling for cytological microscopic examination after fast-staining

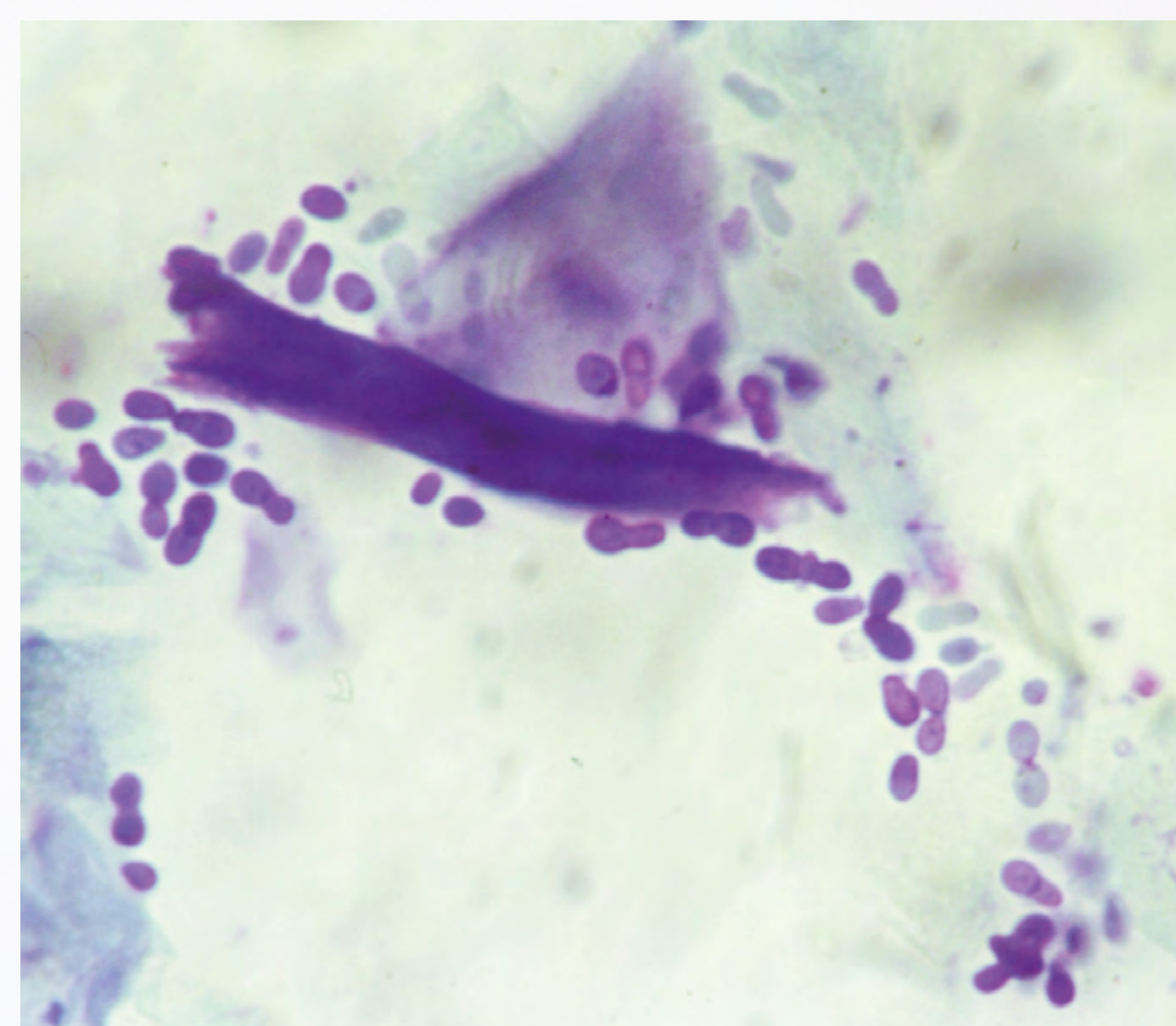
- Look for perpetuating microbial factors: yeasts (mainly *Malassezia pachydermatis*), cocci (*Staphylococcus pseudintermedius* in particular), rods (*Pseudomonas aeruginosa* most frequently)...
- Presence of neutrophils indicating the presence of pus in suppurative otitis externa.
- Refer to the procedures in the "Pyoderma" and "*Malassezia dermatitis*" monographs.

6/Otoscopy / Video-otoscopy

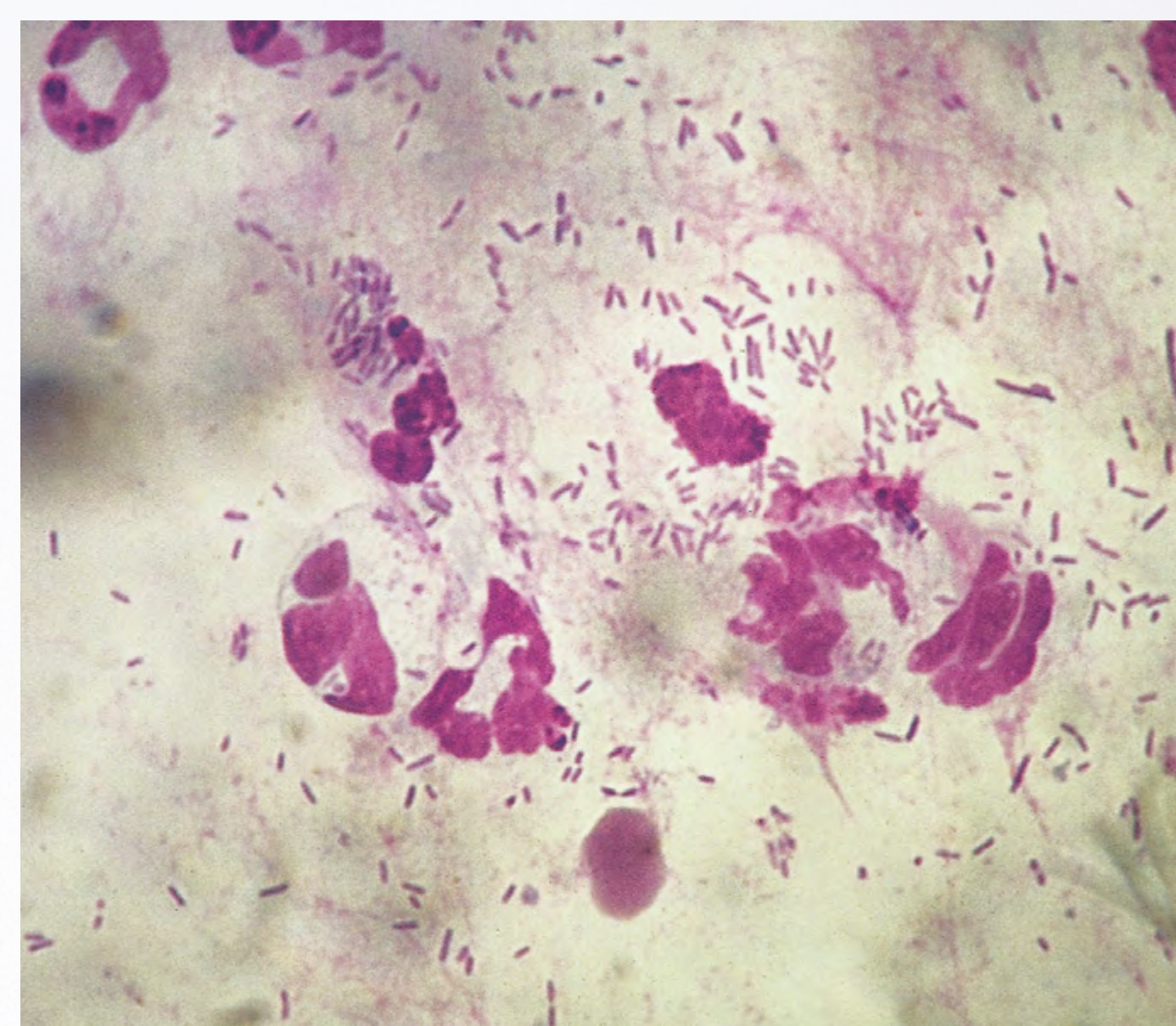
- General aspect of the ear canal lining including assessment of amount and quality of discharge, presence of ulcers and/or nodular lesions.
- Appearance of the tympanic membrane.
- Look for foreign body
- Video-otoscopy has same use as otoscopy but with better accuracy (requires a good quality video-otoscope). It can be very demonstrative for the owner and allows to take pictures and assess the healing.
- Clinical method of investigation



Erythmato-ceruminous otitis. Direct cytological examination of an exudate sampling. Cocci secondary infection with *Staphylococcus intermedius*. See also few *Malassezia*. (Diff-Quik stain, x1000). Courtesy of: D. Pin



Erythmato-ceruminous otitis. Direct cytological examination of an exudate sampling. Yeast secondary infection with *Malassezia pachydermatis*. (Diff-Quik stain, x1000). Courtesy of: D. Pin



Suppurative otitis. Direct cytological examination of an exudate sampling. Secondary infection with rods. (Diff-Quik stain, x1000). Courtesy of: D. Pin

OTITIS MANAGEMENT

Clinical method of investigation

7/Ear canal cleansing and further otoscopy / video-otoscopy

- If the ear canal is severely occluded.
- When the tympanic membrane has not been visualized, in particular in severe and/or chronic cases where an otitis media may be suspected.
- It allows a thorough assessment of the local disease; ear canal inside layer, presence of nodular and/or ulcerative lesions, presence of foreign body and observation of the tympanic membrane – on which any lesions would suggest otitis media (however, absence of tympanic membrane lesions does not exclude a suspicion of otitis media).

8/Exploration and management of an otitis media

- Major suspicion in cases of chronic otitis externa, particularly when suppurative, with or without rupture of the tympanic membrane.
- Diagnosis:
 - otitis media likely when the tympanic membrane is ruptured,
 - CT-Scan imaging: very useful diagnosis method,
 - myringotomy and tympanic bulla aspect• open mouth tympanic bulla radiographs (older method, much less accurate than CT-Scan).
- Management:
 - when the tympanic membrane is ruptured or after a myringotomy: sampling for culture and sensitivity (+mycology and sensitivity to antifungal agents),
 - refer to "therapy".

9/Use of samples from the ear canal

- Send to a laboratory for bacteriology / mycology in cases of:
 - otitis media,
 - chronic suppurative otitis,
 - severe recurrent otitis.
- Sensitivity must include antibiotics usually effective on the bacteria found in otitis:
 - important if a systemic treatment is prescribed,
 - provides useful information but is less determinant regarding choice of topical treatment (local antibiotic concentrations are far in excess of the systemic concentrations assayed in the in vitro sensitivity determination).



Cleansing: bulb flushing.
Courtesy of: D. N. Carlotti



Suppurative otitis before cleansing.
Courtesy of: D. Pin



Suppurative otitis after cleansing.
Courtesy of: D. Pin

10/Therapy: in clinic and by the owner

Foreign Body Otitis

- Withdrawal of the foreign body.
- Secondary infection treatment.

Parasitic Erythematous-Ceruminous Otitis externa (ear mites)

- Topical acaracidal therapy.
- Systemic acaracidal therapy (refer to systemic therapy of sarcoptic mange).
- Concomitant antiseptic flushing solution can be used when *Malassezia sp.* is also present.

Infectious Erythematous-Ceruminous or Suppurative Otitis externa (yeast and/or bacteria)

- Classical treatment involves a topical preparation containing antibiotic, antifungal and anti-inflammatory agents, known to be effective.
- As inflammation is most probably at the origin of the microbial proliferations, the strongest but safest corticosteroid might be chosen.
- Prerequisite initial cleansing in the practice in presence of copious discharge and exudates: ear flushing using adapted devices, most often under general anaesthesia, with an antiseptic and cleaning solution.
- Regular cleansing by the owner in presence of copious discharge and exudate:
 - with an antiseptic cleaning solution applied generously,
 - gentle massage of the ear canal,
 - wipe off the secretions and excess product that appear at the external orifice of the ear canal with a paper towel,
 - repeat the procedure several times if necessary,
 - the therapeutic preparation should preferably be applied a few minutes later.
- Control of the inflammation on the long term: can persist once the infection is controlled:
 - use of a therapeutic preparation containing corticosteroids to control and prevent inflammation,
 - **the basic therapy is the treatment or control of the associated disease.**



Parasitic erythematous-ceruminous otitis.
Courtesy of: D. N. Carlotti



Non parasitic erythematous-ceruminous otitis with *Malassezia*. (*Malassezia dermatitis* & Atopy).
Courtesy of: D.N. Carlotti



Non parasitic erythematous-ceruminous otitis with microbial secondary infection (Atopy).
Courtesy of: D. Pin



Suppurative otitis with *Pseudomonas*.
Courtesy of: D. Pin

Clinical method of investigation

Otitis media

- Flushing with saline water, under sedation, when the tympanic membrane is ruptured or after myringotomy.
- Topical therapy with a preparation containing antibiotic, antifungal and anti-inflammatory (corticosteroid) agents.
- Antibiotic systemic therapy at high dosage.

Topical therapy summary

- An antiseptic topical cleanser can be used in the first intention and can be excellent in maintenance.
- A therapeutic product specific for acute otitis externa classically includes a broad spectrum antibiotic, an antifungal agent (effective against *Malassezia*) and a potent corticosteroid.
- The immediate efficient control of inflammation might be the most important factor for a quick relief.
- Long-term control of inflammation may avoid otitis externa relapses, both through local control and general therapy of the underlying allergic dermatitis.

Systemic therapy summary

- Antibiotic and/or antifungal agents: useful in case of otitis media (at a high dosage) in order to increase the local level of the active ingredients eventually delivered by the topical therapy.
- Corticosteroids: can be useful (in some severe cases of otitis externa) to reduce thickening of the integument and narrowing of the ear canal in chronic otitis externa and therefore to avoid surgery (which would not solve the problem on the long term).

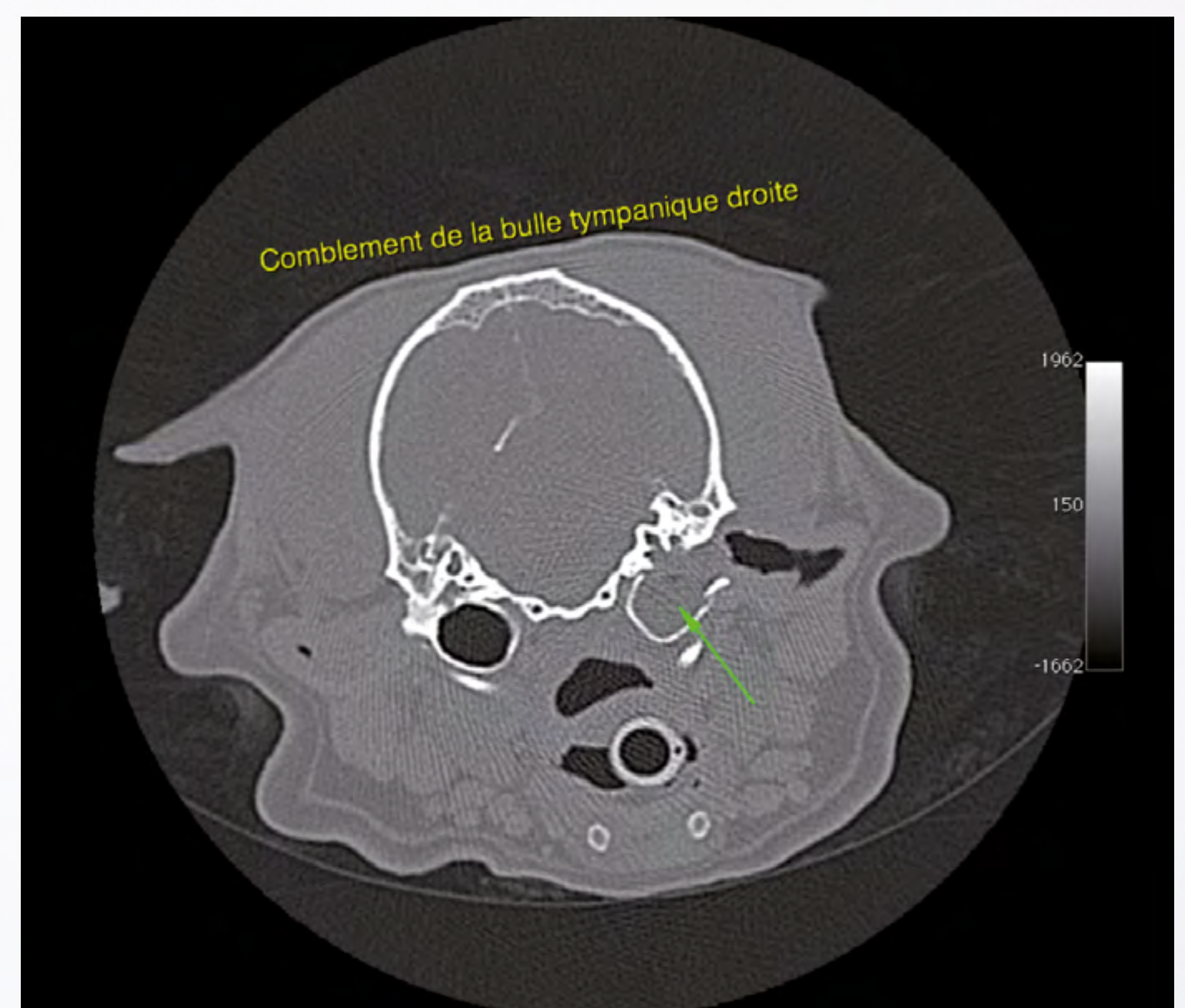
Exploration and control of the associated dermatosis is the next critical step.

INTEGRATION OF CHRONIC OR RECURRENT CASES OF OTITIS IN THE GENERAL DERMATOLOGICAL APPROACH

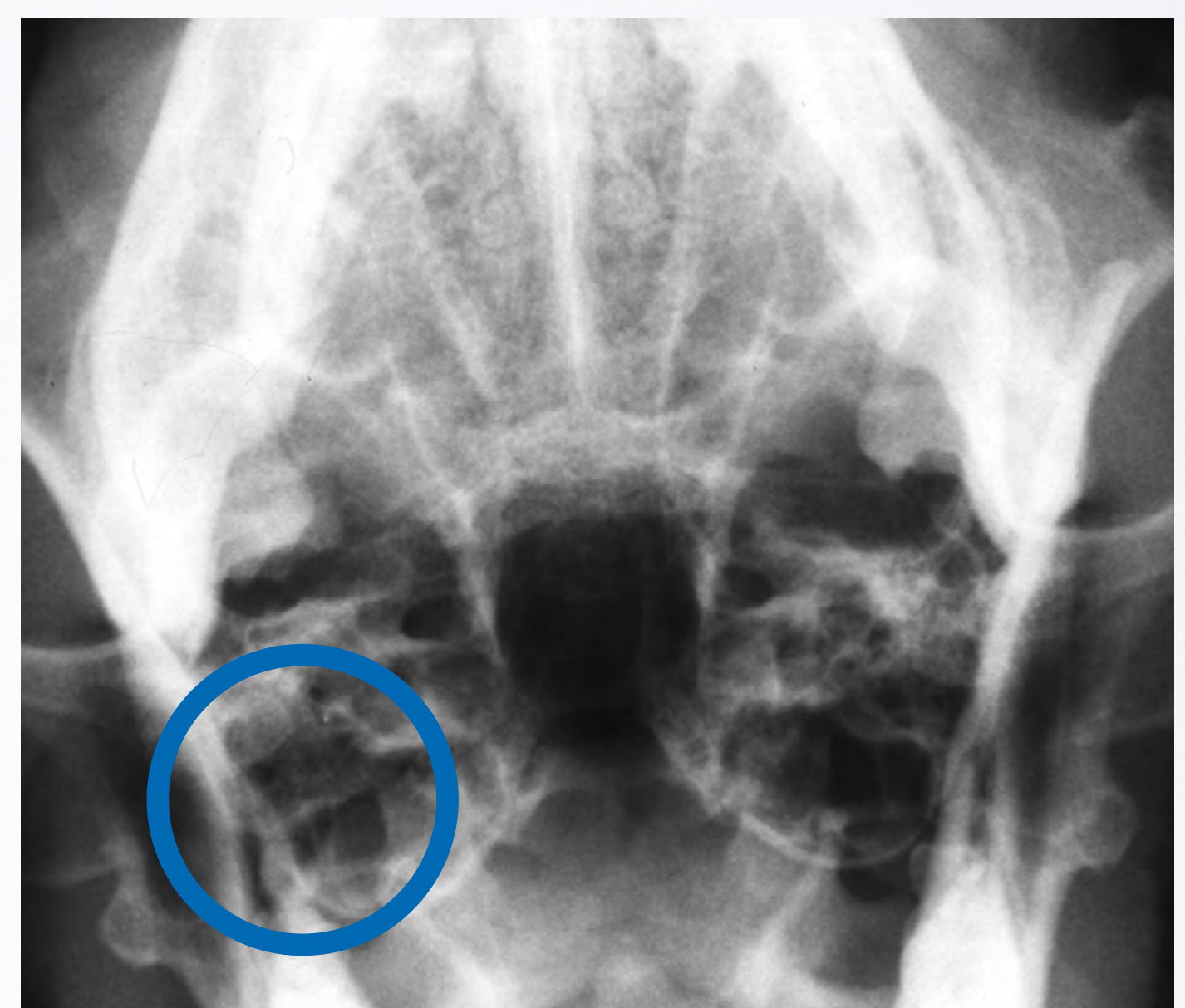
(Refer to Part.1)



Myringotomy under video-otoscope. Courtesy of: D. N. Carlotti & O. Toulza



CT-Scan imaging. Filled right tympanic bulla. Courtesy of: F. Durieux



Open mouth tympanic bulla radiograph: aspect of the tympanic bulla in a case of chronic otitis media. Courtesy of: École Nationale Vétérinaire d'Alfort, France.

CONCLUSIONS

Prevalence of otitis externa

Type	Average prevalence	Unilateral (U) or Bilateral (B)	Primary causes	Perpetuating factors to control
FBO (Otitis due to a Foreign Body)	ε	U	Foreign Body (FB)	Possible secondary infection
PECO (Parasitic Erythematous-Ceruminous Otitis)	~ 1/10	B at 95%	<i>Otodectes</i> +++, others +-	Possible secondary infection
NPECO (Non Parasitic Erythematous-Ceruminous Otitis)	~ 2/3	B at 75%	Allergic dermatitis in 85% of cases: mainly atopic dermatitis	Mainly yeast (<i>Malassezia pachydermatis</i> +++) and cocci (<i>Staphylococcus pseudintermedius</i> +++, <i>streptococci</i> +, others +-)
SO (Suppurative Otitis)	~ 1/4	U at 50%	ECO complication (refer to its causes) FB otitis complication	Bacteria and particularly rods (<i>Pseudomonas aeruginosa</i> +++, <i>Proteus spp</i> +, others +-)

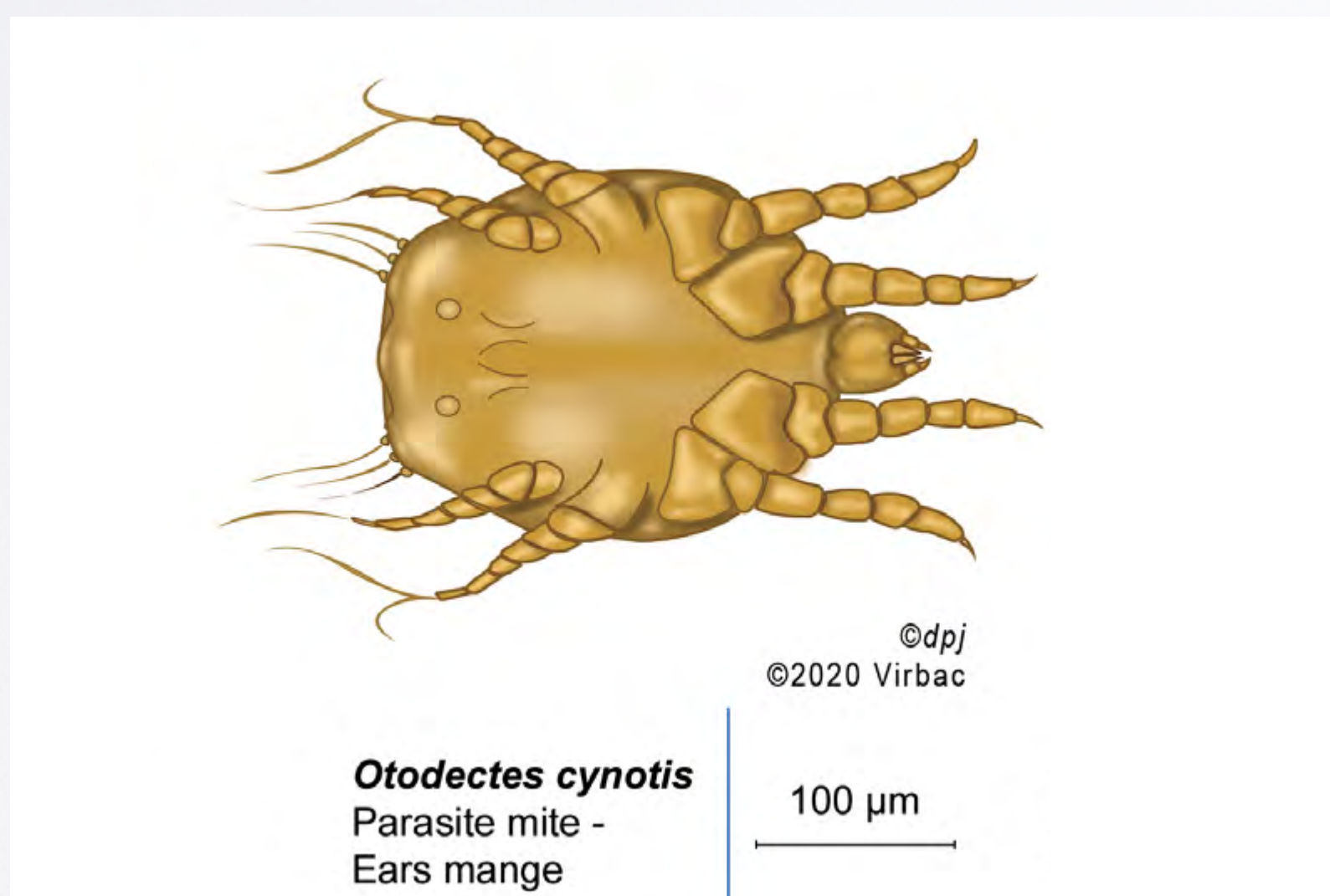
ADULT DOG

Infectious Erythematous-Ceruminous Otitis externa are commonly found, and can degenerate into suppurative otitis externa in the most chronic (and/or poorly controlled) cases.

Otitis externa, especially Erythematous-Ceruminous Otitis externa, is generally found in adult dogs as they are quasi systematically associated with a general dermatosis (in particular an allergic dermatitis) which concern only adult dogs.

YOUNG DOG

The young dog is mainly affected by parasitic otitis externa, which may become secondarily infected, or less commonly, by foreign body otitis externa.



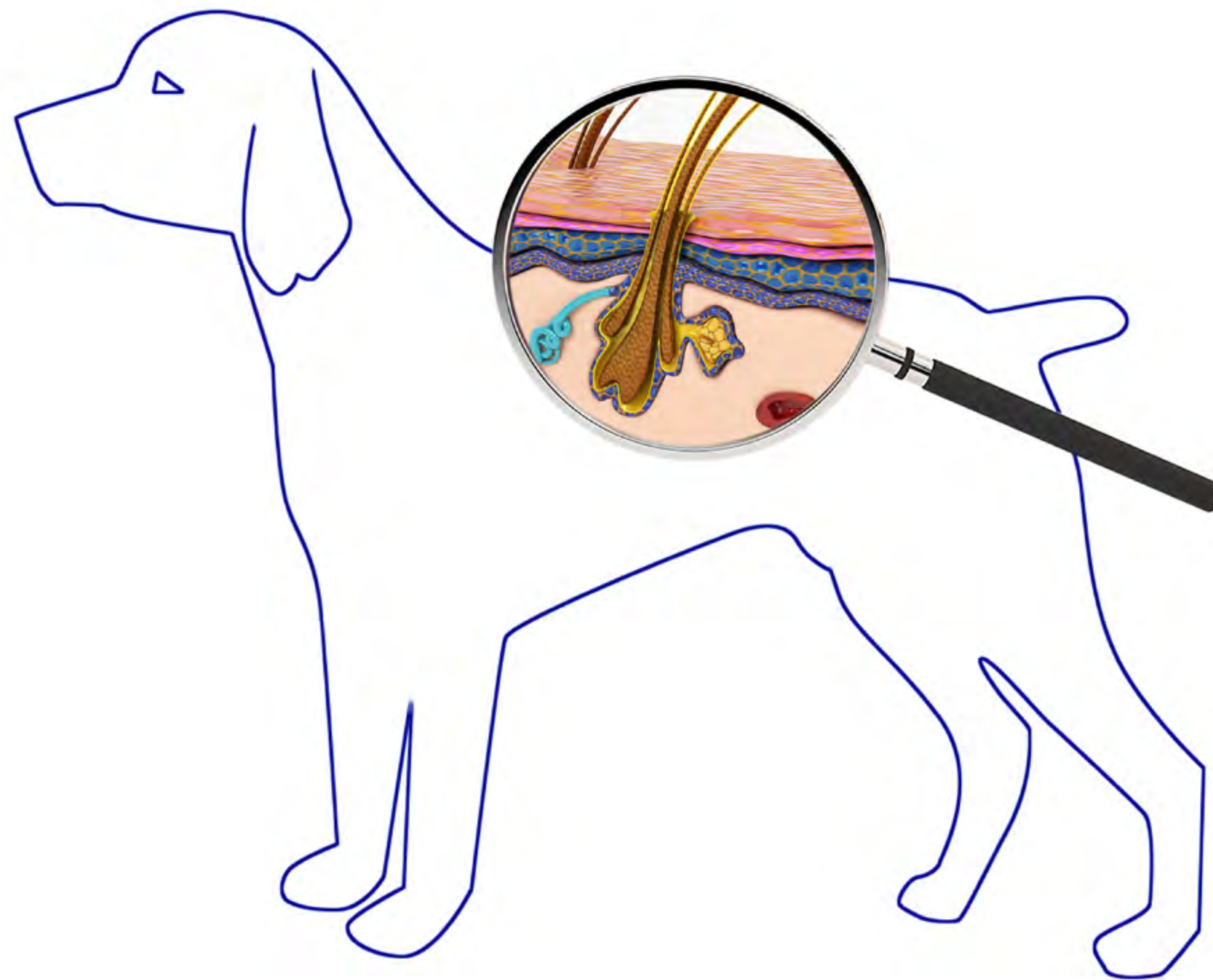
Courtesy of: P. Jasmin

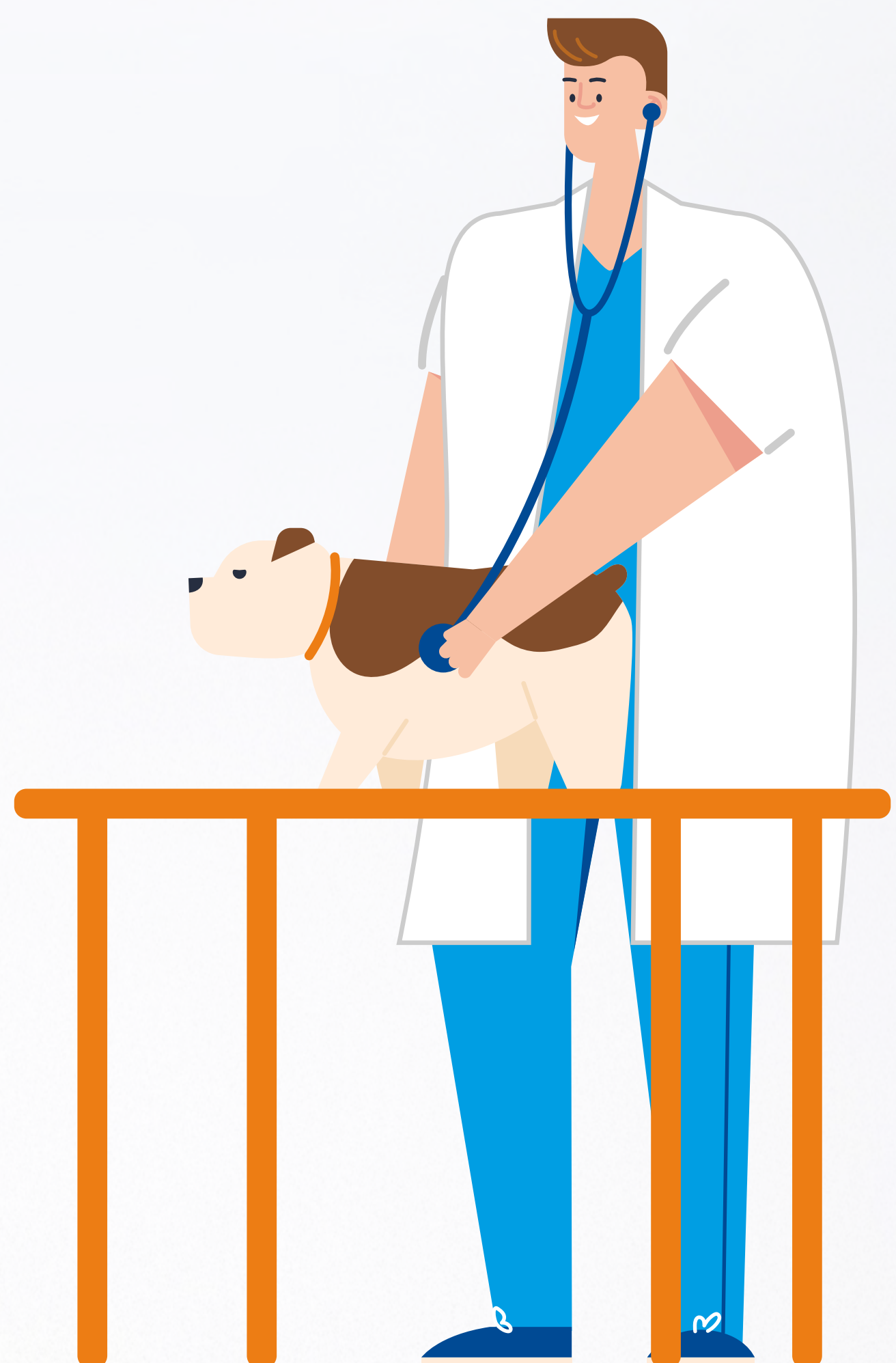


Erythematous-ceruminous otitis with *Malassezia*.
Courtesy of: D. Pin

Part. 3

Applications and use of **skin biopsies**





INTRODUCTION

- ▶ **Skin biopsy followed by histopathological analysis** is one of the most helpful procedures in the diagnosis of dermatological problems.
- ▶ This chapter is entirely devoted to the description of skin biopsies, their indications and techniques. Its goal is to demonstrate the major indications for this procedure and to give some basic rules that will enable optimum information to be derived from the histological examination.
- ▶ Skin biopsies are particularly helpful in the diagnosis of the **rarer dermatoses**, for which the clinical approach is more difficult. They are not necessarily indicated for the more **common dermatoses** for which the **clinical approach** is a **prerequisite**, but biopsies are **never useless**.

THE ROLE OF THE CLINICIAN AND THE ROLE OF THE PATHOLOGIST

- ▶ The analysis of skin biopsies requires close teamwork between the clinician and the pathologist.
- ▶ The role of the clinician is very important as he/she is responsible for the first step: the choice of the area to biopsy.
- ▶ The role of the pathologist is of course equally important and critical, as he/she has to interpret, without seeing the animal, a histological picture at a fixed time point in what is an evolving pathological process. It is usually a combination of images, observed on histopathological sections from one or several specimens that enables the pathologist to distinguish one (or several) differential(s) with more or less certainty.
- ▶ When skin biopsies are performed:
 - The first objective may be to reach the diagnosis with the highest positive predictive value (PPV).
 - Of equal importance, the second objective could be to rule out one (or several) differentials. In this case, the goal is to derive the highest negative predictive value (NPV).
 - These predictive values depend as much on the pathologist as the clinician and in particular, the PPV of the former and the NPV of the latter.
- ▶ The clinician is responsible for the type, the quality and the number of samples submitted to the pathologist who must have particular expertise in dermatopathology, and the submission must be accompanied by a complete history, a report of the dermatological examination, and a map of the lesions with the biopsy sites indicated.
- ▶ The pathologist's interpretation and conclusions may be useless to the clinician unless these few basic rules are followed.

THE ROLE OF THE CLINICIAN

- ▶ Histopathology may well be inconclusive if the biopsies submitted by the clinician have not been selected from the optimal site, if poor technique has been used, or they have not been well preserved.
- ▶ If all the above conditions are met, a good pathologist should be able to provide you reliable and often conclusive information.

WHEN TO BIOPSY ?

GENERAL INFORMATION / CLIENT INFORMATION

- ▶ Performing a skin biopsy is never useless: at best it may give a definitive diagnosis and at worst it will help by pointing the clinician in the right direction.
- ▶ When this procedure is advised, the owner must be made aware that the results will not necessarily provide a precise diagnosis, but the information obtained will nonetheless be extremely useful in the case management. Also important is the fact that the cost/benefit ratio is high, and that the results can be obtained relatively quickly.
- ▶ The skin biopsy should be scheduled for a specific appointment to ensure that it is performed optimally, and to emphasize the importance of the procedure to the owner.
- ▶ Also an indication of the likely total cost must be given, emphasizing the potential benefits relative to that cost.

INDICATIONS FOR SKIN BIOPSIES IN THE GROUPS OF RELATED DERMATOSES

(refer to the first part of the handbook)

- ▶ For the most frequent dermatoses (groups 1 and 2), the clinical approach is essential.

 - Nevertheless, for those in group 1 (specific infectious and parasitic dermatoses), the histopathology results are sometimes diagnostic and if not they may help rule out some differentials.
 - For those in group 2 (most frequent primary dermatoses - allergies and endocrine disorders), histopathological examination is seldom diagnostic.
- ▶ For all the other, less common (group 3) dermatoses, histopathology is essential to establish the final diagnosis. This is because they are often severe requiring long and expensive treatment which may have side effects, and thus a definitive diagnosis, obtainable only by skin biopsies, is essential.
- ▶ Skin biopsies are thus particularly indicated:

 - When a specific condition is suspected:
 - for which the analysis of skin biopsies is recognised to be diagnostic,
 - when one wishes to support one's diagnosis for a group 1 or 2 dermatosis.
 - When the lesions appear atypical, or have a sudden and dramatic onset.
 - For any erosive dermatosis (e.g.: generalised ulcerative lesions).
 - If there is any suspicion of neoplasia.
 - When any dermatosis belonging to group 3 is suspected. In this case, histopathology almost always gives a diagnosis.
 - When the performance of other tests have not enabled a diagnosis.
 - When a treatment, apparently correctly followed, has not resolved the problem.
 - When one wishes to confirm the clinical approach taken towards such dermatoses, in particular for the most frequent primary dermatoses (group 2). It may first of all confirm the absence or regression of secondary dermatoses (group 1b) and give an indication for possible further diagnostic tests helpful in the differential diagnosis of, for example, allergies or endocrine disorders.
- ▶ In all cases, and more particularly for the group 1 and 2 dermatoses, the establishment of the diagnosis is the responsibility of the clinician, taking into account the history, the clinical examination and possible other additional tests.

DIAGNOSTIC GROUPS OF RELATED DERMATOSES (see lists of the specific dermatoses)		SEQUENCE OF INVESTIGATION	USEFULNESS OF HISTOPATHOLOGY
GROUP 1: Specific infectious and parasitic dermatoses	GROUP 1a: Some primary dermatoses <i>Few and relatively uncommon.</i>	Always as a first step	Rarely used, the diagnosis is mostly clinical. The clinical approach is essential.
	GROUP 1b: Secondary dermatoses <i>Few but common. (occurring secondary to the primary dermatoses, essentially of group 2)</i>		
GROUP 2: Commonest primary dermatoses <i>Few but very common. (very often associated with secondary dermatoses)</i>		Only as a second step	Rarely diagnostic. May help the clinician to re-orientate his/her approach. The clinical approach is essential.
GROUP 3: Rare primary dermatoses <i>Many different dermatoses but rare.</i>		At any time if suspected	Diagnostic in the great majority of cases with good biopsies. Many skin biopsies are indicated.

WHAT TO BIOPSY ?

How many samples?

- When it has been decided to undertake skin biopsies, with the owner's agreement, there should be no hesitation in taking a number of samples: the cost is identical, the time required almost the same and the value of the information obtained is often directly proportional to the number of samples.
- Different areas are often in different stages of the disease process. The performance of numerous biopsies therefore gives a better "sampling" of the various phases of the pathological mechanism in question. This can be enormously helpful to the pathologist.
- The clinician will thus have to endeavour to sample different areas of different clinical aspects (ranging from the most severely affected areas to the normal).
- Taking **three to five biopsies** is an acceptable average.

With experience, and guided by previous results, the clinician will in time be able to refine his choices and thus reduce the number of biopsy samples submitted for analysis.

Nature of the samples.

- **Primary lesions of all types must be sampled first** (papular, pustular, nodules, or even erythema...). As they result from the principal pathogenic processes, they will be more reliably diagnostic.
- As a rule, biopsy **"all" suspect lesions**, particularly when the primary lesions are not easily identifiable. A crust examination, for example, will sometimes give extremely useful information.

HOW TO BIOPSY ?

Material.

- Ready availability of all the necessary instruments and materials will facilitate high standards and ensure that biopsies can be undertaken whenever there is any indication.
- The goal is not to work under aseptic but clean conditions. However, sterile instruments and materials must be used.
- A small surgery box should be reserved exclusively for skin biopsies and contain only the necessary instruments.
- The materials necessary are not highly specialised:
 - the appropriate amount of a local anaesthetic (2% lidocaine), enough for 1 to 2 ml for each biopsy site, sterile syringes and needles; a general anaesthetic should also be available,
 - suture, absorbable or non-absorbable,
 - a pair of sterile gloves,
 - absorbent paper towel on which to dab the samples,
 - a small cold sterilisation tray containing the 6mm sterile punches, in good condition,
 - a small sterile surgical box containing: a new blade, a scalpel handle, two pairs of thin scissors, straight and curved, dissecting forceps, a small clamp, a very small pair of eye forceps, gauze pads, suture material (rat-toothed forceps and needle holder),
 - 10% formalin-filled vials,
 - and the necessary labels and documents for appropriate submission.



The requisite material. Courtesy of: D. Pin

► **Patient preparation.**

- The biopsy sites must remain perfectly intact, as the skin surface material is often of great value to the pathologist:
 - avoid clipping (or plucking!) the hair before sampling, as important material could be removed, however, when hair is abundant and would prevent a good biopsy, then clip while avoiding to damage the lesions;
 - avoid preliminary scrubbing.
- Before anaesthesia it is preferable to circle with an indelible marker the sites that will be sampled.
- Note the sites on the lesion map and indicate precisely the nature of the samples (type of lesion, normal area immediately adjacent to such lesion...).

► **Local anaesthesia.**

- Most of the time, skin biopsies may be performed under local anaesthesia with appropriate physical restraint:
 - a sub-cutaneous injection of 1 ml (or 2 ml) of 2% lidocaine per site is sufficient,
 - gently fold the skin, without damaging the lesions,
 - the anaesthetic is injected **under** the biopsy site making sure that the product penetrates under the skin,
 - introduce the needle into the immediate periphery of the biopsy site and reposition the needle carefully, several times, depositing the anaesthetic in several places,
 - wait approximately 5 to 10 minutes before performing the biopsy.

► **General anaesthesia.**

- General anaesthesia may be useful for fractious animals.
- Sedation with dexmedetomidine is advisable to allow for a better technique.
- It is generally necessary when sampling the feet (footpads, nails), face (periorbital, muzzle, nasal planum), ano-genital areas, the medial aspect of the pinnae or the tail.

► **Punch biopsies.**

- This is the simplest and quickest technique.
- In general, a **6 mm punch, better 8 mm punch** provides good sampling material with minimal trauma.
- Hold the skin flat without stretching it.
- Apply the punch perpendicular to the skin surface.
- Exert sufficient pressure to the punch with the hand while “rolling” it with a continuous rotational movement between the thumb and the index finger.
- The pressure must be maintained until one feels the skin loosen as the blade of the punch penetrates the subcutaneous tissue.
- Pick up the sample very carefully by the under surface, taking care not to crush or even squeeze it:
 - the fragment sampled generally emerges when the punch is withdrawn, then the subcutaneous fat by which it is still attached just has to be cut,
 - if not, gently lift the sample by introducing closed forceps into the wound.
- The specimen may be picked up by the subcutaneous fat.
- In order to remove the blood, gently blot the distal surface of the sample on an absorbent paper towel.
- Then put it immediately into the fixative.
- The biopsy punch technique has the enormous advantage of allowing numerous samplings, generally under local anaesthesia, and is well accepted by the owner.
- However, it does not allow the inclusion of diseased and normal tissue within the same sample (except if the lesion is very small). If a comparison has to be made between the diseased skin and normal skin of the same region, an adjacent normal area has to be biopsied separately (refer to the chapter concerning the sites to biopsy).



Patient preparation, marking of the sites for biopsy. (*)



Local anaesthesia. (*)



Punch biopsy technique. (*)



Punch biopsy technique. (*)



Punch biopsy technique. (*)



Punch biopsy technique. (*)

(*): Courtesy of D. Pin

► **Elliptical wedge biopsies.**

- This biopsy technique is useful when the lesions to be sampled are large (nodules, neoplasia...) and/or deep (panniculitis) and/or very fragile (big pustules, bullae, vesicles...).
- This method is also used when surgical resection of the lesion is indicated (nodule, tumour...).
- However, in order to enable adequate fixation by the formalin, the specimen submitted for histopathologic analysis must not be too large; a representative piece will suffice.
- Another interesting feature of this method is that the section defines a long axis if one requires the specimen to be cut prior to bring embedded (see chapter concerning the precise selection of sites to biopsy).
- The dermis and epidermis must be sectioned simultaneously, firmly and continuously.
- Pinch and slightly elevate the specimen by the subcutaneous fat using a pair of fine eye forceps.
- Trim away the deep tissue with fine iris scissors.
- Gently blot the distal surface of the specimen on an absorbent paper towel in order to eliminate excess blood.
- Immediately place the sample into the fixative.
- This technique is theoretically the best, but presents certain disadvantages: it takes more time, generates larger wounds, does not facilitate multiple sampling, and ultimately is less acceptable to the owner.
- It is on the other hand the only technique allowing the inclusion of lesional tissue as well as normal tissue in the same sample (see chapter concerning the precise selection of sites to biopsy).



Elliptical wedge technique. Biopsy site after local anaesthesia. (*)



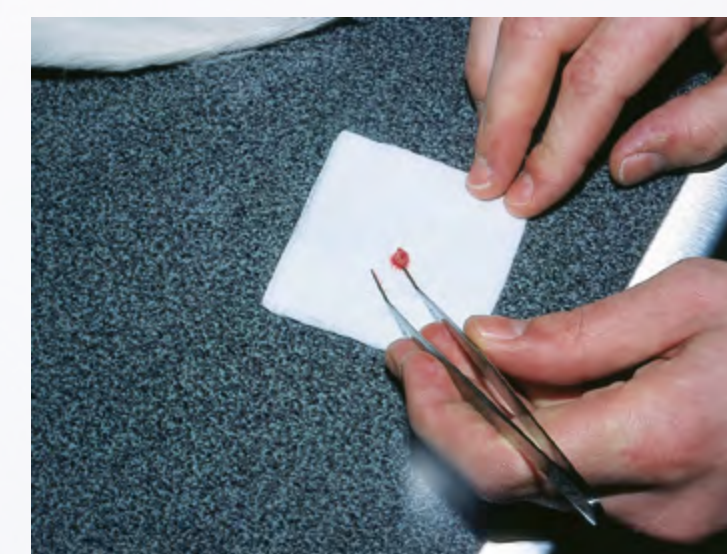
Elliptical wedge technique. Section of the biopsy. (*)



Elliptical wedge technique. Suture. (*)

► **Specimen conservation.**

- Place each sample in formalin (10% phosphate-buffered) **immediately** after removal, thus preventing desiccation and autolysis.
- Do not use other fixatives (such as Bouin's fluid).
- Some specialist laboratories provide vials containing the correct fixative.
- All specimens may be placed in the same vial, but the total volume of fixative must be at least ten times greater than the total volume of the specimens.
- Distribution of multiple samples in different vials may be useful for sample identification: a vial, for example, for each site biopsied.



Sample to be dropped in a fixation vial. Blood elimination. (*)

► **Haemostasis, antiseptis and suture.**

- Do not worry about the bleeding until the samples are completely removed and placed in the fixation vials!
- Haemostasis is generally readily effected by simple compression. It may sometimes be more difficult in certain areas (facial, pedal, auricular).
- Dab gently with an antiseptic solution and suture the wounds when all biopsies have been taken. If a wound keeps bleeding, compress firmly with clean gauze before suturing. The use of haemostats is rarely necessary.
- For 6mm punch sites, a single interrupted suture is generally sufficient.
- For 4mm punch sites, sutures may not be necessary.

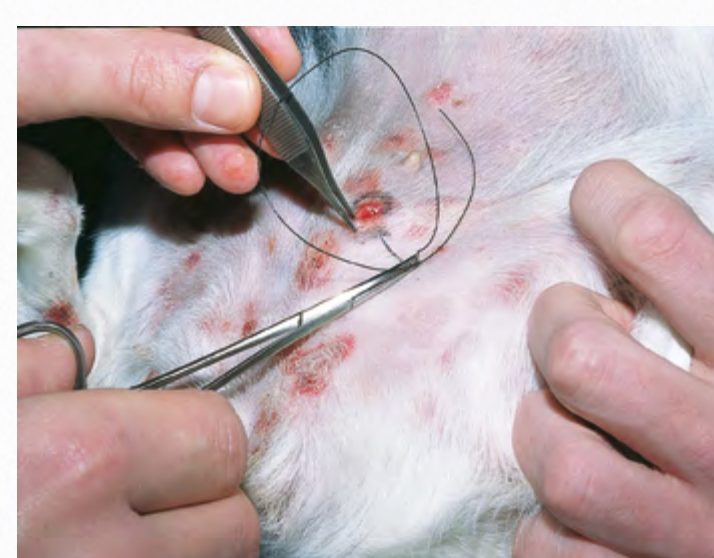


Biopsy site after sampling. (*)

For elliptical wedge biopsies, suture (preferably simple interrupted) appropriate to sample size.



Compression haemostasis. (*)



Suture of a biopsy site (6 mm punch). (*)



Suture of a biopsy site (6mm punch). (*)

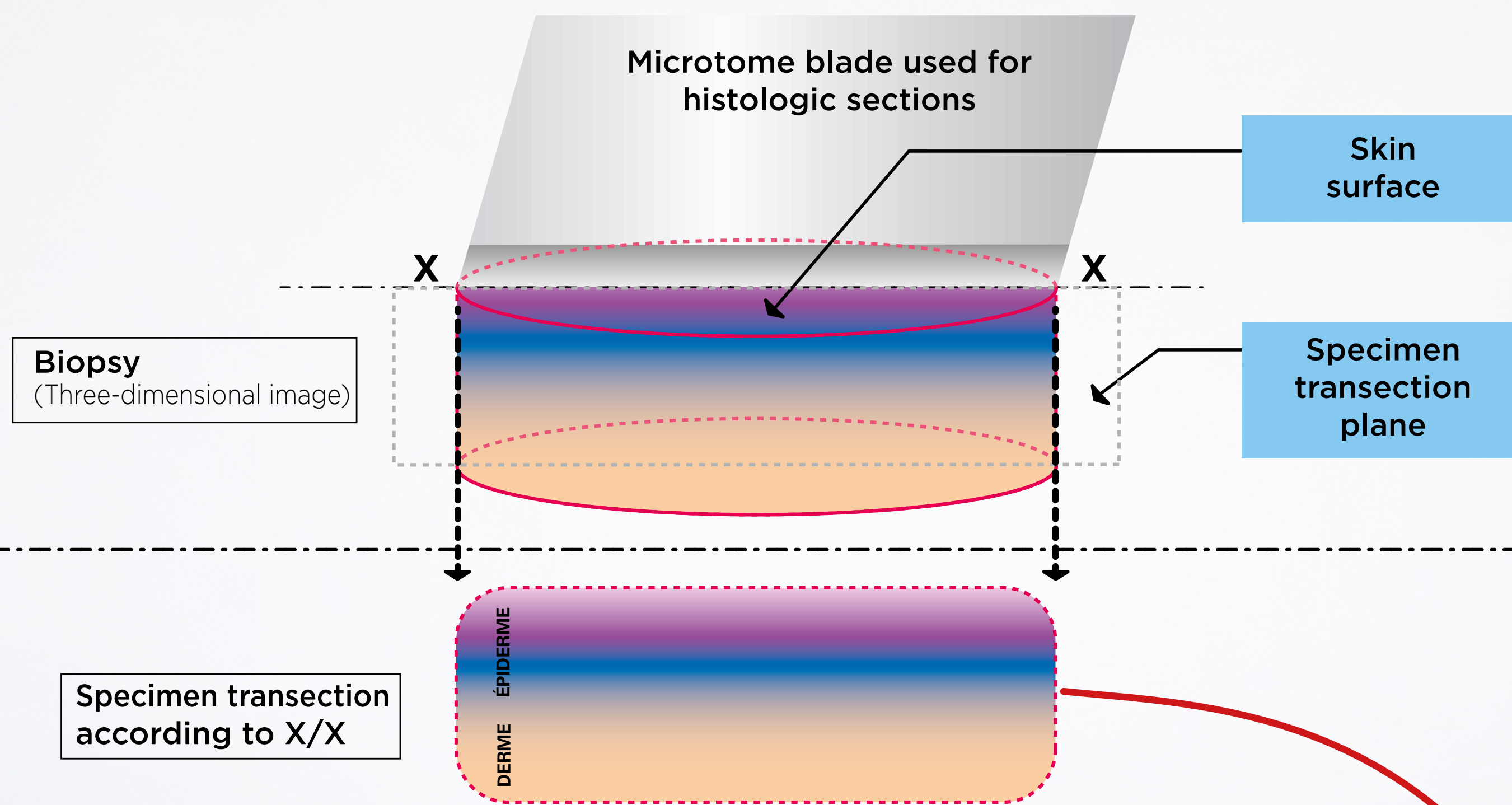
(*): Courtesy of D. Pin

PRACTICAL GUIDELINES

General method.

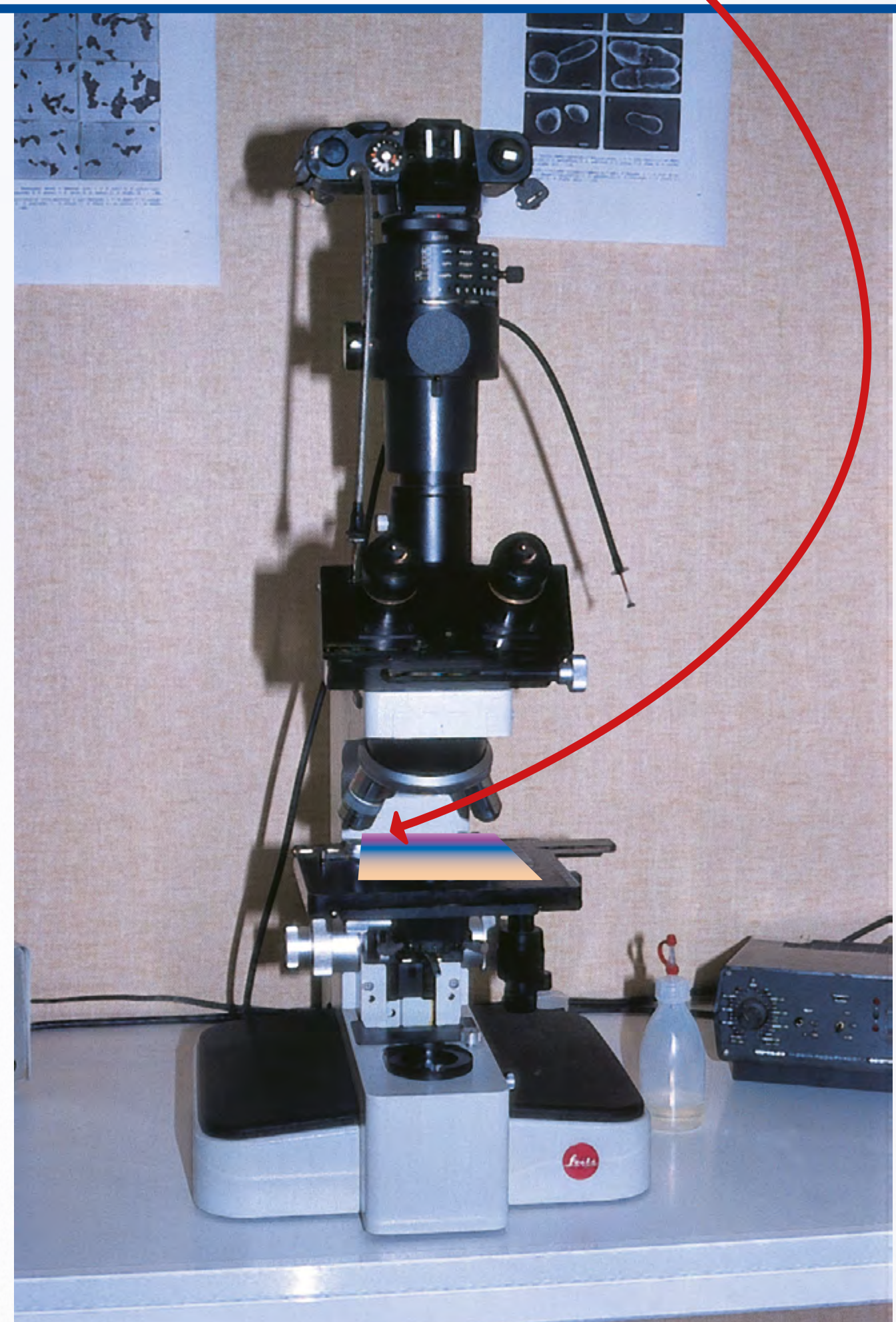
- Search for several lesions of the same type; choose the best specimen - not just the first one found.
- Care must be taken not to damage the lesion while sampling, especially primary lesions such as pustules, which can be very fragile.
- Ensure that all parts of the biopsy sample are placed in the fixation vial, e.g. crust. All material provided are (normally!) analysed by the laboratory and observed by the pathologist (a crust may carry useful information).
- Keep in mind that the pathologist will bisect the specimen through its long axis, symmetrically and perpendicularly to the skin surface (Fig1).

Fig1



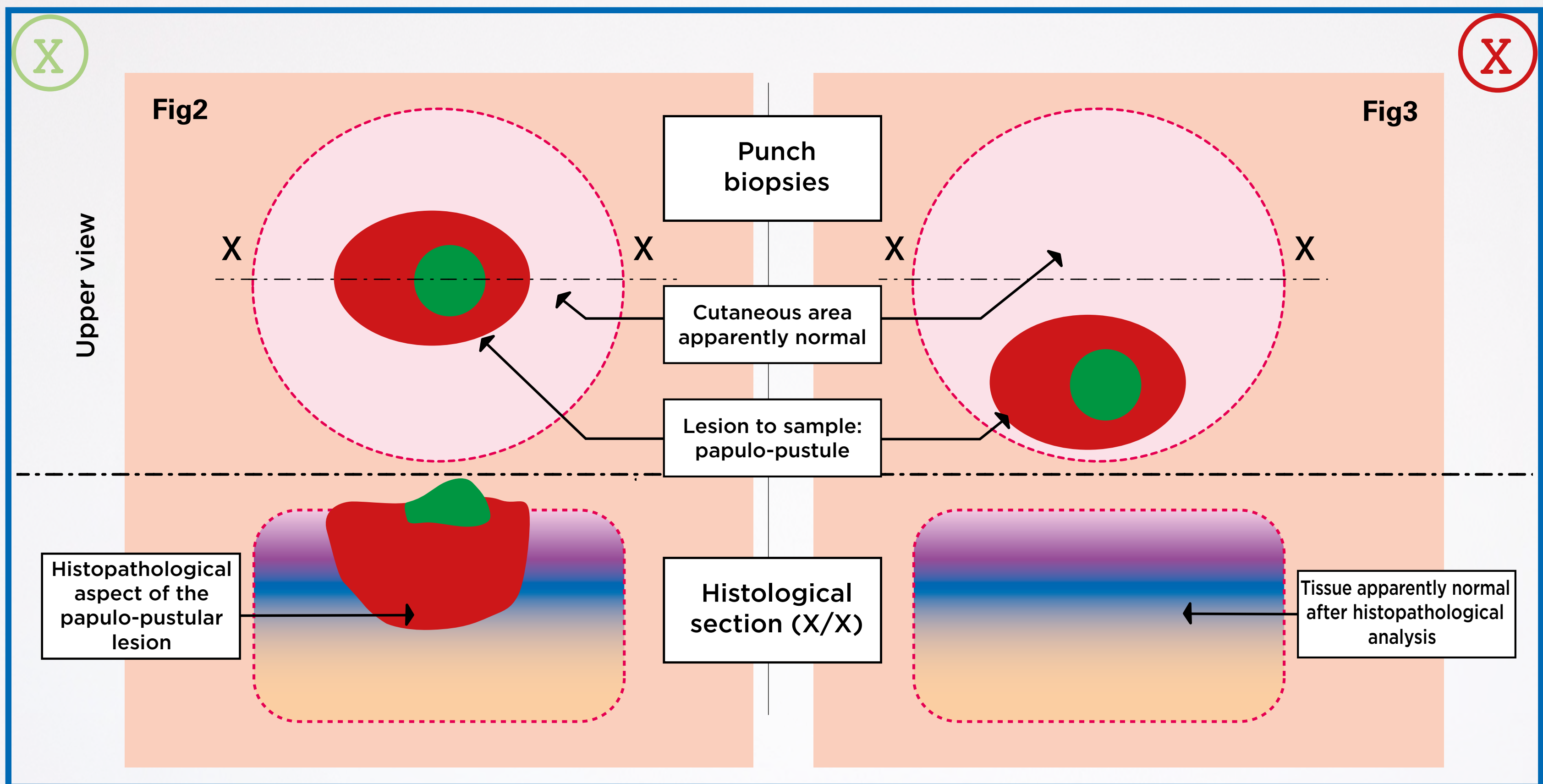
Captions for the diagrams

-  = patient skin
-  = punch biopsy
-  = elliptical wedge biopsy
-  = area apparently healthy
-  = extensive lesional area
-  = lesion considered as significant
-  = histological section
-  = correct biopsy procedure
-  = biopsy procedure incorrect

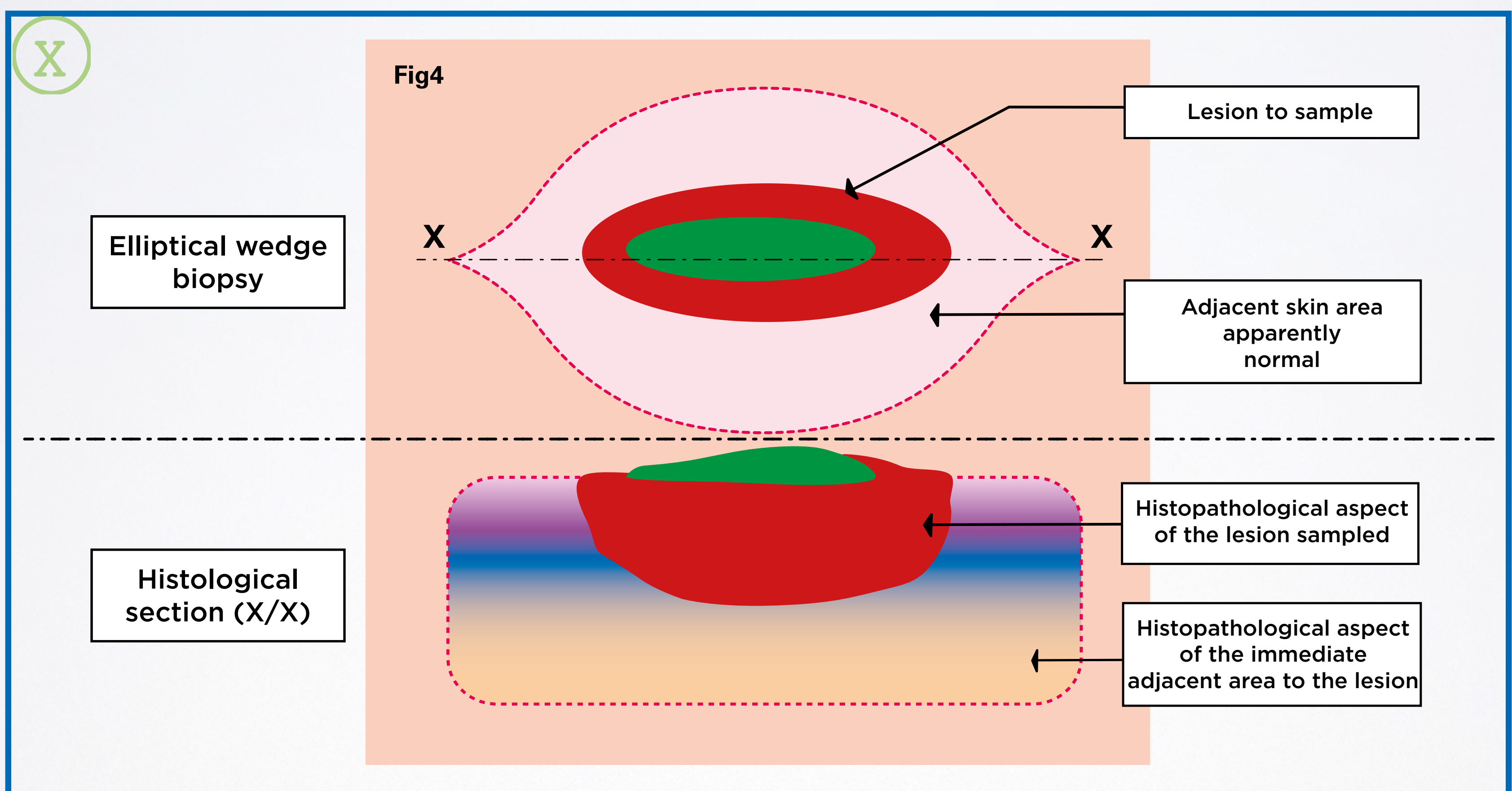


► **Sampling of well-demarcated lesions.**

- Most of the time, a punch can be used.
 - When the biopsy is performed with a punch, the specimen is cylindrical and the section will be generally done randomly according to one of the diameters.
 - It is thus very important to accurately focus the punch on the chosen lesion (Fig2).
 - If the lesion is not centred, the bisection will probably miss the lesion and normal tissue will be processed (Fig3).
 - Furthermore, focusing the punch will considerably limit the risk of damaging the lesion that will then be preserved intact (a critical factor for enabling a diagnosis with a skin biopsy).

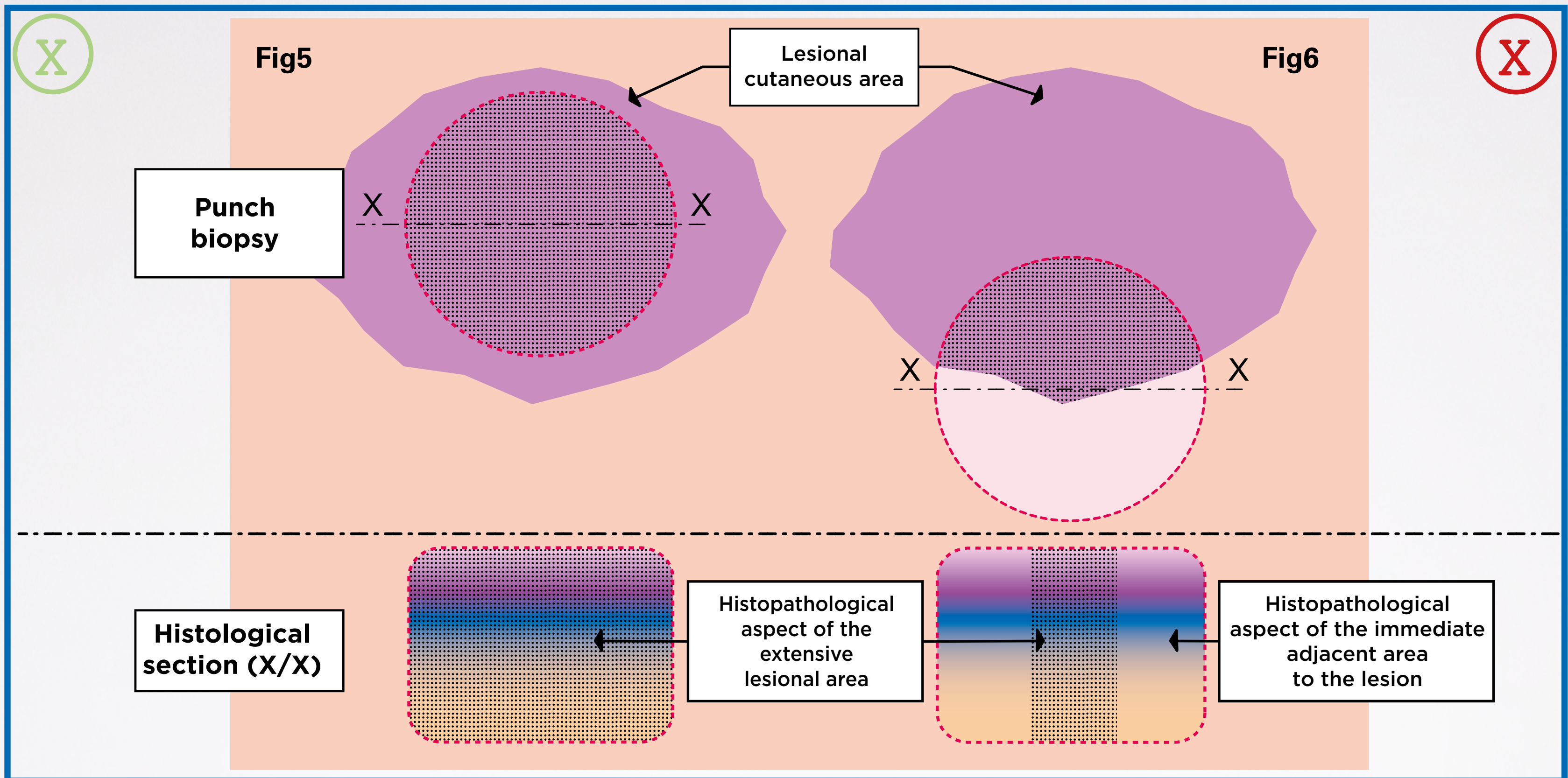


- In the case of a larger lesion, sample it entirely by performing an **elliptical wedge biopsy**, keeping in mind that the long axis must pass through the lesion (Fig4). This technique is a prerequisite with fragile and/or transient lesions (bullae, vesicles, or even furuncles...).

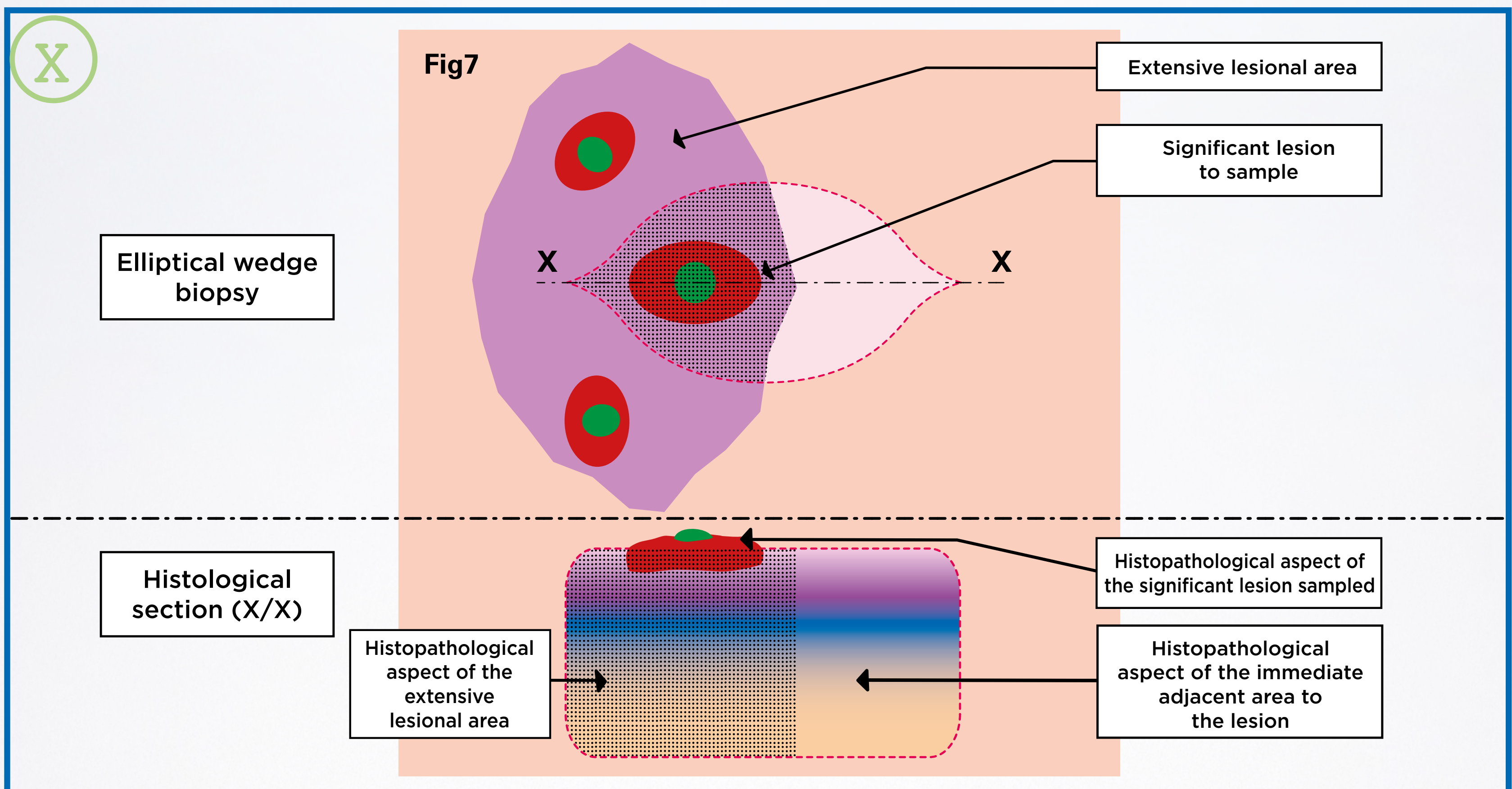


► **Sampling extensive lesional areas.**

- The biopsy must be performed within the lesion (Fig5).
- **With a punch**, it is preferable not to biopsy surrounding normal skin, for there is a great risk that such a sectioning such a biopsy may miss the lesion (Fig6).



- It is **better** to perform an **elliptical wedge biopsy with a scalpel**; the long axis will be chosen perpendicular to a tangent of the lesion (Fig7). Otherwise two or three punch biopsies are necessary.
 - The section, done along the long axis of the specimen, will then allow the processing of the lesional area with the adjacent cutaneous area.
 - If well-demarcated lesions considered significant are present within the extensive lesion, at least one of them should be included in the biopsy specimen, along its long axis.

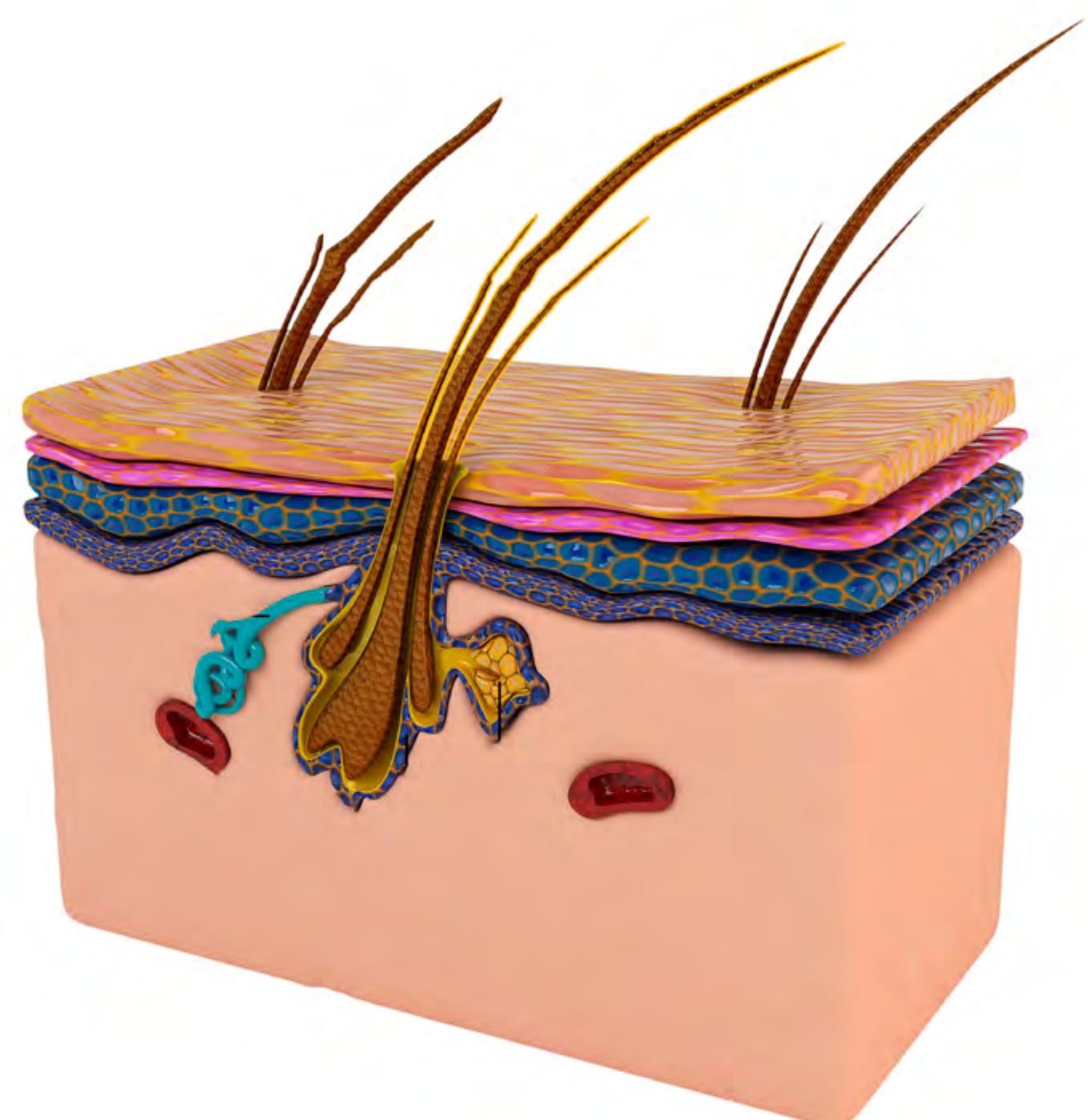


KEY POINTS TO KEEP IN MIND

- Histopathology is an important part of the diagnostic work up of the dermatological case.
- Skilled teamwork between the pathologist and the clinician is essential to obtain the best information from the skin biopsies.
- For this same reason, the choice of the pathologist to whom the samples will be sent is crucial.
- It is strongly recommended to have the skin biopsies examined by a veterinary dermatologist proficient in dermatohistopathology or by a veterinary pathologist specialising in dermatohistopathology.
- It should be made clear on the report which pathologist has examined the biopsies in order to facilitate any later discussions.
- However, the clinician should be able to rely on the pathologist and the resultant report if the few basic rules which were described are followed, i.e. if the **biopsy samples** are:
 - 1°) in sufficient **quantity**,
 - 2°) of suitable **quality**,
 - 3°) of **relevant nature** (i.e. taken from areas truly representative of the skin condition),
 - 4°) and **accompanied by**:
 - a well described **history** of the case,
 - concise **description** of the results of the **dermatological examination** (a detailed **lesional map** is an excellent method),
 - the **results** of other **laboratory examinations** and any **therapeutic trials carried out**,
 - the **results** of **all previous treatments**,
 - and possible **differential diagnosis indicated from the history and clinical examination**.
- Particularly, the biopsies must:
 - be multiple,
 - include all primary lesions, as well as secondary lesions,
 - as far as possible, include the whole lesion and part of the immediately adjacent area,
 - otherwise, the centre of the lesion, a peripheral area, an area bordering normal skin and even normal skin itself.
- The number of sites to biopsy may seem numerous, but:
 - first of all, there is usually no additional fee for several specimens,
 - then, the greater the number of samples, the better are the chances of finding diagnostic sections,
 - finally and most importantly, it is quite obvious that not every biopsy submitted along these lines will have the same diagnostic value. Nevertheless, when the likely diagnosis is unclear, it is better to provide samples that will not be useful, rather than failing to provide samples that could have been crucial in establishing the diagnosis!
- Of course, with experience, or in the case of a classical condition with limited differentials, the selection of the sites to biopsy may be refined and the number of samples reduced.
- It is also important to **specify if one wishes a precise diagnostic confirmation** of a strong clinical suspicion and/or if one wishes on the contrary to **rule out such or such differential** for which the clinical suspicion is weak, or even if one wishes to rule out a rare dermatosis (group 3).
- Not having a precise idea (or any idea at all!) of the cause of the skin condition is important information which will still be of value to the pathologist!

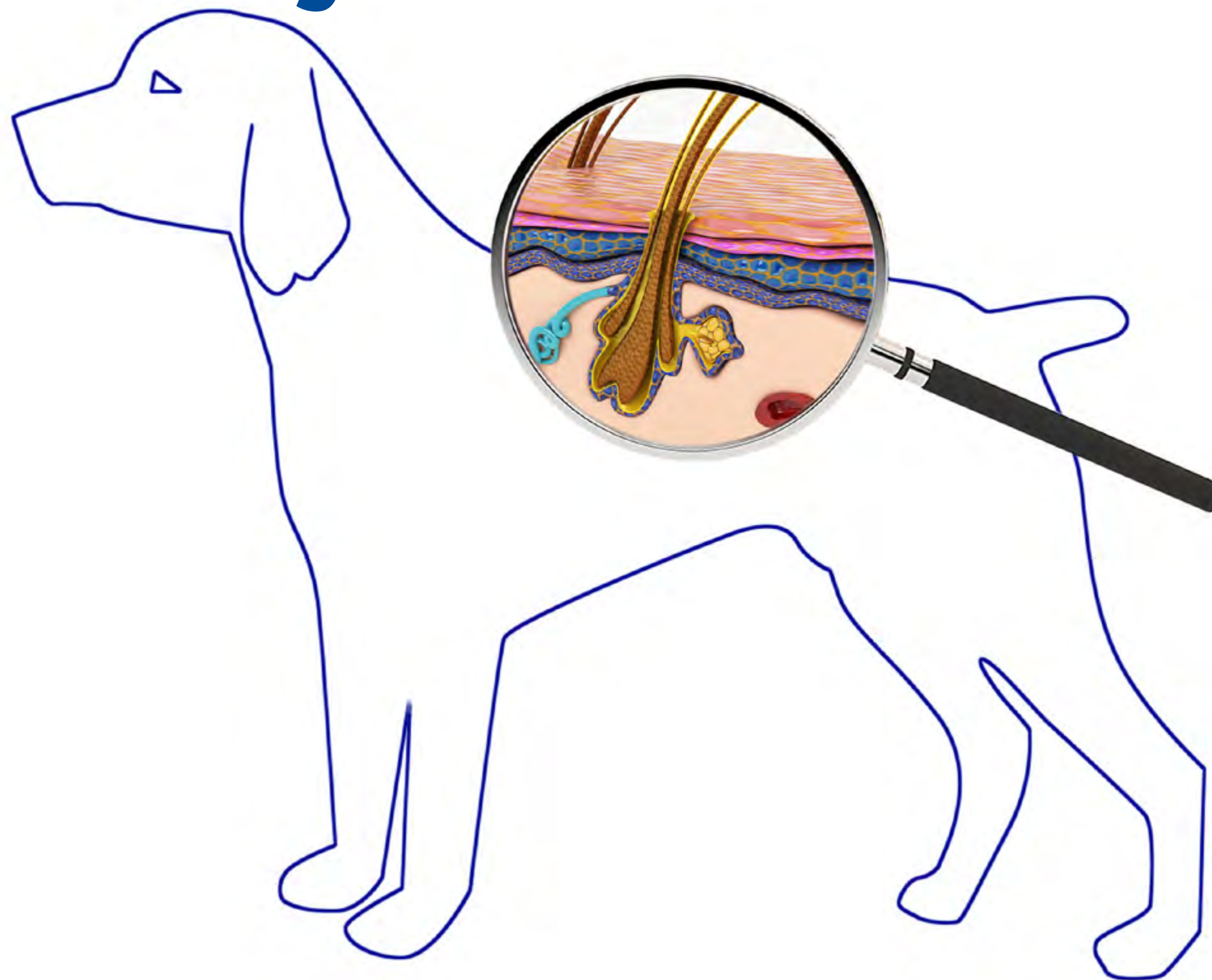
CONCLUSIONS

- **Well conducted histopathology is:**
 - **Seldom useless**, even for the most frequent dermatoses (for which the clinical approach is essential), particularly for those of group 1. The skin biopsy results will at least allow the clinician to rule out certain diagnostic differentials (more particularly from the group 3).
 - **Suggestive in many cases** (for example for the group 2 dermatoses, for which once again, the clinical approach is essential).
 - **Diagnostic for a great number of dermatoses** (belonging in particular to group 3).
- **All in all, histopathological analysis is as revealing by what it shows as by what it does not show!**



Part. 4

Elements of **physiology** and **structure** of **healthy** canine skin





PHYSIOLOGY OF THE DOG'S SKIN

The skin should be considered as a vital organ, providing whole body protection (for other organs and tissues): it has connections with other organs and with the interior of the body (usually via the mucosae) at the eyes, tympanic membrane, nose, mouth, and ano-genital area.

The skin is also responsible for many physiological functions, with continuous renewal of the epidermis and of the haircoat via the follicular cycle.

GENERAL FUNCTIONS

Enclosing barrier:

The most important function of skin is to make possible an internal environment for all other organs by maintaining an effective barrier to the loss of water, electrolytes, and macromolecules.

Environmental protection:

A related function is the exclusion of external offending agents, chemical, physical, and microbiologic, from entrance into the internal environment.

Motion and shape:

The flexibility, elasticity, and toughness of the skin allow motion and provide shape and form.

Adnexa production:

Skin produces important keratinised structures such as hair, claws, and the horny layer of the epidermis.

Temperature regulation:

Skin plays a role in the regulation of body temperature through its support of the hair coat and regulation of cutaneous blood supply.

Storage:

The skin is a reservoir of electrolytes, water, vitamins, fat, carbohydrates, proteins, and other materials.

Indicator:

The skin may be an important indicator of general health, internal disease, and the effects of substances applied topically or taken internally.

Immunoregulation:

Keratinocytes, Langerhans' cells, and lymphocytes together provide the skin with an immunosurveillance capability that effectively protects against the development of cutaneous neoplasms and persistent infections.

Pigmentation:

Processes in the skin (melanin formation, vascularity, and keratinisation) help determine the colour of the coat and skin. Pigmentation of the skin helps prevent damage from solar radiation.

Antimicrobial action:

The skin surface (superficial lipid film) and epidermis (antimicrobial peptides) have antibacterial and antifungal properties.

Sensory perception:

Skin is a primary sense organ for touch, pressure, pain, itch, heat, and cold.

Secretion:

Skin is a secretory organ by virtue of its apocrine (epitrichial), eccrine (atrichial), and sebaceous glands.

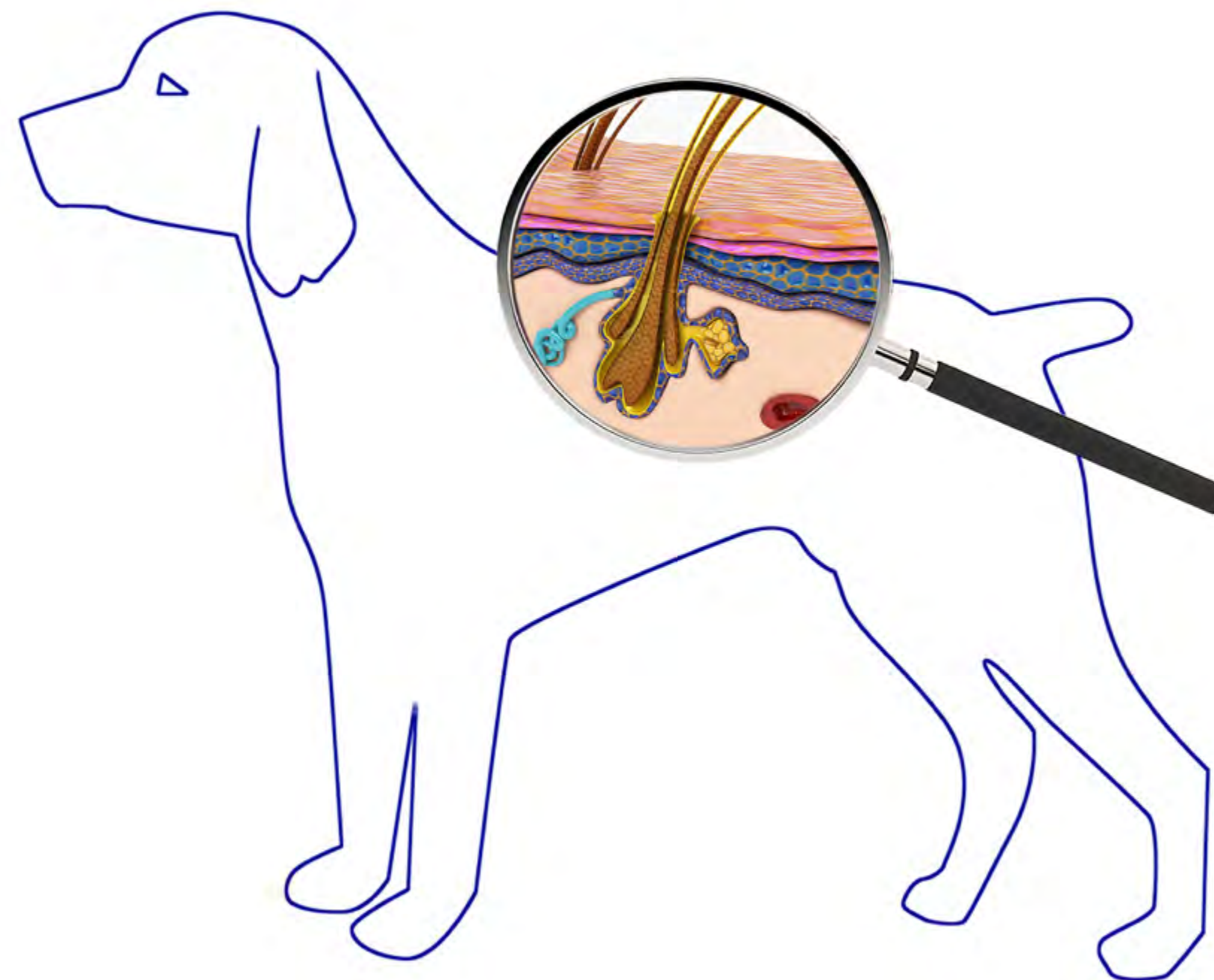
Excretion:

The skin functions in a limited way as an excretory organ.

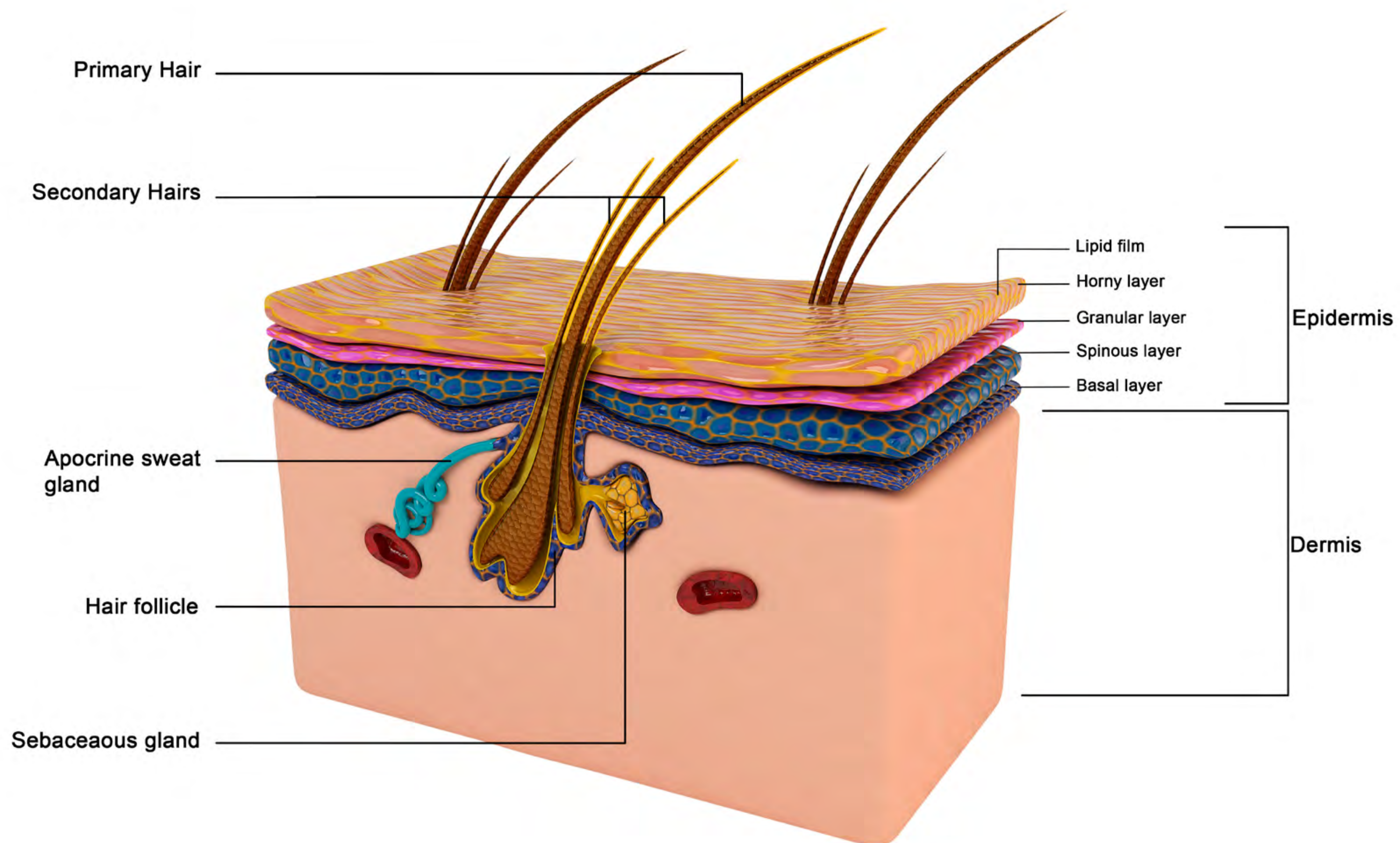
Vitamin D production:

Vitamin D is produced in the skin through stimulation by solar radiation. Vitamin D₃ is formed in the epidermis and hydroxylated in the liver and again in the kidney. It is important in the regulation of epidermal proliferation and differentiation.

NORMAL DOG'S SKIN STRUCTURE



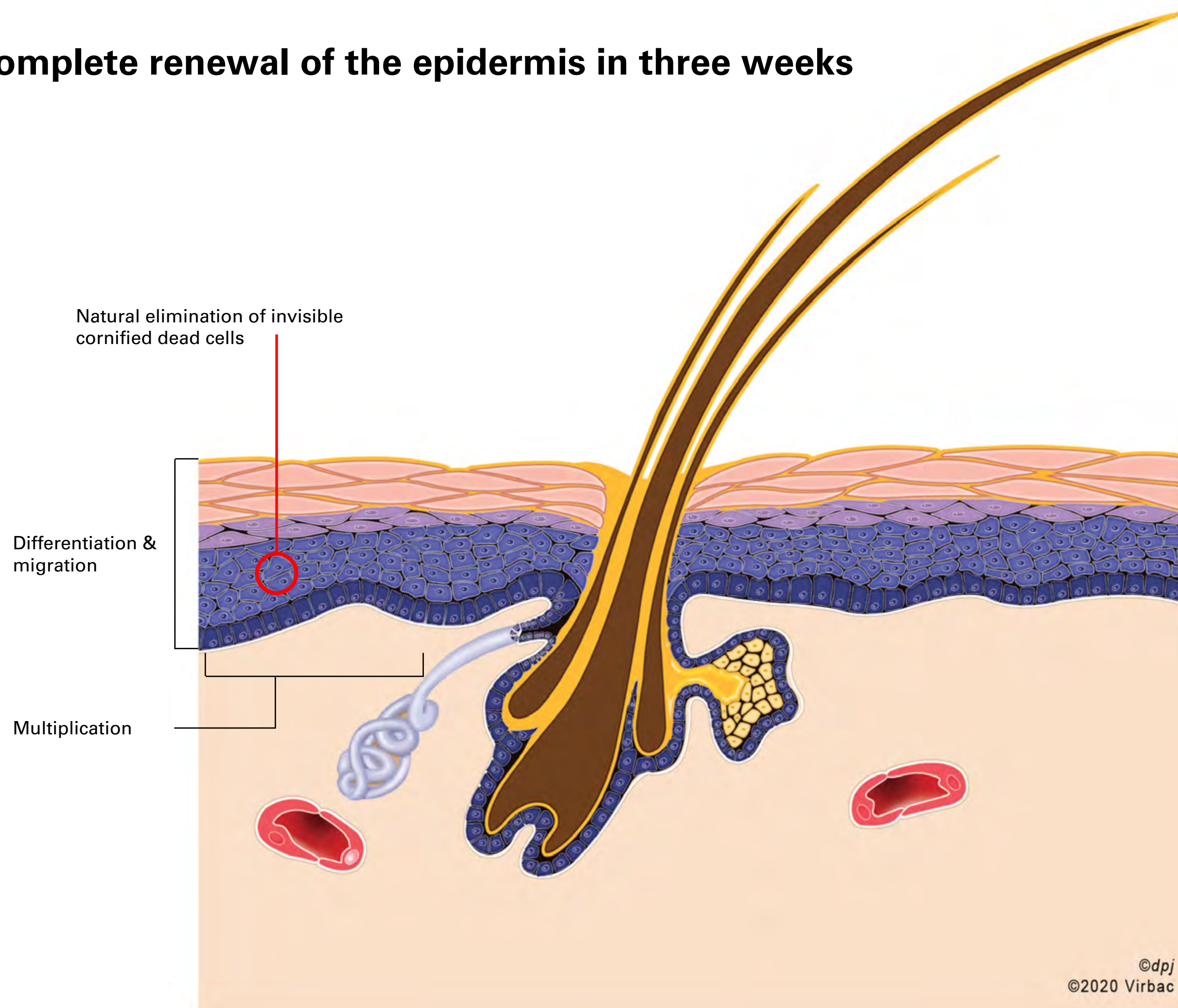
Courtesy of: P. Jasmin



Dog's skin structure. Courtesy of P. Jasmin

EPIDERMIS RENEWAL & FOLLICULAR CYCLE OF THE DOG'S SKIN

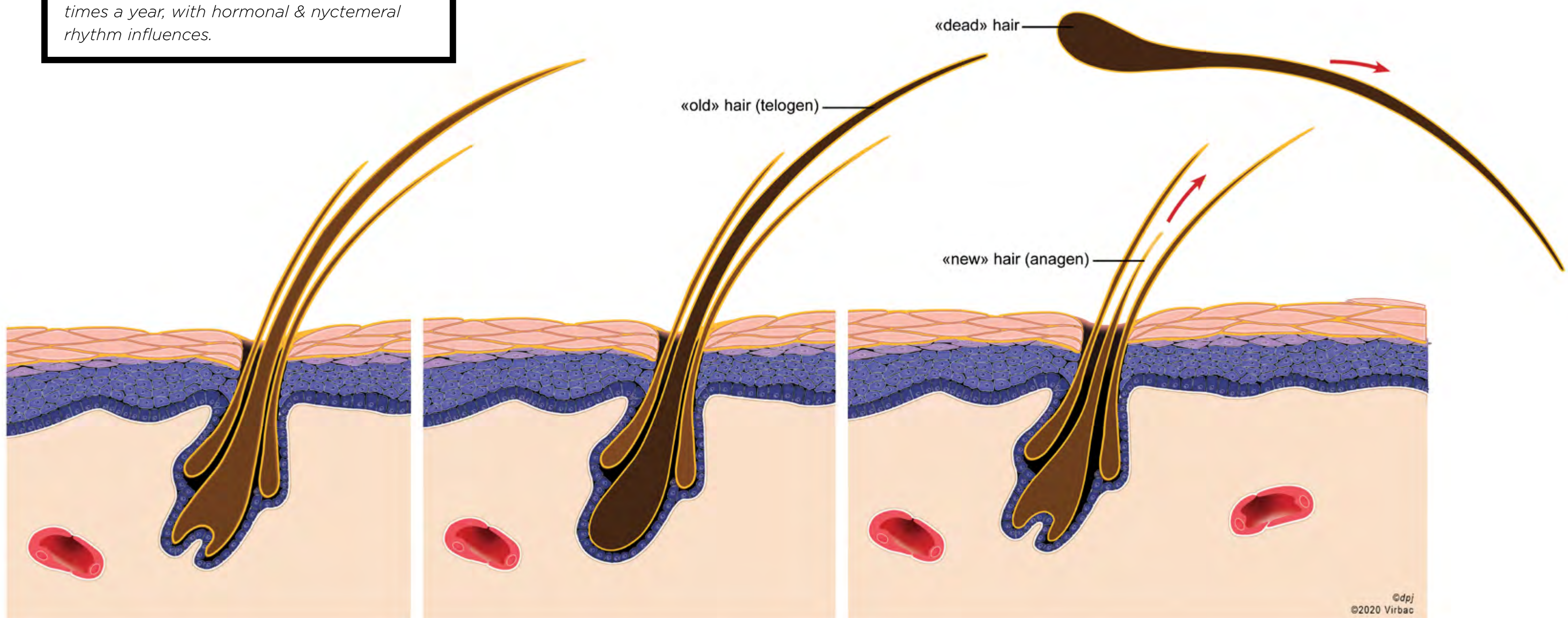
Complete renewal of the epidermis in three weeks



Epidermis renewal of the dog's skin. Courtesy of: P. Jasmin

Follicular cycle

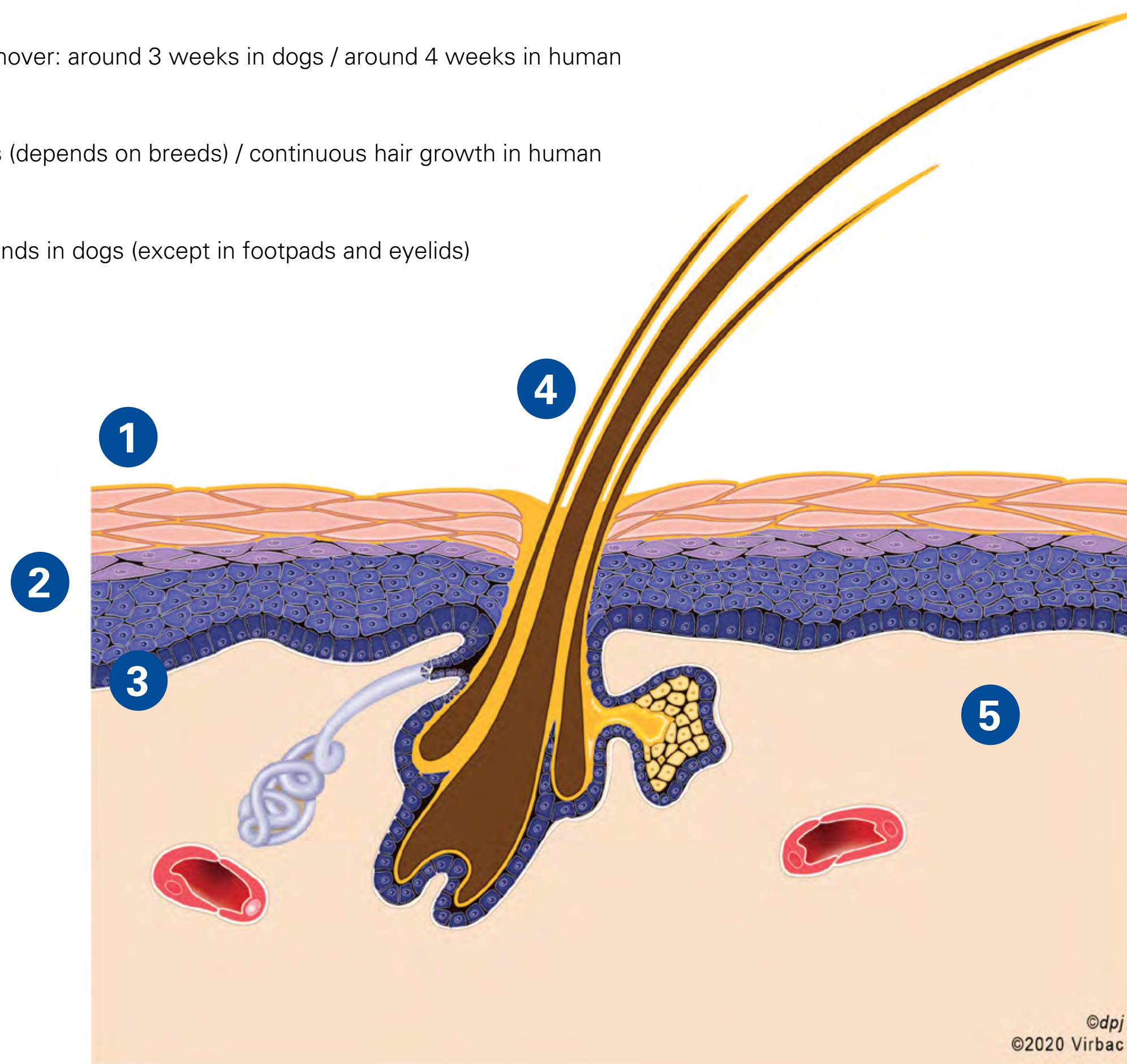
Growth of a new hair (anagen) under and beside the old one (telogen), the "dead" hair staying in the hair follicle.
The "dead" hair is pushed out by the new one and falls down.
A complete mosaic shedding occurs 3 to 4 times a year, with hormonal & nyctemeral rhythm influences.



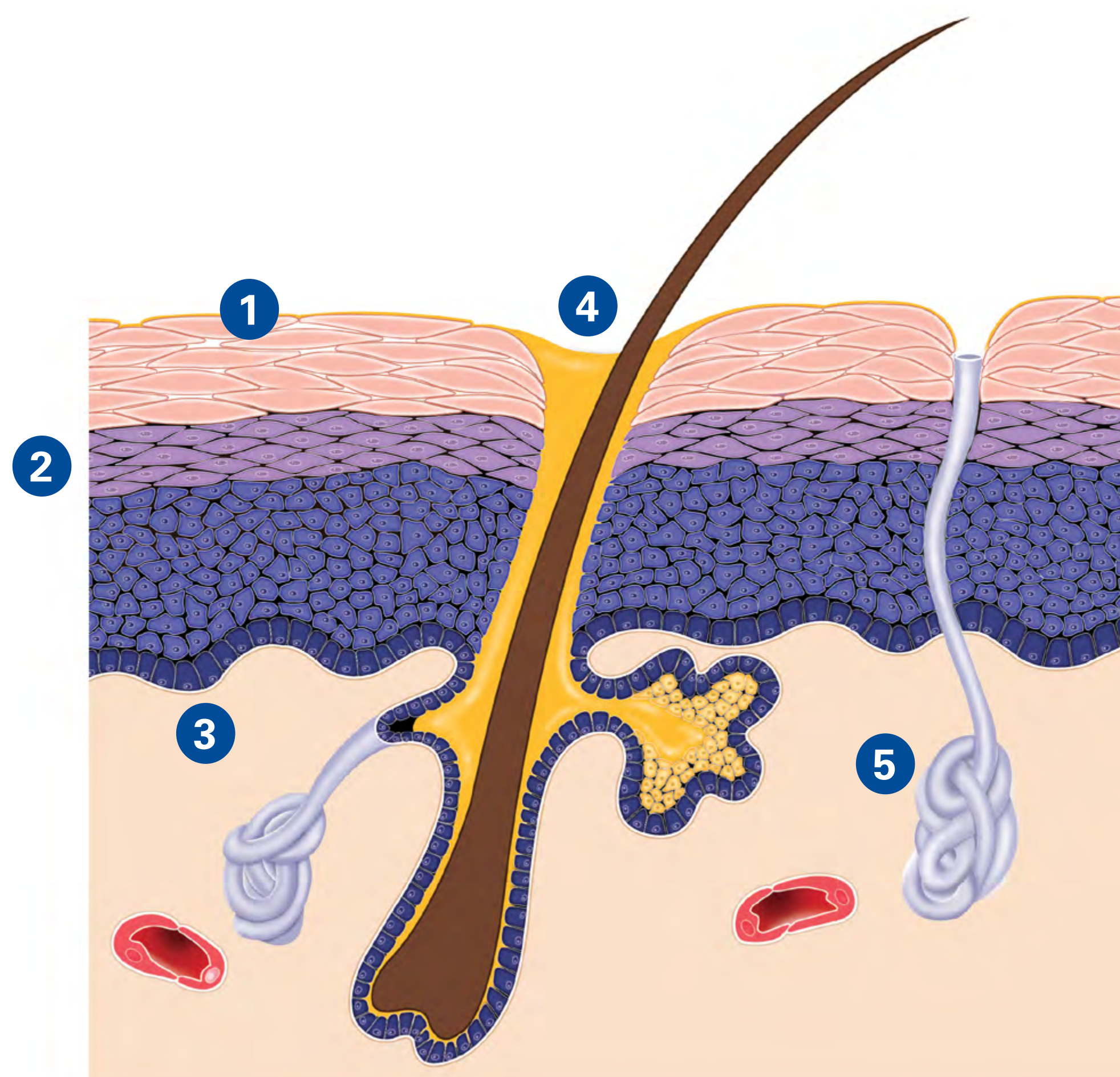
Follicular cycle of the dog's skin. Courtesy of: P. Jasmin

FUNDAMENTAL DIFFERENCES BETWEEN CANINE AND HUMAN SKIN

- 1 Cutaneous pH: close to neutral in dogs / more acidic in human
- 2 Epidermis thickness: 3-5 layers in dogs / 10-15 in human
- 3 Quicker epidermis turnover: around 3 weeks in dogs / around 4 weeks in human
- 4 Follicular cycle in dogs (depends on breeds) / continuous hair growth in human
- 5 No exocrine sweat glands in dogs (except in footpads and eyelids)



Canine skin
Courtesy of: P. Jasmin



Human skin
Courtesy of: P. Jasmin