Clinical Dermatology in the Dog and Cat

Module 1

VICAS 2010

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Microbial Skin Diseases

Bacterial dermatitis

A varied population of microbes is found on the normal canine and feline skin. This microfloral population has been reported to be influenced by pH, temperature, and moisture, as well as the surface concentrations of albumin and various fatty acids. The normal skin flora is actually composed of two distinct populations of microbes, namely a resident population and a transient population. Both populations are regarded as normal inhabitants that have adapted to surviving on the skin surface. The difference between the two groups centres on their ability to successfully multiply on the skin surface.

Resident bacteria form colonies on the superficial epidermis and in the infundibula of hair follicles. This relationship between host and microbial species is symbiotic in nature, as such resident microbes antagonise colonisation of the skin by other potentially pathogenic bacteria. Certain bacterial species, such as *Bacillus spp.* can produce antimicrobial factors, which may inhibit the growth of other bacterial species. The number of resident organisms on the skin surface can vary markedly both from dog to dog and with time. The total count of aerobic organisms on normal canine skin is reported to be as high as $10^3$/cm$^2$. In dogs with seborrhoeic skin disease, the total count was shown to be significantly higher. Controversy exists as to whether *Staphylococcus pseudintermedius* should be regarded as a resident organism. Despite its pathogenic significance, the organism can nevertheless be cultured from the skin of many normal healthy dogs and cats. It appears likely that resident microbial species are acquired from the dam early in life. Areas of the skin which are constantly moist and areas of intertrigo may have a higher population of certain microbial species than dry, well ventilated regions.

<table>
<thead>
<tr>
<th>Resident organisms</th>
<th>Transient organisms</th>
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<tbody>
<tr>
<td><em>Staphylococcus spp.</em> (coagulase +ve)</td>
<td><em>Escherichia coli</em></td>
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<tr>
<td><em>Staphylococcus spp.</em> (coagulase –ve)</td>
<td><em>Proteus mirabilis</em></td>
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<tr>
<td><em>Micrococcus spp.</em></td>
<td><em>Corynebacterium spp.</em></td>
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<tr>
<td>Alpha-haemolytic streptococci</td>
<td><em>Bacillus spp.</em></td>
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<tr>
<td><em>Acinetobacter spp.</em></td>
<td><em>Pseudomonas spp.</em></td>
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Transient organisms appear to originate from the animal’s environment or from faecal contamination of the coat or skin. Although clinical disease does not normally result from such colonisation of the skin, the organisms are potentially pathogenic in the presence of trauma or underlying disease processes that give rise to significant pruritus. Gram-negative organisms are rarely pathogenic unless warm, moist conditions predominate, or unless the Gram-positive populations are reduced by certain treatment regimes. Anaerobes tend to originate from intestinal sources or from soil, and include organisms such as *Bacteroides* and *Clostridium species*, and others such as *Actinomyces* species. Fungal species which may be recovered from normal skin include *Malassezia pachydermatis*, *Alternaria*, *Aspergillus* and *Penicillium* species.

*Staphylococcus pseudintermedius* and *Staphylococcus aureus* can be cultured from the skin of up to 90% of normal dogs. However, *S. pseudintermedius* is the principal bacterial skin pathogen of the dog. This bacterial species commonly produces protein A, which may facilitate bacterial cell adhesion to skin and other cells, thus increasing the organisms pathogenicity. Bacterial adherence is a feature of some skin pathogens, and therefore may be of importance in facilitating colonization. The normal shedding of skin surface cells,
together with non-specific defence mechanisms such as washing and drying, hinder skin colonisation. It is further postulated that certain bacterial strains may be better adapted to adhering to certain body sites, thus offering a possible explanation for the regional distribution of certain bacterial skin diseases. The particular species and the numbers of organisms present are often dependent on particular disease states. *Staphylococcus pseudintermedius* is the dominant species encountered in most cases of canine pyoderma and seborrhoeic skin disease (Scott et al, 1995). In general, an increased number of different resident bacterial species may be found on dogs with immune-mediated dermatoses. Such increased numbers of bacteria are found at most body sites, not just areas where gross lesions are evident. This finding is important when considering the likely colonisation potential resulting from self-trauma in such dogs. Colonisation may lead to a host reaction to the organism, and subsequently to skin infection.

Most infections of canine skin with *S. pseudintermedius* are secondary to a range of underlying disease processes, including conditions as diverse as hypersensitivities, hormonal imbalances and metabolic disturbances. Primary cutaneous diseases may predispose to secondary infection by a variety of mechanisms. These include increased bacterial numbers on the skin and self-inflicted trauma to the physical skin barrier. In addition, the immunosuppressive properties of corticosteroids frequently used in treatment protocols may predispose to skin infections. Hair follicles may be particularly prone to secondary bacterial infection due to inflammation and obstruction, which provides a more suitable environment for the development of such infection. Endocrine abnormalities frequently have an adverse effect on the functioning of the immune system, and furthermore may lead to marked changes in hair follicle morphology e.g. loss of hair shafts, follicular keratosis etc.

Secondary bacterial skin diseases are classified according to the depth of the resultant reaction in the skin and adnexal structures. Thus, bacterial pyoderma in the dog is described as surface, superficial or deep.

Primary bacterial infections of the skin in the dog are uncommon. They are considered to occur in animals with otherwise normal skin, and are usually successfully treated with appropriate antibiotics. *Staphylococcus pseudintermedius* is the organism regularly involved. Recurrence of the clinical condition would not be expected following appropriate therapy. However, it cannot be determined at the time of initial consultation if infection will recur. Consequently, the diagnosis is usually made retrospectively.

**Clinical signs**

- Primary staphylococcal dermatitis is rare in dogs and cats. Consequently, there may be signs evident, which relate to an underlying immunosuppressive disease.
- Pustules are the hallmark of pyoderma in dogs, but are not common in cats. Lesions with obvious purulent discharge may be evident, particularly in the canine. Any site on the body may be affected.
- Erythema and scale/crustiness may be seen clinically. The hair follicles may be involved, with resultant alopecia. Lesions may become pigmented in the centre, where resolution is occurring, but have an outer red zone, where infection is still active.
- A moth-eaten appearance, typically affecting the body trunk, is occasionally seen in the dog.
- In cats, lesions may progress to appear as papules, thus taking on a miliary pattern.
- Areas of the body that are being self-traumatized e.g. pododermitis, may have discharging sinus tracts etc.
• Staphylococcal infection may present as abscesses or infections of the ears and conjunctiva. Deeper infections are infrequent. Other bacterial species e.g. Nocardia species may present as cutaneous nodules or discharging masses.

**Diagnosis**

• A diagnosis is often suspected on clinical signs alone.
• Staphylococci and other bacterial species can be readily cultured from infected lesions. Care is required as most normal dogs and cats possess coagulase-positive staphylococci on their skin.
• Biopsy may show evidence of bacterial folliculitis, pyoderma or deeper infection.
• Dynamic endocrine testing may be required if an endocrinopathy is suspected.

**Treatment**

• In most cases, treatment with antibacterial agents known to be effective against *S. pseudintermedius* is clinically effective e.g. amoxycillin-clavulanate, cephalosporins, flouroquinolones etc.
• In repeat cases or those that do not respond, bacterial culture and appropriate antibacterial selection should be performed.
• Topical washes and shampoos can be highly beneficial, particularly when the infection is not deep or when the hair follicles are involved. Appropriate agents include chlorhexidine, benzoyl peroxide, ethyl lactate etc.
• Address any underlying immunosuppressive or endocrine diseases that are predisposing to recurrent bacterial diseases.

**Systemic antibacterial agents**

Some of the critical factors that must be borne in mind when choosing an appropriate antibacterial agent for treating canine/feline pyoderma include;

• Efficacy of the compound against *S. pseudintermedius* and any other relevant pathogens,
• Use of a narrow-spectrum bactericidal agent, whenever possible,
• Systemic bioavailability, especially following oral dosing,
• The likely presence of effective therapeutic concentrations above the MIC$_{90}$ of relevant organisms in the skin and on the skin surface,
• Safety and tolerance, particularly with prolonged use (*N.B. Convenia - long acting formulation*)
• Resistance patterns - specific and general.

The following table outlines some of the main systemically acting antibacterial agents used in canine and feline pyoderma. Whilst some of the drugs can be given by parenteral routes also, we are concentrating here on the oral route for obvious reasons;
<table>
<thead>
<tr>
<th>Antibacterial drug</th>
<th>Dose (mg/kg)</th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td>Clindamycin</td>
<td>11</td>
<td>SID</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>10-15</td>
<td>BID</td>
</tr>
<tr>
<td>Lincomycin</td>
<td>22</td>
<td>BID</td>
</tr>
<tr>
<td>TMP-Sulphadiazine</td>
<td>30</td>
<td>BID</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>22-30</td>
<td>BID</td>
</tr>
<tr>
<td>Oxacillin</td>
<td>22</td>
<td>TID</td>
</tr>
<tr>
<td>Amoxicillin-clavulanate</td>
<td>11-22</td>
<td>BID</td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>2.5</td>
<td>BID</td>
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<tr>
<td>Marbofloxacin</td>
<td>2</td>
<td>SID</td>
</tr>
<tr>
<td>Ibafloxacin</td>
<td>15</td>
<td>SID</td>
</tr>
</tbody>
</table>

**Topical antibacterial agents**

A large number of formulations are marketed for their topical antibacterial effect in small animals. Amongst the more common are benzoyl peroxide, chlorhexidine, ethyl lactate and sodium fusidate. In addition, many active ingredients contained in commercial shampoos, such as sodium salicylate and Sulphur, also possess antibacterial activity. There are many topical formulations that also contain antibiotics, such as neomycin, polymixin B etc. etc. These agents may be successful on their own for surface, or even superficial infections, of the skin. However, in many cases, they may be used in combination with a systemic agent. Again, rather than providing an exhaustive list, I propose to concentrate instead on those agents which are regularly used and have given consistently good results.

- Benzoyl peroxide – available both as a shampoo and a topical gel. This agent is particularly useful, as it possesses many different activities; it is antibacterial, anti-seborrhoeic and has a follicular-flushing effect. It can be used successfully as a sole therapy for surface pyoderma or in combination with antibiotics, for deeper infections. Benzoyl peroxide is particularly useful for infections involving the hair follicles and cases of acne. The principal mode of action of this potent oxidizing agent is to interact with biological elements, causing disruption of the microbial cell membrane through the formation of benzoyl peroxy radicals. Concentrated gels may be irritant to some animals, particularly cats. The shampoo is applied as often as is necessary, but care must be exercised to ensure the coat does not become excessively dry. The frequency of shampooing can be reduced as the condition improves.

- Ethyl lactate – wide spectrum of antibacterial activity, with excellent tolerance. Similar rules on frequency of use apply. The compound is degraded, within the skin and on the skin surface, into lactic acid and ethanol. Ethanol has well documented antimicrobial properties. The lactic acid is believed to have some bactericidal effects.
and also serves to reduce the surface pH, thus inhibiting bacterial growth. Ethanol is also suitable for treating comedones and removing surface grease.

- **Fucidin** – long-term use in human medicine has demonstrated the efficacy of fucidic acid against staphylococcal species. This compound is sometimes combined with a corticosteroid. Fucidic acid is generally effective in the treatment of surface pyoderma and conjunctivitis associated with *S. pseudintermedius* infection. Because this active ingredient is combined with a carbomer gel base in certain commercial formulations, it is able to attach to wet lesions and is quite miscible with purulent material. Fucidic acid is active in the presence of pus. Its ability to penetrate skin is high, and effective therapeutic concentrations are maintained for relatively prolonged periods e.g. in the conjunctival sac.

- **Chlorhexidine** – just because it’s simple and has been around for a long time, don’t forget simple chlorhexidine. This biguanide compound is highly suitable, in terms of efficacy, safety and expense for the treatment of many forms of skin infections. Resistance is uncommon, although some Pseudomonas spp. are not sensitive. Effective concentrations vary between 0.05 – 2%. Different forms are available e.g. shampoo and surgical scrub. I have found it very useful for flushing out wounds and as a whirlpool bath for the treatment of pododermatitis. Normally applied 2-4 times daily, except in shampoo form. The combination of chlorhexidine and miconazole in Malaseb shampoo is very effective for secondary bacterial/yeast dermatitis.

- **Iodine** - not as commonly used nowadays as heretofore. Mainly used as a surgical scrub.

**Feline Leprosy**

This condition is reported rarely in practice. Controversy exists as to the precise aetiological agent involved. Whilst a Mycobacterial species is definitely involved, whether *M. lepraemurium* is the precise agent or not is uncertain. Culturing of the causal organism is frequently unrewarding. Whilst suspicions surround its zoonotic potential, reported cases of transmission from cat to owner are absent from the literature. The clinical signs of feline leprosy consist of one or multiple nodular growths in the skin. These nodules often grow quite large in diameter, and on occasions, the cat may be covered in lesions over most of its body. Lesions are most common on the head and extremities. The nodules frequently ulcerate, and may ooze sero-sanguinous material. Most affected cats are quite young (less than 4 years of age). The draining lymph nodes may be enlarged.

Diagnosis is based on the characteristic histopathology of the affected lesions i.e. tuberculoid reaction or lepromatous leprosy (see pathology notes). Special stains are often employed to demonstrate acid-fast organisms in the lesions.

The treatment of choice involves surgical removal of the lesion(s). If this is not feasible due to the number or size of such lesions, then clofazimine (2-3mg/kg SID) for 6-10 weeks until after lesion regression. Dapsone was used in previous years, but the side effects of this medication may be significant in individual animals.
**Dermatophytosis**

Dermatophyte infections are seen more commonly in cats than in dogs. Dermatophyte species parasitize the superficial keratinized layers of the skin, hair follicles and nails. Microsporum canis is frequently involved in the cat. The same species is important in the dog, but so also is M. gypseum and Trichophyton mentagrophytes.

Younger animals and animals with immunosuppression are at particular risk. Older animals are more resistant. Dermatophytes can induce a localized inflammatory or even a hypersensitive response. Infection may lead to hyperkeratosis, epithelial hyperplasia, and folliculitis. This can result in hair shaft breakage and alopecia. Secondary bacterial infection is common and rupture of follicles may lead to a granulomatous reaction in the skin. Viable dermatophyte organisms can still be isolated from lesions after clinical resolution. A genetic predisposition is possible in certain breeds of cats, such as Persians. The condition is zoonotic.

**Clinical signs**

- Initial lesions are commonly present on the face, head and feet. Large areas may become involved.
- Raised, erythematous plaques and scale may develop initially.
- Alopecia develops and lesions expand to form larger plaques, which appear grayish and hyperkeratotic.
- Initial hair loss tends to be in the centre of the lesion. Hairs on the periphery appear discolored and brittle.
- Upon regression, initial hair re-growth appears in the centre of the alopecic areas.
- Secondary bacterial infection is common.
- Infection may involve the whiskers in cats or nail beds, with resultant deformities.
- Infection of deeper tissues may result in nodular skin lesions.

**Diagnosis**

- Fluorescence under ultraviolet light (Wood’s lamp), may detect approximately 50-60% of cases of M. canis infections in cats. Trichophyton species do not fluoresce.
- Skin scrapings and hair plucks may be examined microscopically for spores or hyphae.
- Fungal culture of scrapings, hair plucks and nail samples can identify the species of dermatophyte involved, but is time-consuming.
- Biopsy of affected tissue may confirm a diagnosis. Special stains may be required.

**Treatment**

- A variety of agents are available for both topical and systemic treatment of dermatophytosis.
- Topical agents include clotrimazole, ketoconazole, enilconazole and miconazole.
- Systemic agents include griseofulvin (10-50mg/kg per day for 4-8 weeks). Do not administer to pregnant animals. Availability is an issue in several countries.
- Ketoconazole (10mg/kg BID PO) for 4 weeks is also effective. Hepatic dysfunction and pregnancy are contraindications. Itraconazole and fluconazole are highly effective, but expensive.
- Clipping of hairs from and surrounding the sites of lesions, or full body clipping in disseminated cases.
- Removal of nodules or malformed nails may be indicated.
• Antibacterial therapy, if secondary bacterial infection is present.

**Prognosis**

• Although the prognosis is generally good, some cases may require many months of therapy. In non-responsive cases, consider the dermatophyte species, dosage levels, potential for re-infection and immunosuppression.

**Prevention**

• All in-contacts should be examined and treated prophylactically if necessary, especially in large pure-bred catteries. Isolate infected animals.
• Extreme care (disinfection or disposal) needs to be taken with bedding, clothing, grooming combs etc. to ensure no cross-infection.
• Immunity to dermatophyte infection is not complete at the time of clinical resolution.
• New animals, especially in catteries, should be isolated until confirmed free of infection.

**Transmission**

• Direct or indirect contact. Spores have survived in the environment for over a year.

**Malasseziasis**

Considerable controversy surrounds the clinical significance of this common saprophytic yeast. Malassezia pachydermatis is a normal inhabitant of the skin, mucous membranes and external ear canals of most dogs and cats. Isolation of this organism from infected or inflammed sites poses the obvious question; is it significant and did it cause the problem or did it act as an opportunist invader? Some authors believe *M. pachydermatis* to be highly significant. Factors which are believed to increase the numbers of Malassezia organisms at various sites include recent antibiotic treatment, glucocorticoids and the presence of seborrheic skin disease. A breed predisposition is believed to exist in Westies due to a deficient T-lymphocyte response to the organism. Other terrier breeds are also commonly affected. Another important factor is the fact that humans with atopic dermatitis have been shown to mount immune responses to this organism. The possibility of both immediate and delayed type hypersensitive responses to *M. pachydermatis* are being investigated at present, and an intradermal skin test challenge is possible in dogs. Malasseziasis is much less common in cats; when it does occur in this species, it is normally associated with otitis externa, acne and exfoliative erythrodema.

**Clinical signs**

• Clinical signs of disease tend to be more common in warmer periods of the year, and in the middle of allergy seasons.
• Pruritus varies from mild to marked. It is one of the most common signs.
• Erythema, scaliness and a greasy smell and feel to the coat.
• Common sites affected include the face, ears, feet and ventral surfaces.
• Affected skin may become thickened and hyperpigmented.
• Otitis externa may be a dominant sign in certain animals.
• Signs of an underlying skin disease e.g. atopy, seborrhoea etc., are often present.

**Diagnosis**
• Cytology performed on tape strips, glass slides rubbed against the skin or superficial skin scrapes. Special stains such as Dif-Quik are employed.
• Collected surface material can also be cultured, but growth responses of M. pachydermatis can sometimes be disappointing.
• Biopsy may demonstrate the organism, but this does not prove an aetiological role.
• Response to treatment is used by many clinicians as a diagnostic tool.

Treatment

• Topical shampoos are popular and can be highly effective. “Malaseb” contains a combination of chlorhexidine and miconazole. Other agents that are effective include selenium and enilconazole. Dogs are generally washed twice weekly until lesions resolve. This may take several weeks. Focal lesions may be washed more frequently.
• Oral ketoconazole is highly effective (10mg/kg BID), but expensive. Itraconazole has also given encouraging results.
• Any underlying immune-mediated dermatitis, keratinization disorder etc. must be treated to minimize the chance of recurrences. Be wary of the immunosuppressant effects of glucocorticoids, however.

Feline Orthopox Virus infection

Uncommon viral dermatosis of cats. There is much discussion over whether some cases are never diagnosed properly. This condition is zoonotic to humans.

Clinical signs

• More common in young to middle aged cats.
• Initial history of a single lesion on the head, neck or fore-limbs earlier on in the history.
• The primary lesion consists of a non-healing sore or ulcerated skin tissue with a raised indurated border.
• Within days to weeks, papules begin to appear in several sites. The papules commonly become eroded or ulcerative, and scab over.
• When the scabs fall off, areas of alopecia and scarring are evident. These lesions gradually heal. As some lesions heal, new lesions can also develop.
• Pruritus is seen in all stages.
• New hair growth takes 6-8 weeks.
• Secondary infection, abscess or cellulitis are all possible.
• Ulceroproliferative lesions may also develop in the mouth, pharynx, conjunctiva and on the muzzle.
• Systemic signs of ill-health are present in many cases.

Diagnosis

• Biopsy reveals the presence of intracytoplasmic inclusion bodies, either Type A or Type B. Healing lesions may be negative.
• Electron microscopic examination of unfixed scab or biopsy material can be used to identify orthopoxvirus particles.
• Viral isolation techniques are available in special laboratories.
• Serologic tests for detection of orthopoxvirus antibodies.
Treatment

• Symptomatic – as stated above, most cases recover spontaneously in 6-8 weeks time. Antibiotic coverage is often performed, and fluid therapy etc. may be necessary if inappetant.
• Do not use corticosteroids, as they can lead to cutaneous forms becoming systemic.
**Parasitic Dermatoses**

**A) Mange Mites**

**Demodicosis**

Common condition encountered in practice. Although demodicosis is occasionally seen in cats (often FeLV or FIV-related), it is far more common in dogs. The clinical condition is divided into juvenile forms (generally seen at 3-12 months of age) and adult onset forms (sometimes related to immunosuppression). Some cases are focal or localized, whilst other cases are classified as generalized, depending on the extent and distribution of lesions. *D. canis* is a normal inhabitant of canine skin. The role of genetic predisposition in facilitating the initial proliferation of mites is well reported. The presence of disease, often with secondary infection as a complication, is implicated in leading onto a generalized immunosuppressive condition in affected animals. Although transmission is from dam to progeny, the condition is not contagious in the general sense between in-contact pets.

**Clinical signs**

- **Localized form** – alopecia and mild erythema / scaliness, often affecting sites such as the face, around the eyes, muzzle and the legs. Many of these cases have minimal or no pruritus. The body trunk is rarely affected. Many cases heal within weeks to months even without treatment. Most commonly seen in young dogs, particularly of the shorter-coated breeds.

- **Generalized form** – can affect most, if not all areas of the body. The face and entire ventral surfaces are particularly common, including the feet. Some cases start out as focal lesions, but progress and coalesce with time. Alopecia is a major feature. The skin becomes thickened, seborrheic and hyperkeratotic. There is often secondary bacterial (and yeast) infection, giving a pustular form to the disease. Pruritus is common and may be marked. Lymphadenopathy may be present. Affected animals may be depressed and inappetant, or may show other evidence of an underlying disease process.

- **Pododemodicosis** – although the feet may be involved in either of the above two forms, some cases present with lesions on the feet only. Alopecia, hyperkeratosis and increased pigmentation are primary signs. The condition is often complicated by pyogenic infection or sinus tracts. One or all 4 feet may be involved. The animal may be lame. Regional lymphadenopathy is common.

**Diagnosis**

- History and clinical signs
- Deep skin scrapes / impression smears from pustules
- Skin biopsy – see mites in hair follicles etc.
- In adult onset cases, attempts should be made to elucidate any underlying causes, but in several cases, no underlying disease may be evident.

**Treatment**

- Some localized cases require no therapy at all.
- Weekly washes with amitraz (4-8ml of amitraz/litre of water). Continue for 8-12 weeks or beyond, until at least 2-3 successive skin scrapes are negative for mites.
Some cases require long-term washing every 2-4 weeks to maintain any improvement.

- **Ivermectin** – *oral* ivermectin therapy at dosage rates of 200-600µg/kg per day for at least 60-90 days can be highly effective. Not currently licensed for this use and avoid collies/shelties and their crosses.
- Milbemycin oxime is also highly effective – oral doses of 0.5 mg/kg SID or BID are used.
- Advocate is licensed for this indication, *but several cases of lack of efficacy have arisen in recent years. The license indication has recently changed to allow for more frequent dosing to combat demodicosis.*
- Antibiotics are often indicated for several weeks. *Never use corticosteroids.*

**Prognosis and Prevention**

- Depends on the age of onset and whether an underlying cause is present or can be reversed.
- As generalized demodicosis is hereditary in juvenile animals, such cases should not be bred from.

**Feline Demodicosis**

**General**

- Whilst most normal animals have a low mite burden probably derived from maternal transmission, cats with clinical demodicosis have a proliferation in mite numbers.
- Immunosuppression appears to be an important factor.
- Whether or not there is a genetic predisposition in the cat is unknown.
- There are 2 species of democid mites recognized in the cat. *D cati* inhabits hair follicles and sebaceous glands. A second unnamed species, appears to replicate within pits of the stratum corneum.

**Clinical signs**

- Focal alopecia particularly in the region of the ears, nose and eyes. Lesions may also develop on the chin, thorax, abdomen, inner thighs, flanks and perineum. Alopecia may become generalized.
- Mild erythema, scale/crust and occasional papules.
- Hyperpigmentation and bilaterally symmetrical alopecia may develop.
- Secondary infection possible.
- Pruritus is not a dominant feature in the majority of cases.

**Treatment**

- Lime-sulphur baths (once/week for 4-8 weeks) are both safe and effective. This agent has sometimes been combined with phosmet.
- Amitraz (0.0125-0.0250%) applied topically once a week for 6-8 weeks, though beware toxicity.
- There is no conclusive evidence on the efficacy of ivermectin in feline demodicosis. Anecdotal reports suggest it is efficacious.

**Prognosis**

- Spontaneous remission is possible in some younger animals after several weeks to months.
• However, the majority of cases persist and may worsen over time. The prognosis is obviously affected by any underlying disease condition that cannot be rectified.

Prevention

• Avoidance of stressful conditions and prompt treatment of potentially immunosuppressive diseases.
• There is no evidence to currently support the non-use of clinically affected animals in a breeding program, although such an approach may be judicious.

Sarcoptic mange

Common condition in the dog; the clinical equivalent in the cat (Notoedres cati) is very rare in this part of the world, but is still reported in certain regions. Highly pruritic and highly contagious between dogs. This condition is also highly zoonotic. The source of infection may be an infected dog or infected wildlife (particularly foxes). The number of mites recovered from scrapes may be remarkably low. However, the prognosis is excellent in virtually all cases. It is postulated that some animals with severe pruritus may have developed a hypersensitive response to the mites.

Clinical signs

• Although mites may be present at any site on the body, S. scabiei has a predilection for the ears and elbows. Other sites commonly affected include the ventral chest abdomen, legs and face.
• Pruritus is marked to severe. This is one of the most pruritic conditions reported in dogs in practice. Primary lesions often appear as papules.
• Self-induced trauma leads to alopecia, scale, erosions and secondary infection. Bleeding and a yellow-brown crust overlying the papules are common.
• Left unchecked, the condition may spread all over the body.
• Depression and inappetance may develop if pruritus is severe.

Diagnosis

• Multiple deep skin scrapings, down to a bleeding surface. The ears and elbows are usually highly rewarding sites. Sarcoptes mites are not normal inhabitants of the skin, so even finding one egg is diagnostic. Beware false-negatives as this is a hugely significant problem. If you suspect sarcoptic mange, treat for it and use the response to treatment as a retrospective diagnosis.
• Although biopsies may exhibit mites or mite eggs in the skin, in my experience this is not a fruitful technique for diagnostic purposes in the dog.
• Older serology tests are marketed to allow detection of sarcoptes species antibodies in blood – the presence of antibodies, however, does not equate with current infection. More recently, a PCR test to detect sarcoptes antigens in the blood has become available, and is far more reliable.

Treatment

• Many antiparasitic agents are effective for this condition. Amitraz washes once a week for 4-6 washes are highly effective. Older agents such as phosmet and phoxim are still effective but rarely used nowadays.
• Ivermectin (200µg/kg) for 2-4 injections at fortnightly intervals is one of the treatments of choice. Remember the previous warnings on its use. Related products of this and similar families are generally successful also.
Advocate and Stronghold are both highly effective. I personally use these agents at fortnightly intervals, not monthly.

Symptomatic therapy in the form of antibiotics, topical shampoos and corticosteroids to reduce infection and pruritus are commonly used.

In-contact animals should be treated in general.

Eliminate any contaminated bedding.

Prognosis

Generally excellent, although repeat infections are not uncommon due to insufficient treatment or repeat contamination from wildlife etc.

Cheyletiellosis

Not as commonly encountered as certain other mange mites, but nonetheless still a significant problem, especially in puppies, kittens and other pets such as rabbits. Several Cheyletiella species can infest dogs and cats, but C. yasguri is generally more common on dogs and C. blakei more common on cats. This condition is again highly contagious and zoonotic. Pruritus is mild-to-marked. Cheyletiella spp. attach to hairs and may resemble nit eggs to the naked eye. Many clinical cases are mistakenly diagnosed as dry or flaky seborrhea.

General remarks

- Mites are superficial, surface dwellers that feed on skin debris and are quite mobile.
- The feeding behavior leads to pruritus and self-trauma.
- The entire life cycle is completed on the host in as little as 21-35 days.
- A hypersensitive response may develop.

Clinical signs

- Mild to moderate pruritus, often most marked along the dorsum.
- Seborrhea and a papular dermatitis.
- The movement of mites may resemble the appearance of “walking dandruff”.

Diagnosis

- Mites may be visible on the skin or hair coat with a magnifying glass.
- Comblings from the coat or the acetate tape technique may also be used.
- Cheyletiella eggs may be evident along hair shafts with appropriate magnification.
- Occasionally, mites have been detected in the pet’s faeces, as a result of grooming.

Treatment and Prevention

- Pyrethrins and organophosphates (care with use) are effective. Other effective agents include sulphur preparations and ivermectin (not licensed). Fipronil is also reported to be effective.
- Re-treatment should be performed as appropriate.
- The environment and in-contact animals should also be treated.

Transmission

- Direct contact with infected animals, or indirect via grooming equipment etc.
**Otodectes cynotis**

Otodectes cynotis is primarily, but not exclusively, a parasite of the external ear canal. Some cases present with dermatological disease affecting the skin around the neck, head or even further afield. This mite causes marked irritation due to its movement and feeding habits (skin debris etc.). The resultant inflammatory response leads to marked pruritus and self-trauma. Clinical signs in the ear canal are those of otitis externa. Frequently, the ear canals are blocked with a waxy yellow-brown exudate. Cases complicated by significant bacterial infection may have a more purulent exudate, with an increase in the associated pain and pruritus. Lesions on the skin are typified by papules and secondary staphylococcal dermatitis. Sub-clinical infection is extremely common. Life cycle typically takes three weeks. Many animals acquire infestation from the dam when very young. The entire litter may be affected.

**Clinical signs**

- Many cases are typified by a waxy otitis externa and head-shaking. The exudate is yellow-brown and may be voluminous. General health is usually good.
- Skin lesions may be found in areas surrounding the ears, including the neck, head and thorax.
- Pruritus and secondary bacterial infection are common, along with alopecia of the pinna or surrounding skin.

**Diagnosis**

- Mites are often visible on examination of the external ear canal with an otoscope.
- Samples of exudate can be examined by magnifying glasses or on slides to identify *O. cynotis*.

**Treatment**

- *O. cynotis* in the external ear canal was susceptible to a wide range of otic products containing agents such as lindane, thiabendazole etc.; however, in most countries, such agents have been removed from sale.
- Stronghold and Advocate are highly effective. Mites are also susceptible to treatment with ivermectin (200µg/kg subcutaneously or orally, repeated two weeks later). However, ivermectin is not licensed for this purpose.
- Antibacterial treatment, plus or minus a short course of corticosteroids, are often indicated. Most otic preparations contain a mixture of antibacterial, antifungal and anti-inflammatory agents.

**Prevention**

- Repeat treatment is often indicated, irrespective of the form of disease.
- All in-contact animals should be treated.
- The mode of transmission is not always fully understood. Considered to be directly spread from one animal to another in most cases, but mites may survive off host for a short period of time.

**Neotrombiculosis**

The larval stages of *N. autumnalis* feed on surface debris by inserting their mouth-parts into the skin of the host. The adult stages are not parasitic. The resultant inflammatory reaction gives rise to significant self-trauma. A hypersensitive response may develop in certain animals. This condition is most commonly seen in summer and autumn,
particularly in grassy areas or hedgerows. Many dogs and cats re-present at regular intervals with repeat infestations of this parasite.

**Clinical signs**

- Pruritus and self-trauma can be mild to marked.
- Papules and secondary bacterial infection may be evident, accompanied by focal areas of alopecia.
- Infestation is most common on the feet, head and lower limbs. Other regions are also possible, particularly if they are in contact with contaminated hedgerows etc.

**Diagnosis**

- Larval stages can normally be seen with the naked eye by their orange-red color. The use of magnification makes this procedure easier.
- Mild scrapes or the acetate tape technique are also useful for diagnostic purposes.

**Treatment**

- Organophosphates (care with use) and sulphur containing products are effective. Non-licensed agents which are also highly effective include fipronil and ivermectin.
- Corticosteroids may be indicated to relieve pruritus.

**Prognosis**

- Excellent. However, re-infestation is common.

**Prevention**

- Repeat courses of treatment to combat re-infestation.
- Keeping animals away from contaminated grass and hedgerows during particular times of the year.

**Transmission**

- Larval stages are contracted from gardens, hedges etc. This parasite is not normally spread from one animal to another.

**B) Pediculosis (Lice infestations)**

Lice infestations are still encountered on a regular basis, although fortunately the incidence has declined in more recent times. Both biting and sucking lice can be encountered on companion animal species. In general, lice tend to be highly host specific. As well as inducing dermatological disease, they may also act as the intermediate host for other parasites e.g. Dipylidium caninum. Pediculosis is often seen in young, immunosuppressed or neglected animals. Infestation is commonly a disease of poor hygiene or over-crowding. Cases are more common in wet and colder months due to factors of long coats, high population densities and inter-current stress. Whilst any part of the body may be involved, sites such as body orifices, ears and areas of matting of the coat are particularly common. Whilst pruritus is a particular feature of biting lice, anaemia may also be seen with severe infestations of sucking lice. Biting lice feed on epithelial debris and hair.
Aetiologies

Two species of lice may infest the dog - biting lice (Trichodectes canis) and sucking lice (Linognathus setosus). The biting louse (Felicola subrostratus) affects cats.

Clinical signs

- Infestations may be sub-clinical, but in most cases pruritus will vary from mild to severe. The resultant self-trauma leads to hair-loss and secondary infection.
- Clinical signs particularly evident around body apertures or where hair coat is long or matted.
- Infestation with sucking lice may lead to anaemia.
- The animal may exhibit signs of inter-current disease.
- Secondary seborrhea.
- Animal may also have tapeworm infestation – D. caninum.

Diagnosis

- Gross visual inspection of the hair coat. Both the adults and eggs are visible. Beware rapid movement of adults.
- The acetate tape technique can be used to trap and identify lice species.

Treatment and Prevention

- Pyrethrins and organophosphates (care with use) are commonly used. Ivermectin and fipronil are not licensed for this particular indication, yet appear to have good efficacy.
- Repeat treatment is indicated to kill newly hatched eggs.
- Predisposing factors, such as neglect or parasitism should be addressed. Grooming and clipping of the coat is important. Grooming equipment should be cleaned and treated also.
- In-contact animals should also be treated.

Prognosis

- Provided predisposing factors are properly addressed, and repeat treatment performed as necessary, the prognosis is excellent.

Transmission

- By direct contact or indirect contact via grooming equipment etc.
Flea Dermatitis

Extremely common and troublesome problem in clinical practice. Flea dermatitis cases may present as relatively straightforward cases, with pruritus, alopecia and fleas evident on the animal. Some cases may be sub-clinical. However, many cases go on to develop an immune response to agents such as flea saliva, and present with various cutaneous manifestations which can be individually recognized e.g. FAD, eosinophilic granuloma complex, miliary dermatitis. In many of these latter cases, no fleas or flea faeces may be evident on examination. This variety of presentations may cause confusion to the clinician as to the underlying aetiology.

The movement and blood sucking activities of fleas leads to irritation, pruritus and self-trauma. Severe cases may present with anaemia. Many species of flea can parasitize the dog and cat. Ctenocephalides felis is the dominant species involved for both dogs and cats on a worldwide basis. However, in Ireland, C. canis is the dominant flea found on dogs. The rabbit flea, Spilopsyllus cuniculi, may cause pinnal dermatitis in the cat. Adult C. felis can begin feeding the moment they find a suitable host. A female C. felis can lay several hundred eggs within a few days. The duration of the life cycle can vary dramatically (21-200 days) according to environmental conditions. It should be remembered again that fleas may act as the intermediate host for the tapeworm Dipylidium caninum.

Clinical signs

- Pruritus and self-trauma results in alopecia, crust formation and secondary bacterial infection.
- Clinical signs are most common along the dorsal, inguinal and ventral abdominal areas.
- Severe infestation may lead to anaemia.
- Occasionally, D. caninum segments may be identified in the faeces.

Diagnosis

- The absence of fleas on examination does not rule out a diagnosis.
- Fleas may be detected by a methodical examination of the skin and coat, and with the use of a flea comb. Flea faeces can be identified by its red-brown color when suspect material is placed onto damp white paper.
- Evidence of infestation on in-contacts or in the environment may be relevant.
- Intradermal and serology tests are available in cases of suspected flea allergic dermatitis.
General Points for Treatment and Prevention

- A wide variety of anti-flea preparations are available e.g. topical powders, sprays, spot-on formulations and collars. Active ingredients include pyrethrins/pyrethroids, organophosphates, fipronil, imidacloprid and avermectins (e.g. Stronghold). More recent agents include pyripole and metaflumizone.

- Detailed attention needs to be paid to the environment, including rigorous vacuuming and the use of IGRs or Insect Development Inhibitors to disrupt the flea life cycle.

- In sick or neonatal animals or for transient species, simple combing of the coat may remove significant numbers of fleas.

- All in-contact animals should be treated.

- Antibiotics and glucocorticoids may be indicated for symptomatic relief, particularly if a hypersensitive component is involved.

- For animals with an immune-mediated component, the following general principles apply. For more detail, see appropriate sections on the use of antibacterial and immunosuppressive agents in these notes:

  1. Systemic corticosteroids e.g. prednisolone (1-2mg/kg SID or divided BID in dogs and 2-4mg/kg SID in cats for 7-10 days), with gradual tapering of the dose to the lowest level which still controls clinical signs. Depot corticosteroid preparations and megoestrol acetate (cat) are sometimes used, but have been associated with numerous adverse side-effects - *only use with caution*.

  2. If prednisolone is unsuitable, then the use of anti-histamines can be attempted e.g. chlorpheniramine (4-8mg/dog BID PO). Results are not as good, in general.

  3. Hyposensitization has been attempted, but to date most case report studies have been disappointing. However, work is continuing with different vaccine antigens and future results may be more encouraging.

Notwithstanding the above, the main emphasis of this talk is to concentrate on the various preparations available on the market to kill adult fleas and disrupt the flea life cycle. As your own experience has shown, there are countless preparations on the market, covering several different classes of compounds. Furthermore, those who prefer to avoid the use of chemicals will detail how the use of garlic products, orange peel etc. can be used as noxious stimuli to ward off fleas from a pet. The simple combing of the coat can also remove some of the parasitic burden. The aim of this talk is not to cover all potential possibilities, but rather to concentrate on those agents, which have a proven track record of safety and efficacy.

Fipronil

Fipronil has been available on the market for a number of years as a flea adulticide in dogs and cats. The mode of action involves inhibition of a key neurotransmitter receptor (i.e. the GABA receptors) in the flea. GABA is an important neurotransmitter responsible for the inhibition of neurohumoral transmission at the synapse level. Thus, nervous system activity is facilitated in the normal arthropod, once this inhibition is achieved. Chloride flux across cellular channels are regulated by the GABA receptor. Fipronil selectively binds to the receptor at the level of these chloride channels. This results in the
chloride channels being closed when they should be open, thus negating the inhibitory “check and balance” system between ACH and GABA. Fipronil is selective for the GABA receptor of invertebrates rather than in mammals. Because of its rapid mode of action, many fleas are killed before egg-laying begins. It is claimed that this will result in a reduced environmental challenge in the future, but other factors will also influence this phenomenon. Fipronil displays very little skin absorption into the systemic circulation of treated cats and dogs, as it is believed the epidermal basement membrane acts as an effective barrier. However, it does gain entry into the sebaceous glands, thereby allowing for daily replenishment onto the skin surface in sebum. This is one of the principal factors responsible for its long duration of efficacy. Diffusion in surface lipid and transfer by body movement are the proposed methods of diffusion through the skin. Whilst water is not thought to destroy the activity of the compound, it is not advised to bath or shampoo the animal either 2 days before or 2 days after treatment.

The product is available as a non-aerosol spray and as a spot-on. The spray is effective for up to 3 months in dogs and 2 months in cats. The spot-on may offer protection for up to 2 months in dogs and up to 5 weeks in cats. However, monthly treatment is usually recommended. It has been used safely on 2 day-old puppies and 7-week old kittens. Beware alcohol fumes and the flammable nature of the product. In general, pets are considered safe to handle within minutes. Fipronil has also been used off-license to treat a range of other parasitic species. The author has had very positive experiences with this product.

**Imidacloprid**

Imidacloprid is a member of the family of chloronicotinyl nitroguanidines. The product is marketed as a spot-on, which is administered once a month to cats and dogs. It is a compound that is claimed to possess both adulticidal and larvicidal activity. Treatment of the dam can also reduce flea infestation on the offspring, despite the fact that it is not normally indicated for animals below 8 weeks of age. Its rapid onset of action leads to 98-100% of fleas being killed within 24 hours. The mode of action involves interference with nerve impulse transmission in insects. Imidacloprid binds to nicotinic receptor sites on the post-synaptic neurone. At this site, it is slowly degraded, inducing a prolonged agonistic action which disrupts normal neuronal function and leads to the insects death. The minimum therapeutic dose is 10 mg/kg bw, applied as a 10% topical formulation. The product is marketed in different pipette sizes for different weights of patient. Studies have shown a significant reduction in flea egg production, leading to a decrease in the environmental reservoir. This effect is mainly achieved by the rapid killing of adults, prior to the commencement of egg-laying. Again, the compound shows no significant systemic absorption; its effect is obtained following distribution over the entire body surface. However, bathing or swimming have been shown to reduce drug concentrations, and re-treatment is often necessary.

**Selamectin**

Broad-spectrum anti-parasitic agent. Developed from a mutant strain of *Streptococcus avermitilis*, and is currently the only licensed avermectin for use in dogs and cats in the European Union. A fairly wide range of parasite species exists on the data sheet, both internal and external. Marketed as a spot-on formulation, with a range of drug strengths related to species and animal size. The RTD is 6 mg/kg bw, once monthly. Selamectin is a semi-synthetic molecule that paralyses and/or kills a wide range of invertebrate species by inhibiting chloride channel conductance, and thus causing disruption of normal neurotransmission. This inhibits the electrical activity of nerve cells in nematodes and muscle cells in arthropods, which precedes the paralysis or lethal event. The figures quoted for the adult kill rate are very high. Activity has also been demonstrated against
the larval and egg stages of the flea in a number of experiments. The % inhibition of egg and larval development was highly significant. Maximum concentrations are obtained in the plasma after 1 and 3 days in the cat and dog, respectively. The drug persists in the plasma for a relatively long period (terminal elimination half-life of 11 days in the dog), and metabolism is not extensive. Selamectin should not be used below 6 weeks of age. Adverse reactions include alopecia and irritation at the site of application. Clumping of hair and the appearance of a white powder are also reported. Most adverse events have been reported in cats. Selamectin is safe to use during pregnancy and lactation. Wetting of the coat does not appear to interfere with efficacy (avoid time of application). Stated to be safe for use in collies.

Metaflumizone (Promeris and Promeris Duo)

Metaflumizone is a novel semicarbazone insecticide, but with greatly improved mammalian safety. Studies have confirmed that the insecticidal action of metaflumizone is due to the state-dependent blockage of sodium channels. Monthly application of Promeris Duo (also contains amitraz) is generally recommended for optimum flea and tick control in dogs, although efficacy for up to 6 weeks is reported. ProMeris for cats contains only metaflumizone and is effective against fleas for up to 6 weeks. Tolerance is generally high and resistance low.

Pyripole (Prac-tic)

Spot-on solution indicated for the treatment of flea and tick infestations in dogs; efficacy lasts for at least 4 weeks. As for many similar agents, pyripole can be used as part of a treatment strategy for flea allergic dermatitis. Pyripole modulates GABA receptor function, thereby interfering with nervous system function in fleas and ticks. Relatively rapid kill rate (fleas 24 hours and ticks 48 hours). Application site reactions (alopecia, scale, discoloration) are reported rarely.

Other agents

A whole range of products, including organophosphates, carbamates, pyrethrins and pyrethroids are also routinely used for the treatment of fleas. The pros and cons of these classes of compounds will be further discussed.

IGRs and Insect Development Inhibitors

IGRs or synthetic juvenile hormones are hormone-like substances that influence the metamorphosis and development of insects. The main function of this class of compounds is to maintain the life cycle at the larval/ pupal stage or prevent metamorphosis, so as to effectively disrupt or delay the completion of the cycle. Two compounds are commonly used in everyday practice to achieve this;

- **Methoprene** – this analogue of the insect juvenile hormone (entocon) acts principally on the fourth larval instar stage of the flea life-cycle. Thus, one of the later phases in maturation is inhibited, in which the larva passes on to the pupal stage. Methoprene can persist in the environment for months, often remaining efficacious for at least 3-4 months. It should not be used outdoors as it is unstable in sunlight. Methoprene is not active against adults, and for this purpose, it is normally combined with a pyrethroid.

- **Lufenuron** – this compound belongs to the class of substituted ureas, which interfere with chitin formation in arthropods. It is an “insect development inhibitor”, not a
growth regulator. Treated larvae do not moult properly, with only part of the new instar stage being able to leave the old cuticle. Thus, the larval stage dies entrapped in the exuviae, as the shell cannot be breached by the flea’s egg tooth. Lufenuron is not adulticidal. The product is administered orally once a month to the dog/cat. The dose rate for the oral formulation is 10 and 30 mg/kg bw/month for the dog and cat, respectively. The product is normally administered with food. A suspension formulation is available for cats, and provides protection for up to 6 months. It is absorbed into the bloodstream, and is ingested by female fleas when they ingest a blood meal from the host. The female transfers the compound to the ovaries, resulting in a “trans-ovarial effect”. The eggs that are subsequently laid are rendered sterile, even though their numbers usually remain unaffected. There is no effect on male fleas. The manufacturers claim that approximately 95-99% of flea eggs are affected within 24-48 hours. Some veterinarians only use it during the flea season, others being more thorough, employ it all-year round.
Hypothyroidism is considered to be the most common endocrine disorder of the dog. Some dogs with diseases that mimic the clinical features and laboratory findings of hypothyroidism are erroneously diagnosed as hypothyroid, while those with the more unusual signs of hypothyroidism may remain undiagnosed. A major problem with this disorder, apart from the expense of thyroid hormone analyses, is the numerous factors that can affect thyroid function tests particularly non-thyroidal illnesses and various drug therapies. Despite this, once diagnosed the disease is relatively easy to treat and the prognosis is excellent. Hypothyroidism can be classified as:

- **Primary hypothyroidism:** This is responsible for over 90% of cases of hypothyroidism. It occurs in adult dogs as a result of immune-mediated destruction (lymphocytic thyroiditis) or idiopathic atrophy of the thyroid glands (approximately 50% of cases each respectively).
- **Central hypothyroidism:** This accounts for less than 5% of cases of hypothyroidism, and is characterised by failure of TSH output from the pituitary either resulting from pituitary neoplasia, hypothalamic problems, trauma or a congenital deficiency, often accompanied by deficiencies of other pituitary hormones.

**In both forms there is an eventual reduction in the circulating concentrations of the thyroid hormones T4 and T3 which give rise to the clinical signs.**

**Signalment**
Hypothyroidism can affect any age or breed of dog. However, it appears to be more common in mid to large pure-bred dogs including Labradors, golden retrievers, Dobermans, setters, spaniels and Shetland sheepdogs. It typically occurs in middle-aged dogs and is rarely diagnosed in animals less than two years of age. There is no sex predisposition.

**Clinical features**
Thyroid hormone deficiency causes a variety of clinical signs that are usually vague, non-specific and insidious in onset. Those highlighted in bold are common.

- **General**
  - Lethargy/mental dullness
  - Weight gain
  - Exercise intolerance
  - Cold intolerance
  - Dermatological abnormalities
  - Poor quality coat
  - Hair thinning
  - Endocrine alopecia
  - “rat-tail”
  - Hyperpigmentation
  - Myxoedema - tragic face

- **Coma**
  - Cardiovascular
  - Bradycardia
  - Gastrointestinal
  - Constipation
  - Bacterial overgrowth
  - Reproductive
  - Prolonged/persistent anoestrus

- **Neuromuscular**
  - Peripheral/poly neuropathies

- **Myopathy**
  - Muscle weakness

- **Gastrointestinal**
  - Constipation

- **Reproductive**
  - Prolonged/persistent anoestrus
Classically, hypothyroid dogs suffer a combination of metabolic and dermatological abnormalities. The metabolic abnormalities are relatively mild compared to those caused by hyperadrenocorticism. They commonly include weight gain or obesity, lethargy and exercise intolerance. Occasionally, affected animals are described as heat seeking. Dermatological abnormalities typically include non pruritic hair thinning or alopecia frequently in association with a poor quality coat and hyperpigmentation. The hair thinning/alopecia is often first noted in areas undergoing friction such as the neck in dogs wearing collars, the lateral aspect of the extremities in large dogs, or the tail resulting in the characteristic ‘rat tail’ of hypothyroidism. As the disease advances the alopecia is distributed in a bilaterally symmetric pattern sparing the head and distal extremities.

A variety of other ‘atypical’ and secondary dermatological abnormalities are also possible. The alopecia may be patchy and asymmetric or may only affect one area e.g. the bridge of the nose. Seborrhoeic changes may occur in the ears or on the body (focal or generalised) and can be greasy or dry. Such affected animals are predisposed to Malassezia infections which intensify the seborrhoeic changes and cause pruritus. Pruritus may also be caused by a secondary bacterial pyoderma that can be recurrent or poorly response to appropriate antibacterial therapy. Easy bruising and altered wound healing may be obvious and the most common manifestation of the latter is excessive fibrous tissue at common or unusual pressure points. Hypertrichosis (carpet coat) can occur particularly in Irish setters and boxers. As a result of the development of myxoedema (glycosaminoglycan accumulation in the dermis) the skin can thicken and become puffy but non-pitting. These changes are most pronounced on the face and result in the characteristic tragic facial expression due to drooping of the eyelids and thickening of the lips and over the forehead.

Diagnosis
Dependent on appropriate clinical signs, non-specific haematological and biochemical changes and abnormal thyroid function tests. All drug therapies, particularly those known to interfere with tests of thyroid function should be withdrawn for several weeks prior to function tests being performed.

- Mild non-regenerative normochromic/normocytic anaemia
- Hypercholesterolaemia
- Mild elevations in ALT/ALKP
- Increased creatine kinase (CK) concentrations

Thyroid function tests
- Serum total T3 concentrations
Depressed in hypothyroid dogs but affected by as many non-thyroidal factors as T4 is. In addition, the response of a failing thyroid is to increase production of the more metabolically active T3 in addition to increased peripheral production and many hypothyroid dogs therefore have reference range concentrations. Considered of no additional value over a total T4 estimation alone.

- Serum total T4 concentration
Most hypothyroid dogs have reduced circulating concentrations of total T4 (<15 nmol/l). However, reduced concentrations may also result from non-thyroidal illness, certain drug therapies (glucocorticoids, anti-convulsants and potentiated sulphonamides) and non-specific hormone fluctuation. Older dogs and sight hounds of any age also tend to have reduced circulating total T4 concentrations.
### Total T₄

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inexpensive and sensitive marker for hypothyroidism</td>
<td>Low values do not confirm hypothyroidism</td>
</tr>
<tr>
<td>Widely available and easily measured</td>
<td>Lower in elderly dogs and large breeds</td>
</tr>
<tr>
<td></td>
<td>Decreased by most nonthyroidal illnesses</td>
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<tr>
<td></td>
<td>Subnormal at random times during the day</td>
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<tr>
<td></td>
<td>Decreased by steroids, barbiturates, NSAIDS, and sulphonamides</td>
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</tbody>
</table>

### Endogenous cTSH concentration

**cTSH**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helps differentiate low T₄ of hypothyroidism from other causes</td>
<td>Should not be measured alone</td>
</tr>
<tr>
<td></td>
<td>Increased by sulphonamides and recovery from illness</td>
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<tr>
<td></td>
<td>“Normal” in 20-30% hypothyroid dogs</td>
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</tbody>
</table>

### Serum free T₄ concentration

Free T₄ is the active portion of total T₄ and is widely acknowledged to more closely reflect metabolic status at the tissue level than total T₄. In addition, not as affected by nonthyroidal factors as total T₄ is. Considered to be the best single diagnostic test for hypothyroidism but not without problems. Unfortunately, free T₄ can only be accurately measured by special assays.

### Free T₄

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less affected by NTI and drug therapy than total T₄.</td>
<td>Decreased values are more specific for hypothyroidism than total T₄</td>
</tr>
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<td></td>
<td>Must be measured by “dialysis” and is more expensive than total T₄</td>
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<td></td>
<td>Can occasionally also be decreased in severe illness or by certain drugs</td>
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<td></td>
<td>May be low-normal in early hypothyroidism</td>
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### Thyroid autoantibodies

Thyroglobulin autoantibodies (TgAA) are produced during the course of lymphocytic thyroiditis. A reliable assay for canine TgAA is now commercially available. Positive results occur in approximately 30 - 50% of hypothyroid dogs equating to the estimated prevalence of lymphocytic thyroiditis as a cause of hypothyroidism. Autoantibodies to T₄ can also be produced, albeit infrequently, in hypothyroid dogs. These can be individually measured by most commercial laboratories but given that they are usually associated with TgAA, it is not strictly necessary to measure both. They are important because of their ability to falsely increase measured total hormone concentrations.

### Thyroglobulin Antibodies (TgAb)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliable method for determination is now available</td>
<td>Provides no assessment of thyroid functional capacity</td>
</tr>
<tr>
<td>A positive result is extremely suggestive of thyroid pathology</td>
<td>A negative result does not rule out significant thyroid disease</td>
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Combining diagnostic tests

<table>
<thead>
<tr>
<th>Normal T4</th>
<th>Low T4</th>
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<tbody>
<tr>
<td><strong>Normal cTSH</strong></td>
<td><strong>Euthyroid</strong></td>
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<tr>
<td><strong>Non-thyroidal illness</strong></td>
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<tr>
<td><strong>Drug therapy</strong></td>
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<td>Old age/certain breeds</td>
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<tr>
<td>Hypothyroidism (20 – 30 % of cases)</td>
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<tr>
<td><strong>High cTSH</strong></td>
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<tr>
<td><strong>Recovery from illness</strong></td>
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<td><strong>Withdrawal from drugs</strong></td>
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<tr>
<td>Hypothyroidism with T4 autoantibodies</td>
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<tr>
<td>Compensating hypothyroidism</td>
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<tr>
<td><strong>Hypothyroidism</strong></td>
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</table>

Guidelines for interpreting total thyroxine (T4) and canine thyroid stimulating hormone (cTSH) concentrations. Those highlighted in bold are most likely within each category.

- Dynamic thyroid function tests
  For the TSH response test, bovine TSH was administered parenterally and hypothyroidism confirmed by demonstrating a minimal circulating total T4 response. Although widely acknowledged as the best single test for assessing thyroid function and functional reserve capacity, it is not without problems. Bovine TSH is expensive, difficult to obtain, potentially antigenic and has been associated albeit rarely, with anaphylactic reactions. The use of recombinant human TSH has recently been evaluated in healthy dogs but further studies are required in hypothyroidism. The TRH response test was recommended as a useful alternative for assessing thyroidal reserve. TRH is relatively inexpensive and available for parenteral use. However, failure of total T4 to respond to TRH does not confirm hypothyroidism as it is a frequent finding in both healthy dogs and those with non-thyroidal illness.

- Thyroid scintigraphy
  Uptake of technetium or radioactive iodine is now considered by some to be a gold standard test for diagnosing hypothyroidism. There appears to be little overlap in uptake results between hypothyroid dogs and those with non-thyroidal illness. However, although reasonably accurate in distinguishing hypothyroidism from health and other illnesses (with low T4 values), too few animals with early hypothyroidism or those with equivocal results or those having received thyroid suppressive medications have yet been tested.

**Treatment**
Sodium levothyroxine (L-thyroxine) is the treatment of choice for hypothyroid dogs. The use of synthetic T4 as replacement therapy is preferred over crude thyroid extracts, T3 or T3 and T4...
combinations. Synthetic T4 products have greater standardisation and potency and a longer shelf life compared with crude preparations. T4 itself is considered to be a physiological pro-hormone, serves to normalise both circulating T4 and T3 concentrations and pituitary cTSH production, and can effectively be administered once daily. In addition, because of virtually unsaturable binding proteins and regulation of conversion to T3, it is difficult to overdose dogs. Recommendations on the therapeutic regimen vary. However once daily administration of approximately 0.02 mg/kg T4 suffices in the majority of patients. In adequately treated dogs, there is usually a dramatic improvement in metabolic signs within days. Dermatological abnormalities can take several months to improve and frequently there is worsening of alopecia before new hair regrowth commences. Most dogs will be essentially normal within three months of commencing therapy but it must be continued for life.

<table>
<thead>
<tr>
<th>Dose of 20 µg/kg SID</th>
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</table>

There are several licenced and authorised preparations in Ireland – tablets include Thyroxyl® (Arnolds Veterinary Products), Soloxine® (Virbac) and Forthyron® (Eurovet), and liquid 1 mg/mL Leventa® (Intervet Schering Plough). The interindividual variation in absorption is less for licenced than generic preparations. Administration of food can adversely affect thyroxine absorption so as far as possible a standard regimen should be followed in individual cases.

Post-pill testing (6 hours after administration) is required to assess for efficacy. A serum total T4 concentration should be greater than approximately 35 nmol/l, aiming for at least 50 nmol/l – i.e. the upper end or above the reference range.

The most common reason for failure of therapy is an inappropriate diagnosis when hypothyroidism does not exist. Other potential complications are overdosage of replacement therapy, a failure of compliance in regularly administering the drug, inadequate dose or frequency of administration, failure of gastrointestinal absorption (particularly if administered with vitamin/mineral supplements) or administration of an inactive preparation.

Adequately treated dogs have a normal life expectancy and quality of life.
There are two major causes of naturally occurring hyperadrenocorticism.

- **Pituitary-dependent hyperadrenocorticism (PDH):** This accounts for approximately 80-85% of cushingoid cases. The underlying lesion is chronic excessive ACTH secretion resulting in excess glucocorticoid secretion and, eventually, bilateral adrenocortical hyperplasia. Most dogs with PDH are found to have pituitary tumours; over 80% of tumours are microadenomas rather than macroadenomas.

- **Adrenal tumours (AT):** Approximately 15-20% of cases are the result of primary adrenal tumours, either adenomas (50% of cases) or carcinomas (50%). Adenomas are usually small, well-circumscribed tumours that do not metastasise and are not locally invasive. Carcinomas are usually large, haemorrhagic, necrotic and locally invasive. Carcinomas, particularly of the right adrenal frequently invade the phrenicoabdominal vein and caudal vena cava and metastasise to the liver, lung and kidney. With both adenomas and carcinomas there is striking atrophy of the opposite non-tumour-bearing adrenal because of suppression of pituitary ACTH secretion by excess cortisol.

**Signalment**
Middle-aged to old dogs, no sex predisposition, most frequently small breeds such as poodles, dachshunds and terriers. The likelihood of AT increases with the size of the dog e.g. > 40% of cushingoid cases weighing > 20 kg have AT.

**Historical and clinical features**
The main features of Cushing’s syndrome are understandable in terms of the known actions of glucocorticoids. In summary, glucocorticoids are gluconeogenic, lipolytic, protein catabolic, anti-inflammatory and immunosuppressive. When present in excess (either endogenous production or exogenous administration) a variety of clinical signs referable to these actions is possible. The course of the disease is usually insidious and slowly progressive. The number and severity of clinical signs vary between individuals. Classically there is a prolonged history of polyuria/polydipsia, polyphagia, development of a pot-belly and exercise intolerance in association with a variety of dermatological abnormalities. Larger breeds of dogs rarely show all of the classical signs.

**Common and less common or subtle presenting signs and laboratory abnormalities associated with hyperadrenocorticism.**

<table>
<thead>
<tr>
<th>System</th>
<th>Common</th>
<th>Less common/subtle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic</td>
<td>Polyphagia</td>
<td>Severe weight loss</td>
</tr>
<tr>
<td></td>
<td>Pot belly</td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>Dermatological</td>
<td>Endocrine alopecia</td>
<td>Calcinosis cutis</td>
</tr>
<tr>
<td></td>
<td>Thin skin, prominent veins, loss of elasticity</td>
<td>Hyperpigmentation</td>
</tr>
<tr>
<td></td>
<td>Comedones</td>
<td>Coat colour change</td>
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<tr>
<td></td>
<td></td>
<td>Secondary pyoderma/seborrhoea</td>
</tr>
<tr>
<td>Urinary</td>
<td>Polyuria/polydipsia</td>
<td>Urinary tract infection</td>
</tr>
<tr>
<td></td>
<td>Isothenuria</td>
<td>Hyposthenuria</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Excess panting</td>
<td>Proteinuria</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>Muscle weakness/atrophy</td>
<td>Dystrophic calcification</td>
</tr>
<tr>
<td>Reproductive</td>
<td>Prolonged anoestrus</td>
<td>Pseudomyotonia</td>
</tr>
<tr>
<td>Haematological &amp; Biochemical</td>
<td>Eosinopenia, lymphopenia, neutrophilia, increased ALT &amp; ALKP, hypercholesterolaemia, low total T4</td>
<td>Polycythaemia, monocytosis, hyperglycaemia, low free T4</td>
</tr>
</tbody>
</table>

**Dermatological features**

Frequently occur. Classically bilaterally symmetric non-pruritic alopecia sparing the head and distal extremities. If hair is shaved, regrowth is poor or nonexistent and any new hair is likely to be brittle, sparse and fine. Hair colour may change. Compared to other endocrine dermatoses, a distinguishing feature of hyperadrenocorticism is the development of thin and inelastic skin most prominent over the ventral abdomen where the veins become more prominent and easily visible. Comedones (keratin-filled follicles) are common. Excessive bruising can follow venepuncture or other minor trauma and wound healing can be severely delayed. Pressure sores are common in older dogs and in severe cases old scars may break down. Because of the immunosuppressive effect of steroids, pruritus may develop in association with pyoderma or seborrhoea and generalised demodicosis and dermatophytosis have been described. Calcium deposition in the dermis (calcinosis cutis) is a rare but pathognomonic sign - feels like firm plaques surrounded by a ring of erythema and if severe can cause weeping open sores.

**Diagnosis**

In dogs, investigation of hyperadrenocorticism depends on depicting at least some non-specific indicators of the disease (see above table) before embarking on the more expensive dynamic function tests designed to definitively diagnose the condition and help determine the origin of the problem.

**Abdominal ultrasonography**

Experienced ultrasonographers may be able to image both adrenal glands (right adrenal gland is difficult to find). In cases of PDH, both adrenals increase in size particularly in thickness although they may remain essentially normal in size. In AT, an adrenal mass will be visible and the contra-lateral gland will be smaller than normal (or impossible to find).

Adrenal function tests are used for confirming a diagnosis and differentiating the causes of hyperadrenocorticism.

- **Circulating cortisol concentrations**

  The reference range for circulating cortisol concentrations varies between approximately 40 and 250 nmol/l. However, basal cortisol concentrations are of little diagnostic value because of the overlap between normal, cushingoid and sick dogs.

- **Urinary cortisol(corticoid):creatinine ratio**

  Cortisol and its metabolites are excreted in urine and measurement of urine concentrations with creatinine reflects cortisol release over a period of several hours. The ratio is determined by
dividing the urine cortisol concentration (in µmol/l) by the creatinine concentration (in µmol/l), values above 10 x 10^6 are considered abnormal. Values below this are unlikely to be cushingoid and although elevated values are consistent with such a diagnosis, similar results commonly occur in dogs with non-adrenal illness. Therefore only ever used as a screening test. Useful because owners can collect urine samples at home in a non-stressful environment.

**ACTH response test**
This is a simple and quick test that relies on the documentation of excess cortisol production by the adrenal gland via stimulation with synthetic ACTH (tetracosactride, Synacthen®). The test is carried out as follows:

| Withdraw 3 - 5 ml blood into heparinised tube for cortisol measurement |
| Invert 0.25mg Synacthen intramuscularly |
| One hour later withdraw 3 - 5ml of blood into heparinised tubes |

Lower doses of ACTH (1 – 5 µg/kg) can be used but are usually retained where synthetic ACTH is expensive.

*Interpretation:* In normal dogs, cortisol concentrations show a 2 - 3 fold increase but remain < 450 nmol/l. In dogs with hyperadrenocorticism, the post-ACTH concentration usually exceeds 600 nmol/l.

Measurement of cortisol precursors (such as 17-OH progesterone etc.) provide no further information over cortisol except in the rare cases of adrenal tumours where cortisol concentrations fail to rise after ACTH administration.

**Low dose dexamethasone suppression (LDDS) test**
This test relies on the negative feedback effect of glucocorticoids on ACTH thereby decreasing cortisol output from the adrenal gland. Dexamethasone is used because it does not cross react with endogenous cortisol in laboratory assays.

| Withdraw 3 - 5 ml blood into heparinised tube for cortisol measurement |
| Inject 0.015 mg/kg dexamethasone intravenously |
| At three hours withdraw a further blood sample |
| At eight hours withdraw another blood sample |

*Interpretation:* Normal dogs show greater than 50 % suppression with values less than 30 nmol/l at eight hours. In hyperadrenocorticism there is little or no suppression. The three hour sample is useful because in PDH there may be inhibition at this time with escape at 8 hours, but this does not occur in AT.

**High dose dexamethasone suppression (HDDS) test**
Supposed to help differentiate PDH from AT because adrenal tumours will never suppress no matter how high the dose of dexamethasone administered (ACTH production is already shut off) whereas in PDH, ACTH production may be inhibited. However, some PDH cases fail to respond to HDDST so it is not a very useful test. Better if adrenal tumour suspected (usually older dogs,
unusual breeds and often females) to investigate through radiography, ultrasonography and/or endogenous ACTH concentrations.

- **Circulating ACTH concentration**
  Currently being offered by some laboratories (typical reference range; 20 – 80 pg/ml). Stringent and meticulous sample handling is crucial as ACTH activity in plasma rapidly reduces with time. Not valuable as a screening test for hyperadrenocorticism but helpful in differentiating causes i.e. high in PDH (within reference range), low in AT (undetectable to < 5 pg/ml). However, very expensive to perform and samples must be centrifuged immediately and dispatched post-haste on dry ice to the laboratory.

**Treatment**
Fortunately the prognosis for hyperadrenocorticism is excellent once effective therapy is instituted and treated dogs have a normal life expectancy.

- **Hypophysectomy**
  If a pituitary adenoma is suspected then ideally therapy should be directed towards removing the pituitary lesion. Hypophysectomy, however, although successful requires an experienced surgeon and has many potential complications.

- **Surgical adrenalectomy**
  There are some reports of satisfactory results with bilateral adrenalectomy for PDH but there are a number of major drawbacks; some will not survive the procedure. If the dog recovers it will require life-long replacement therapy for Addison’s disease. Unilateral adrenalectomy is obviously the treatment of choice for adrenal tumours particularly adenomas or small carcinomas that have not yet metastasised.

- **Medical therapy**

  Trilostane (Vetoryl) has an inhibitory effect on glucocorticoid synthesis within the adrenal gland through reversible blockage of the 3-beta hydroxysteroid dehydrogenase enzyme. It is licensed and authorised for the treatment of PDH and AT within Ireland. However given it is an enzyme inhibitor surgical removal remains the best treatment option for AT.

  It requires daily therapy but the limited risk of severe adverse reactions and their easy treatment by simple drug withdrawal make it an attractive alternative to mitotane. It is available as 10, 30, 60 or 120 mg hard capsules. Hyperadrenocorticism is generally controlled using doses between 2-6 mg/day but because the capsules cannot be split, empirical dosing must be used e.g.

  - > 3 kg, < 10 kg – 30 mg once daily
  - 10-20 kg, – 60 mg once daily
  - > 20 kg < 40 kg, – 120 mg once daily
  - > 40 kg, 120 – 240 mg once daily

  It is usually recommended to start at the lowest dose possible, working upwards if required. Absorption is enhanced by administration in food.

  The drug has a half life measured within hours with a peak inhibitory effect 4 – 6 hours after administration. Cortisol production appears to be inhibited enough over 24 hours to achieve reasonable clinical control in most dogs but some will require twice daily dosing. Trilostane should be administered with food as this enhances absorption.
Evidence of clinical efficacy is slightly slower than with mitotane with some dogs taking up to three weeks for resolution of metabolic signs. Post ACTH cortisol concentrations should be suppressed to < 150 nmol/L but the ACTH response test must be completed 4 - 6 hours after drug administration. ACTH response tests are carried out after 10 days, 4 weeks, 12 weeks and every 3 – 6 months thereafter. However, if suppression is demonstrated but clinical signs persist, an ACTH response test 24 hours after drug administration may exemplify the need for twice daily dosing. It is recommended that the drug be temporarily stopped if there is complete cortisol suppression, recommencing therapy 7 – 30 days later (providing there is cortisol stimulation after ACTH administration) using a lower dose.

The product is contraindicated in dogs with pre-existing renal disease or primary hepatic disease. Sudden death has been particularly described in animals concurrently receiving ACE inhibitors. Potassium concentrations frequently increase over the course of therapy but many dogs do not exhibit adverse clinical effects.

Mitotane (Lysodren) is simpler and was once the mainstay of treatment for PDH - it causes severe, progressive necrosis of the zona fasciculata and reticularis while tending to spare the zona glomerulosa.

Initiating therapy - loading dose: Therapy can commence at home once the owner is adequately forewarned as to potential side effects and forearmed with prednisolone (0.2 – 0.5 mg/kg once daily) once these effects are noted. The initial dose is 50 mg/kg administered once daily or divided twice daily. The drug should be administered either in or immediately following a meal as this enhances its absorption. Handling of the drug should be avoided.

The success of therapy is monitored by measuring the dog’s water intake and stopping treatment once it reaches 60 ml/kg/day. Treatment is also stopped if the animal is unusually listless, becomes anorexic, begins vomiting or has diarrhoea. Owners should not be allowed continue treatment for longer than 9 days without returning to the veterinarian.

At the check-up, if treatment has stopped, an ACTH stimulation test is performed and mitotane withheld until this is evaluated. The goal of therapy is to achieve a response test indicative of hypoadrenocorticism. This occurs in most dogs between 5 and 10 days after commencing therapy when the post ACTH cortisol value will be < 100 nmol/l. Some dogs require a longer course of loading therapy. This should only be continued after the 10 day check-up on the basis of ACTH stimulation tests, with repeated tests every 3 - 5 days thereafter. Almost all dogs respond by day 14.

Maintenance therapy: Once weekly therapy is instituted using 50 mg/kg. The animals should be checked using ACTH stimulation tests at 1 and 3 months and every 3 - 6 months thereafter. Dogs undergoing significant stress should be given additional glucocorticoids.

More recently, the use of a high dose of mitotane to chemically ablate the adrenal glands (50 - 100 mg/kg daily for 25 days) has been recommended with concurrent lifelong mineralo- and glucocorticoid replacement therapy as in Addison’s disease. Unfortunately the initial mortality rate is quite high, relapses do occur, and daily medication with mineralocorticoids may prove as expensive in the long-term. In addition, withdrawal of mineralocorticoid therapy is life-threatening while occasionally missing weekly mitotane therapy is rarely of importance.

Alternative therapies
- L-deprenyl: L-deprenyl (selegeline hydrochloride) is a selective and reversible monamine oxidase inhibitor that ultimately serves to normalise hypothalamo-pituitary dopamine
concentrations. In some cases of PDH, dopamine depletion may play a role in development of hyperadrenocorticism. Preliminary trials into its use are disappointing on a large scale although a small number of individual cases apparently respond but results of adrenal function tests rarely normalise. Selegeline hydrochloride (Selgian®) is only licenced here for behaviour modification. The current recommended dose is 1 mg/kg daily increasing to 2 mg/kg daily if there is no response.

- **Ketoconazole**: Ketoconazole (Nizoral®, Jenssen) has a reversible inhibitory effect on glucocorticoid synthesis. Initially administered at a dose of 5 mg/kg twice daily for 7 days and increasing the dose to 10 or 15 mg/kg depending on clinical response and results of ACTH stimulation tests. Expensive therapy. Often used in dogs in preparation for surgical adrenalectomy.
**Alopecia X**

Alopecia X is a disease of great uncertainty in veterinary dermatology. As the name implies, there are significant gaps in our understanding of the pathogenesis involved, disease diagnosis and the best treatment option in individual cases. Alopecia X is characterized clinically by a non-inflammatory, progressive bilaterally symmetric alopecia in affected dogs. This adult-onset disease has previously been referred to by many other names including:

- growth hormone-responsive dermatosis,
- castration-responsive dermatosis,
- pseudo-Cushing’s syndrome,
- congenital adrenal hyperplasia.

The above nomenclature clearly reflects the multitude of findings when affected individuals are subjected to various hormonal test assays and therapeutic strategies. A variety of breeds are reported to be affected including Alaskan malamutes, huskies, pomeranians, chows, keeshonds, pomeranians, samoyeds and miniature poodles. Although it was postulated that Alopecia X may resemble human congenital adrenal hyperplasia (a disease caused by reduced activity of a 21-hydroxylase enzyme that catalyses cortisol production in the adrenal gland), some data from a study in pomeranians did not highlight any abnormality in the 21-hydroxylase gene (Takada et al., 2002).

The breed predisposition has led some authors to investigate a potential hereditary component to the disorder. Mausberg *et al.* (2007) postulated that Alopecia X may have a monogenic autosomal dominant pattern of inheritance. However, to date, the candidate genes investigated (e.g. cathepsin L2 gene) have not been significantly associated with the disease.

**Signalment**

Clinically, affected individuals are typically in good systemic health, with no abnormal findings on bloods (haematology/biochemistry) and urinalysis. However, cutaneous lesions include symmetrical, hyperpigmented alopecia of the body trunk. The condition is not normally pruritic unless accompanied by secondary microbial infection or seborrhoea. Lesions may start focally, but invariably progress with time. The normal age of onset is 1-4 years of age. Both males and females can be affected.

Histopathological findings in lesional biopsies may include hyperkeratosis, follicular keratosis, flame follicles, thinning of the epidermis, epidermal pigmentation and melanin aggregates within the follicular keratin.

**Diagnosis**

- History and clinical signs
- Biopsy of lesional skin
- Elimination of resembling endocrinopathies e.g. hypothyroidism on bloods etc.
- ACTH stimulation testing - measurement of 17-OH progesterone levels pre- and post-ACTH administration. Any increase should be interpreted in the light of either a normal
or abnormal cortisol response. Some laboratories measure additional intermediate adrenal steroid hormones. An elevated 17-OH progesterone concentration post stimulation is suggestive of a diagnosis of Alopecia X.

**Treatment**

Neutering has often been recommended in intact male dogs; however the success rate is often only about 40% and partial/complete hair re-growth may take up to 6 months.

A wide variety of drug therapies have been advocated. The main problem for clinicians is that there is no one agent that can be recommended as the drug of choice. There is a lot of variability in response, which may reflect the difference in the underlying imbalance in adrenal hormone synthesis etc. in individual animals.

Suggested therapies include:

- Mitotane
- Trilostane - inhibits 3β-hydroxysteroid dehydrogenase. Normally given at a dose rate of 3-4 mg/kg per day PO for several months. Treatment with trilostane has resulted in good hair re-growth in several studies.
- Ketoconazole
- Prednisolone – not recommended by many authors
- Growth hormone – very expensive and difficult to obtain.
- Testosterone
- Melatonin – administered normally at an initial dose of 3-6 mg twice daily (bodyweight can be a factor). Based on clinical progression over several weeks to months, the dose of melatonin may be increased.
- Alpha-tocopheryl
- Oestrogen-receptor blockers – although a regulatory oestrogen receptor pathway for telogen–anagen hair follicle transition has been described in rodents, receptor blockers such as fulvestrant have not been associated with clinical improvement of Alopecia X.

**Prognosis**

At first presentation, it is hard to predict which dogs will respond and which will not. In addition, even for those cases with complete hair re-growth, on-going medication is often required.

**Gonadal sex steroid imbalances**

This is an uncommon group of dermatoses in the dog and cat. Clinically, dogs with sex steroid imbalances typically present with bilateral symmetrical alopecia affecting the groin, inguinal and flank regions. Again, the condition is usually non-pruritic unless secondary problems develop. Affected individuals may suffer from an under-production or over-production of gonadal hormones. In certain cases, the underlying pathology may involve a neoplastic process e.g. over-production of oestrogen by sertoli cell tumours.
Clinical suspicion is normally aroused when other resembling skin diseases are ruled out. At that point, the intact/neutering status of the animal is taken into account and any history of disease exacerbation during periods of hormonal peaks/troughs e.g. oestrogen surges during oestrus.

Treatment involves the removal of the offending hormone e.g. castration for hyperandrogenism, or hormonal supplementation if appropriate e.g. oestrogen or testosterone. In the latter case, it may be more appropriate not to administer treatment when one considers the side-effects of some hormonal therapies.

**Hepatocutaneous syndrome**

This uncommon dermatosis occurs in dogs with underlying significant hepatic pathology e.g. cirrhosis. Although a similar syndrome involving pancreatic pathology (usually glucagon-secreting tumour) occurs in man, most affected dogs do not have a demonstrable pancreatic lesion. Nevertheless, hyperglucagonaemia is an occasional finding and may be related to a failure of hepatic metabolism of this hormone. Affected animals usually present with severe cutaneous lesions including erythema, crusting, oozing and ulceration of the face, muzzle, genitalia, distal limbs and footpads. Hyperkeratosis and ulceration of the footpads are commonly reported. Systemic signs including weight loss, inappetance and lethargy are often present. Histopathological findings in lesional biopsies are highly characteristic and include superficial perivascular to lichenoid dermatitis, parakeratotic hyperkeratosis and a marked intra- and intercellular oedema limited to the upper half of the epidermis.

**Diagnosis**

- Haematology/biochemistry – hepatic enzymes elevated, particularly alkaline phosphatase
- Bile acid stimulation test – typically demonstrates elevated values
- Diagnostic imaging e.g. microhepatica if cirrhosis present
- Biopsy – liver pathology and above noted characteristic signs in lesional skin biopsies

**Treatment**

The prognosis is usually very poor as the hepatic pathology is often irreversible. Could try:

- Hepatic support diet
- Liver supplements e.g. methionine
- Anti-fibrotic agents e.g. colchicine and penicillamine
- Symptomatic treatment for skin lesions e.g. antimicrobial therapy
Feline Skin Disorders

Miliary dermatitis

Miliary dermatitis is a term used to describe a cutaneous reaction pattern in the cat consisting of multiple papulocrustous lesions. It is important to emphasize that it is a clinical, not an aetiological diagnosis. Many veterinarians believe that the term should only be applied to a small number of differentials for this classical reaction pattern. Others include a huge list of differentials for virtually every skin disease that can cause a papulocrustous dermatitis.

Miliary dermatitis is characterized by;

- Multiple papulocrustous lesions on the skin surface.
- Lesions which typically appear in clusters.
- Alopecia.
- Secondary bacterial infection is sometimes present. The skin/coat may feel hot and sticky.
- The mechanism of lesion development is often inflammatory or immune-mediated in nature, but can vary with the underlying aetiology.
- Pruritus is a significant feature, which contributes to lesion development.

Widespread papulocrustous lesions can develop in many sites of the body. The precise location of lesions will vary with the specific condition. The most common sites affected include the dorsal trunk, flanks, caudo-medial thighs and ventral abdomen.

Most cases of miliary dermatitis are due to hypersensitive reactions. A definitive aetiology is not always apparent, and in such cases the cat is usually treated symptomatically.

Flea allergic dermatitis is by far the most common underlying cause of this syndrome.

Food allergy, atopic dermatitis and other hypersensitive disorders are less common. Other causes include ectoparasitism and microbial infections. Neoplasia and various miscellaneous factors such as dietary imbalances etc. are possible causes in a small minority of cats.

Many factors including the history, age of cat, lesion distribution and even geographical location should help to limit the list of differentials in certain cases.

Diagnosis

- As miliary dermatitis represents a cutaneous reaction pattern, the diagnosis is largely based on clinical signs.
- There may be signs related to the underlying cause e.g. fleas etc.
- Histopathology of affected skin will confirm the papulocrustous nature of the lesion, but will rarely reveal the aetiology.

Treatment

- Address the underlying cause if possible. Strict flea control is highly advisable, even if no fleas evident.
• Corticosteroids can be used judiciously to control clinical signs. Progestogens have also been used for this purpose, but are not the preferred option.
• Symptomatic therapy for any secondary infection etc.

**Feline Acne**

Feline acne is rare. Lesions are generally confined to the chin and upper or lower lips. The disease can manifest as recurrent bouts. Adult cats are commonly affected. Both sexes are equally affected. Whilst many underlying diseases are suspected, the condition is basically idiopathic. The lesions in feline acne more commonly resemble true comedones. Secondary infection may lead to pustules developing. The chin (and possibly the lips) may become grossly swollen. Pruritus can be a common feature in advanced cases. Regional lymphadenopathy may be evident clinically. Residual scarring may develop. The diagnosis is often made clinically, but can be confirmed on histopathology. Conditions to rule out include ringworm, demodicosis and the eosinophilic granuloma syndrome.

Topical therapy is frequently beneficial in cats. Benzoyl peroxide may be irritating in some cats, so agents such as sulphur or ethyl lactate can be used instead. Systemic antibiotics are indicated if pustules are present. Vitamin A derivatives and even short courses of prednisolone may be required for severe cases. The need for on-going therapy varies from cat to cat. Some cats only have one bout of disease, others have several bouts or continual disease.

**Plasma cell pododermatitis**

Although this condition is increasingly been recognized, it still represents an uncommon diagnosis in practice. The cause is unknown, but due to the predominance of plasma cells in affected tissue, an underlying immune-mediated mechanism is often suspected. The FeLV status of affected animals was once considered highly significant in the pathogenesis, but this is no longer the case. Suspicions that affected animals may also exhibit signs of systemic immune-mediated disease e.g. glomerulonephritis, have not been backed up by reliable evidence. Affected cats invariably exhibit a significant hyperglobulinaemia.

**Clinical signs**

• The condition may initially appear on one foot, but commonly spreads to other or all four feet.
• The pads are the affected area; in particular the central metacarpal and metatarsal pads.
• The affected pads initially swell and may become slightly tender. The surface epidermis becomes thin. The cat usually continues to walk on the affected feet.
• Later on, the epidermis ruptures and exuberant red tissue emanates through the ulcerated area. These lesions may become secondarily infected, and pain/lameness may be a prominent feature.
• Regional lymphadenopathy may occasionally be seen.

**Diagnosis**

• Biopsy of affected tissue reveals very large numbers of plasma cells, many with distended Russell bodies, in the lesion. Other cell types e.g. lymphocytes, neutrophils etc., may also be present.
• Hyperglobulinaemia on biochemistry.
Treatment

- Prednisolone (2-4 mg/kg/day) initial dose, with tapering to the lowest effective dose.
- Gold therapy may be used if corticosteroids do not succeed.
- Bandaging of affected paws and surgical intervention are usually only necessary in severe, non-responsive cases.

Eosinophilic Granuloma Complex

The eosinophilic granuloma complex is an idiopathic disorder seen primarily in cats, but has also been recorded in dogs. The underlying cause in many cases is considered to be a hypersensitive response. The most likely aetiologies include flea allergic dermatitis, food allergy and atopy. However, an allergic factor cannot be demonstrated in all cases. Clinical signs of disease may be intermittent or perennial, depending on the underlying cause. There are three distinct components to this syndrome;

- Indolent ulcer
- Eosinophilic plaque
- Eosinophilic or linear granuloma.

An individual cat may exhibit signs of one or more of the above components e.g. indolent ulcers and eosinophilic plaques.

Clinical signs

- Indolent ulcers are normally found on either side of the naso-labial groove. They may be unilateral or bilateral. They are rarely pruritic and may go unnoticed for quite some time. They appear as well demarcated ulcerated lesions, occasionally with white foci of collagenous tissue necrosis. The border of the lesion is normally raised. Lesions may also appear in the mouth.

- Eosinophilic plaques are usually multiple, raised, round to oval lesions, often several centimeters in diameter. Common sites include the abdomen, medial thighs and mucocutaneous junctions.
  - Ulceration and oozing.
  - Marked pruritus.
  - Regional lymphadenopathy and secondary infection are sometimes present.
  - Affected cats may also exhibit indolent ulcers, eosinophilic granulomas or ocular lesions.

- Eosinophilic granulomas (linear granulomas) commonly occur on the caudal thighs, but may also appear on the face and oral cavity. Lesions on the thigh are raised, firm and often ulcerated. They tend to have a linear pattern. Lesions on the face or in the mouth are often papular or nodular in nature. Eosinophilic granulomas are rarely pruritic.

Diagnosis

- Characteristic histopathology of lesions.
- A peripheral eosinophilia is common for eosinophilic plaques, but is far less common for the other forms.
Intercellular immunoglobulin is frequently found within the epidermis; however, this should not be mistaken for an auto-immune skin disease.

Investigate for any possible underlying hypersensitive reaction.

Treatment

- Immunosuppressive doses of prednisolone (4.4mg/kg/day initially). The dose is gradually tapered to the lowest effective dose. Therapy may need to be intermittent or perennial.
- Depot corticosteroid preparations are also used in cats difficult to medicate, or where seasonal disease is involved.
- Progestagens are sometimes used. Not the first choice drug, however.
- Older methods of treatment for indolent ulcers included cryosurgery, surgical excision etc., but are rarely indicated nowadays.
- Symptomatic therapy for secondary infection etc.
- The cat should be treated for any possible underlying hypersensitive reaction e.g. FAD, as control of the underlying problem may lead to resolution of the eosinophilic granuloma etc.

Psychogenic dermatoses

The term psychogenic dermatoses is used to describe a number of conditions in which the clinical signs arise due to self-induced damage, and the results of history taking and various ancillary tests indicate that the underlying problem is one of psychological disturbance. The compulsive or obsessive behaviour that induces the skin lesions may arise due to boredom, hyperactivity, stress/anxiety etc. Important factors to be borne in mind in the history include the breed involved (e.g. Siamese cats), the animals daily lifestyle (e.g. left alone all day long) and the animals temperament e.g. highly nervous etc.

The precise interaction between the CNS, various neurotransmitters and the skin lesions evident has not been clearly elucidated in all the conditions involved. It is postulated in certain mutilation conditions that the physical act of biting/chewing is associated with endorphin release and a feeling of “well-being” on the part of the animal. Serotonin appears to play a significant role as well.

Clinical signs of feline psychogenic alopecia

- Remember that many cats are secret groomers and the owner may see no evidence of chewing or licking.
- Alopecia particularly affects the body trunk. Hair loss is often evident along the dorsal spine or lateral abdomen/chest. The groin is another favoured zone.
- The affected hairs are rough, broken and not easily epilated from the skin. In some cases, the alopecia is symmetrical.
- The skin underneath may have slight erythema and scaliness from the self-induced trauma. Long standing lesions may develop hyperpigmentation.
- The cat may swallow excessive amounts of hairs giving rise to fur-balls.

Diagnosis

- Clinical signs and history.
- Use of Elizabethan collars often leads to the re-growth of hair.
- Trichograms reveal fractured hairs and some hairs will be in anagen.
- Biopsy rules out other conditions such as ringworm, demodicosis and telogen defluxion.
Treatment

- An Elizabethan collar can be used if the cat tolerates it.
- The use of chemical agents to reduce stress has been beneficial. This is largely the same approach as used for dogs. Clomicalm has also been used in cats for separation anxiety.
- Try to identify and rectify any underlying cause of stress, anxiety etc.