Continuing Professional Development | Business Success | Clinical Skills

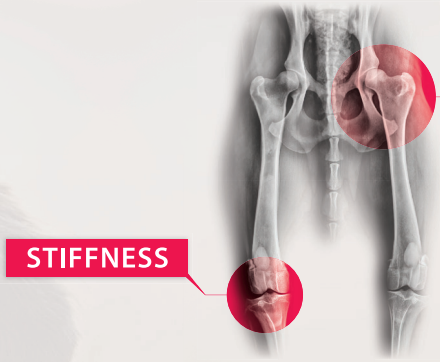
vet 360

Vol 08 | Issue 05 | November 2021

Business
Valuing a Veterinary Practice

CPD Article
Use of Laboratory Diagnostics in Dermatology for Veterinary Clinicians
Part II:Microbiology and Serology

Research Paper
Cats vs. Dogs: The Efficacy of Feliway Friends™ and Adaptil™ Products in Multispecies Homes



20% of dogs 1 year and older &
33% of cats 6 years and older
suffer from

OSTEOARTHRITIS

6 ACTIVES

JOINT REPAIR AND PROTECTION

Collagen Type II, Glucosamine and low molecular weight Chondroitin Sulphate aid in the repair of damaged cartilage in the joint.

- Collagen Type II
- Glucosamine
- Chondroitin Sulphate

MANAGEMENT OF PAIN AND INFLAMMATION

Omega-3, Green Lipped Mussel Extract and MSM can help to reduce pain associated with osteoarthritis.

- Omega-3 Fish Oil
- Green Lipped Mussel Extract
- MSM

GCS JOINT CARE • ADVANCED •

FOR STIFF AND SORE JOINTS

Reg. No. V28125 / V218124 / V27363 / V27365 / V27364 Act 36/1947
Registraton Holder: Ascendis Vet (Pty) Ltd. Reg. No. 2001/017471/07
31 Georgian Crescent East, Bryanston, Johannesburg, 2191.
Tel: 0108800778 E -mail: vet-info@ascendishealth.com JCA.21.09/4

GCS JOINT CARE • ADVANCED • | Ascendis ANIMAL HEALTH

Editor's Note

Some more home grown articles in this edition.
Thank you to the contributors.

Please also take note of our request elsewhere on this page for vets to contact us with questions they have so that we can have a specialist assist column. I believe this could be very helpful to all.

I wish you all a safe and relaxing holiday season and hope each of us gets to take a break.

Regards

Liesel

vet360

Advisory Board

VET360 aims to be a leader in the field of continuing veterinary development in Southern Africa by providing veterinary professionals from diverse disciplines with tools to help them meet the challenges of private practice. The magazine aims to make information accessible, both paper and electronic, and provide clinical, business and other veterinary information in a concise form to enable the practitioner to rapidly acquire nuggets of essential knowledge.

Editor

Dr. Liesel van der Merwe BVSc MMedVet (Med) Small Animals
BVSc (Hons), MMedVet (Med)
Small Animal Internal Medicine Specialist, Small Animal Internal Medicine,
Department of Companion Animal Clinical Studies, University of Pretoria, South Africa

You have a small animal problem. We have an answer...

Vets are invited to send in questions or problems that they have regarding small animal medicine or surgery. The editor will get an expert opinion from colleagues at the Veterinary Faculty. This forum is not designed to assist with specific case management but with concepts. Please keep them short and to the point. If the question is not answered in the magazine we will try to get some advice to you personally or direct you to information sources.
We do not guarantee all questions will be answered as they will be screened.
Please send an email to the Editor at support@vetlink.co.za

We are currently distributing to SAVA members. A win-win situation for SAVA, Vetlink and the reader. Please to subscribe to ensure access to the CPD MCQ. Subscription: www.vet360.vetlink.co.za

SAVA South African Veterinary Association Suid-Afrikaanse Veterinêre Vereniging

Index:

Vet360 is a source of current, relevant educational material for practising veterinary professionals in Southern Africa.
Published Bi-monthly in hard copy and electronically on www.vet360.vetlink.co.za.

Distribution: Southern Africa, 3 500 copies.

Editor: Dr Liesel van der Merwe BVSc (Hons) MMedVet (Med) Small Animals.
Layout and design: Heinrich van Rijn
Publisher and Owner: Vetlink Publications
Other Publications by Vetlink: Vet360 Mobile App, Livestock Health and Production Review, Hooo-Hooo, Equine Health Update

We welcome any comments, contributions, topic suggestions and letters for publication. Send them to:
The Editor, PO Box 232, GROENKLOOF, 0027
Tel: (012) 346 1590, 082 575 6479. Fax: 086 671 9907
Email: lieselvdmvet@gmail.com
(Dr Liesel van der Merwe)

Publisher: Madaleen Schultheiss: madaleen@vetlink.co.za

Advertising Enquiries: AgriConnect
Ilse Liveris
Senior commercial consultant
072-708-4401 / ilsel@agriconnect.co.za

Soekie du Toit
Commercial consultant
078-947-6916 / soekie@agriconnect.co.za

vetlink

Valuing a Veterinary Practice

Andrew Christie
BComm (Business Management)

Establishing the value of a practice is something that every practice owner asks themselves on a regular basis.

A fluctuating economy and turbulent socio-economic conditions in South Africa have caused the question to be asked even more than usual and, perhaps, a little louder. Business valuations are complex in that there are so many internal and external economic factors to consider; vet practice valuations are even more complicated as the number of people who can own a practice is so small, and few people understand of both the profession and the intricate financial aspects of business. However, the factors contributing towards the valuation of a practice can broadly be grouped as follows:

1. Performance of the Practice

The starting point of a valuation should be a careful consideration of the performance of the practice. This is measured by the Income Statement and, to a lesser degree, by the Balance Sheet.
It bemuses many practice owners that the valuation begins with the Annual Financial Statements but there are several key reasons for beginning here:

a. If a potential buyer wants to raise funds to purchase the practice, the financials are what will be examined by the lending institution.
b. The Income Statement specifically measures the performance of any business by comparing income with expenditure over a 2-year period. And, as our history teachers told us, the best predictor of the future is the past.
e. The value of the practice will be measured in Rands, and the financials translate most aspects of the practice into Rands.

Andrew consults extensively on business issues to vet practices and other stakeholders within the veterinary industry, as well as conducting lectures on various aspects of business at Onderstepoort. His expertise with practice management in general and financial management in particular has made him a sought-after advisor on veterinary business issues, including practice valuations.
Email: andrewc@acahr.com | Cell: 082 799 1153

Ideally financials for the past 5 years are necessary; this enables the valuation to reflect the trends over a period of time. For example, turnover increasing over a period of 5 years is a more reliable indicator than the turnover simply increasing from last year to this. Finally, it is important to remember that the income statement also tell us far more than merely the profit and loss of a practice – information pertaining to cash flow, stock management etc, etc can be extrapolated.

2. Condition of the Practice

In valuing a practice, the condition doesn't refer to the ageing x-ray or the leaky roof over the kennels; rather, it refers to the financial state of the business. This can largely be determined by the balance sheet in the financials.

The balance sheet is both more complex and simpler than it appears. Huh? What does that mean?

If we were to consider the value of a business, we could say that it relates to how much it owns vs how much it owes. In other words, the value of a business equals assets minus liabilities.

And that's all a balance sheet is - it reshuffles the formula:

Equity (value) = Assets- Liabilities
into
Assets = Equity – Liabilities.

That's why the balance sheet is simpler than it seems. But the complex parts come in when questions like these are asked:

a. How do we value things that weren't bought (intangible assets like goodwill)
b. Why do we value assets at "cost price"? After all an x-ray machine can often be sold for a lot more than it shows on the balance sheet.
c. What is depreciation and why is it different for different kinds of assets?

(For those nodding that, indeed, these are questions that they ask, the answers appear at the end of the section)

Non-current assets are assets that will produce a benefit for the practice for longer than a year (for example a vehicle or machinery), while current assets will produce a benefit within a year (for example stock or debtors). In a similar manner, non-current liabilities are debts that are paid for a period longer than a year, while current liabilities must be paid within the next 12 months. This differentiation is important to the valuation of the practice as the seller may want to take some of the current assets with them – this is especially common with cash reserves. Likewise, a buyer may insist that the seller settle some of the current liabilities.

As with the income statement, the balance sheet can also be analysed – normally for liquidity and borrowing ability and may yield some valuable information about the performance of the business when looked at in conjunction with the income statement.

Answers to the complex questions:

a. Goodwill – accounting and other – is outlined in the next section.
b. Assets are valued at cost because one of the key accounting principles require figures to be conservative - by using the historical cost less accumulated depreciation, assets are very unlikely to be overstated.
c. Depreciation allows the value of a purchase price of an asset to be allocated over its expected lifespan, which is determined by SARS. This depreciation is included in the income statement as an expense, resulting in a lower tax amount to be paid to SARS.

For example:
- An x-ray machine is purchased for R120,000
- It can be depreciated over a 5-year period
- Each year depreciation of R24,000 will be put through as an expense
- This means that if the taxable amount without depreciation is R60,000, after depreciation is added to the expenses, the taxable amount is reduced to R36,000)

3. Goodwill of the Practice

Consider this:

A young vet opens a practice in your area, literally around the corner. They spend R5 million buying the property and another R10 million building the dream practice with the latest equipment. Are clients going to use this vet? In general, they will remain with you because they have a relationship with you, a relationship that may have spanned many years. This illustrates the potential goodwill of the practice. In a nutshell, it is the reason that your clients come to you, and a value must be given to it.

From an accounting perspective, it is the difference between what is paid for a business and its net asset value at market value.

This presents two problems:

- It is only recorded after the practice has been sold
- The value of the goodwill fluctuates, and the current value may be higher (or lower) than when the practice was bought.

It is for these reasons that valuations should rather re-calculate goodwill.

The following contribute to why a client returns to a practice:

- Client loyalty to a practice
- Client loyalty to a vet
- The practice is in a familiar position to clients
- The practice is clean and comfortable in the waiting area
- "Recognisability", such as branding
- Competitive pricing
- Etc etc etc

These are things that vets know, but how can this be calculated?

When a buyer purchases a practice, they are buying the opportunity to generate a meaningful income for themselves. The past performance is recorded in the income statement, but a buyer isn't buying the last few years' profit - they are buying future profits. It is the likelihood of generating a similar, or better, performance into the future that represents the goodwill. All of the factors shown above will contribute towards that future performance and therefore it is more accurate to forecast the profitability of the practice than to try and put a value on branding etc.

4. Conclusion

Although valuations are rooted in the annual financial statements, the final valuation is part science and part art. Science, in that formulae are used, procedures followed and the result quantifiable; art, in that the variables may be interpreted differently, meaning that the answer is seldom exactly the same between valuators.

At the end of the day, the value of the practice is what the buyer is prepared to pay and what the seller is prepared to accept.

Nevertheless, some owners of practices significantly undervalue the worth of their business and this can lead to years, even decades, of hard work being sold for a pittance. Alternatively, some owners hugely overvalue the worth and this results in a business which cannot be sold and gradually loses its value as the vets age and become less productive and more resentful that no-one has purchased their business.

Hill's Pet Nutrition

Transforming Lives

Launches New Prescription Diet Derm Complete to Help Manage Environmental and Food Allergies in Dogs

Hill's Pet Nutrition announces the launch of Hill's Prescription Diet Derm Complete, the brand's latest groundbreaking innovation in nutrition and addition to the Hill's Prescription Diet portfolio. Derm Complete is the only nutritional solution clinically proven to tackle both food and environmental allergies in dogs[2].

This new product will help alleviate excessive licking, scratching, headshaking and skin redness, often the cause of regular visits to the vet. In an open label study conducted by Hill's, Derm Complete reduced night scratching, with less disrupted sleep within two months in 75% of dogs.[3]

"For years, Hill's has been committed to creating science-led nutrition that improves the quality of pets' lives, and we know that skin sensitivities in pets are challenging for everyone involved. They not only cause discomfort for dogs with irritated skin, but also lead to frustration from pet parents trying to give their dogs a happy, healthy life," says Dr Guy Fyvie, Veterinary Affairs Manager for Hill's Pet Nutrition South Africa. "Derm Complete is the latest breakthrough in pet nutrition that is clinically proven to provide broad derm coverage from the inside-out. Now, veterinarians can start managing skin disease immediately to help end their itching."

New Derm Complete is formulated with optimal levels of key nutrients to help strengthen the skin's natural barrier against environmental allergens, helping avoid future flare-ups. Derm Complete also contains Histaguard complex with bioactives and phytonutrients to help manage a dog's response to environmental allergens. In a study, pet owners reported a reduction in scratching in 82% of dogs with environmental allergies.[4] Derm Complete also contains egg as a single intact animal protein source — a novel protein that avoids 96% of food allergies[5] in dogs and helps to reduce itching.

Historically, dietetic foods have been formulated for either adverse food reactions or environmental allergies. Derm Complete is a breakthrough product and an easy way to help manage both types of allergies and alleviate itching, no matter the trigger.

With the new Derm Complete, dogs will not only have an improved quality of life, but they will also have more time to do what they love — be a best friend.

1. Hill's Data on File. Effects of novel protein and hydrolyzed protein foods in dogs with adverse food reactions.
2. The only dietetic nutritional solution for both food and environmental allergies in dogs supported by 3 clinical studies.
3. Witzel-Rollins A, Murphy M, Becvarova I, et al. Non-controlled, open-label clinical trial to assess the effectiveness of a dietetic food on pruritus and dermatologic scoring in atopic dogs. BMC Vet Res. 2019; 15:220.
4. Hill's Data on File. Clinical nutrition for the management of dogs with environmental sensitivities.
5. Mueller RS, Olivry T, Prélaud P. Critically appraised topic on adverse food reactions of companion animals (2): common food allergen sources in dogs and cats. BMC Vet Res. 2016; 12:9.

About Hill's Pet Nutrition
Founded more than 80 years ago with an unwavering commitment to pet nutrition, Hill's mission is to help enrich and lengthen the special relationships between people and their pets. Hill's is dedicated to pioneering research and groundbreaking nutrition for dogs and cats based on a scientific understanding of their specific needs. For more information about Hill's, our products and our nutritional philosophy, visit us www.HillsPet.co.za

From: Prior, M. R., & Mills, D. S. (2020). Cats vs. Dogs: The Efficacy of Feliway Friends™ and Adaptil™ Products in Multispecies Homes. *Frontiers in Veterinary Science*, 7. https://doi.org/10.3389/fvets.2020.00399

Cats vs. Dogs:
The Efficacy of Feliway Friends™ and Adaptil™ Products in Multispecies Homes

Miriam Rebecca Prior* and Daniel Simon Mills
Animal Behaviour Cognition and Welfare Group, School of Life Sciences, University of Lincoln, Lincoln, UK

Seven percent of UK households are estimated to own both a cat and a dog, despite a popular view that the two do not live well together. This is the first study to evaluate the effects of pheromone products Feliway Friends™ and Adaptil™ on cat-dog interactions, in homes where owners perceived the potential for improvement in the relationship between their cat and dog. A blinded parallel randomized trial design over a 6-week period was used to evaluate the effect of each of the two products, with 17 participants in each group completing the trial. Owners reported weekly on the frequency of 10 specific undesirable interactions and seven specific desirable interactions. Total undesirable and desirable interaction scores both showed significant linear contrasts over time (undesirable score decreased; desirable score increased). Undesirable interaction scores were significantly lower (with a very large effect size) during treatment compared with baseline.

There were no significant differences between the two pheromone products in relation to these outcome measures. Adaptil™ and Feliway Friends™ were both associated with a significant decrease in: dog chasing cat/cat runs away; cat hiding from dog; cat/dog staring at the other; and dog barking at cat. With Adaptil™ a significant increase was also seen in: friendly greeting and times spent relaxed in the same room. From baseline (Week 2) to the end of the study (Week 6) there was a significant improvement in owners' perception of dog relaxation in those participants who received Adaptil™ and of cat relaxation in those participants who received Feliway Friends™. Similarity in the core chemical structure of the appeasing pheromones might explain the main effects, whilst different species-specific additions may explain the product-appropriate species-specific increases in relaxation scores. Specific behavioral improvements seen with Adaptil™ may reflect a greater calming of dogs in this group, reducing their interest in seeking interaction with cats in the same home and the tension in the cat as a result. In conclusion, both products appear to improve the cat-dog relationship and it would be beneficial to further study their use in combination and against placebo. If selecting one product Adaptil™ may be preferable, unless there is a particular need to increase the cat's relaxation.

Introduction

Cats and dogs are the most popular pets, with an estimated 8.5 million pet dogs and 8 million pet cats in residence in the UK: 24% of UK households have at least one dog and 17% have at least one cat (1). These figures are not exceptional with global estimates of household dog ownership reported in the USA at 36.1%, Costa Rica at 53%, Sydney, Australia at 33.4%; and Teramo, Italy at 33%, with cat ownership in the USA at 31.6%; Costa Rica at 15%, Sydney, Australia at 22.5% and Teramo, Italy at 15% (2–5). Multi-species households are also increasingly common with recent estimates suggesting: 7% of UK households own both a cat and a dog; likewise, 7.8% of residents of Sydney, Australia, owned both species; and 7% of the residents of Teramo, Italy, owned both species (4–6).

Despite the prevalence of multi-species households across the globe, there has been little research to date on cats' and dogs' relationships with one another. Feuerstein and Terkel (7) highlight the suspected difficulty inherent in cat-dog communication; a stereotype that has permeated popular culture and is exemplified in the media by shows such as Nickelodeon's "CatDog," Warner Bros. "Cats & Dogs" (2001), and Spike the dog in MGM's cartoon "Tom and Jerry". Challenges in the cat-dog relationship can arise as a result of their differing behavioral tendencies and differences in typical social structure, for example cats lack a widely understood deference signal unlike dogs, and appear to place little importance on any observed hierarchy when determining access to key resources (8). Cats may also be seen as prey to some dogs, particularly those bred for hunting smaller mammals such as sighthounds or terriers. Feuerstein and Terkel (7) identified four behavioral categories in which the conveyed message is contradictory when performed by a cat compared with a dog: the horizontal full tail wag; stretching out forefeet; laying on back; and turning head away, all of which they consider to be appeasing/submissive signals in dogs but signs of frustration/aggression in cats. Despite these differences, cats and dogs are often able to form amicable relationships and most pet owners believe that their cat and dog are comfortable in each-other's presence (7, 9).

However, a poor relationship between a resident cat and dog can have serious consequences for the welfare of individual animals. There may be an unacceptable level of social stress or restricted access to key resources such as food, water or suitable toilet areas. There will also be increased stress for the remainder of the family (both human and animal), and potential risks of injury due to conflict. Importantly, it has been reported that a problematic relationship between a new pet and an existing pet is one of the top ten behavioral reasons for relinquishment to shelters for both cats and dogs (10). Whilst this latter study did not specify the percentage of cases in which problematic relationships were same-species or cat-dog relationships, the authors did specify that where cats were relinquished following acquisition of a dog in the previous year, they were much more likely to be relinquished for behavioral rather than non-behavioral reasons.

Pheromone-related products are believed to affect the emotional processing of animals that can detect them and are in widespread use as environmental adjuncts to aid in behavioral problems associated with stress and the perception of a stressful environment (11). In 1996, Feliway Classic™, utilizing a synthetic version of the cat F3 facial-marking pheromone, was the first pheromone product for companion animals to be launched. Adaptil™, based on the Dog Appeasing Pheromone (DAP) was launched in 2000, and Feliway Friends™ (a.k.a Feliway MultiCat™ in the USA) based on the Cat Appeasing Pheromone (CAP), was launched in 2016 (12).

The mammary region is the natural origin of the appeasing pheromone, being secreted from around 3–4 days after parturition until 2–5 days after weaning. Appeasing pheromones are believed to provide reassurance to offspring that persists even in the absence of a maternal figure (13). It is hypothesized that the presence of this mixture in the environment encourages offspring to remain calm while the mother hunts but also helps to identify safe areas to explore as the young develop and become more independent. The appeasing pheromones thus serve as an environmental signal that encourages a bias toward perceiving things as safe.

The different appeasing pheromone products (Adaptil™ and Feliway Friends™) contain some common fatty acids but also species-specific elements. Similar ratios of oleic acid, palmitic acid, and linoleic acid make up the generalized mammalian appeasing message, but it is suggested that additional species-specific components increase species-specific efficacy (13).

Evidence in support of the reassuring effect of DAP in dogs comes from data relating to a reduction in barking in shelter environments; separation related behaviors; firework fears; and anxiety at the veterinary clinic; as well as improved socialization in puppies (14–18). The quality of published research evidence in support of all of these indications is variable, as is the quality of some of the criticisms made concerning the evidence base. For example, the skeptical review of Frank et al. (19) is often cited in the context of an "evidence-based argument" [e.g., (20, 21)] without equal consideration given to the flaws in this latter work which have been highlighted by both Pageat et al. (22) and Beck (23) in the same journal. Both proponents and opponents to the use of pheromones may selectively cite the literature in favor of their case.

There are very few peer reviewed studies on CAP, however initial results are potentially promising regarding its use in reducing inter-cat conflict in multi-cat households. A case report on the use of Feliway Friends™ in a single multi-cat household documents increased cat-cat proximity, increased tolerance, faster recovery following aversive encounters, and increased duration of sleeping in proximity between cohabiting pairs of cats (24). A randomized, double-blind placebo controlled study of 45 households claims a greater decrease in aggression scores with Feliway Friends™ compared with placebo (25). This study is described as a "pilot study" perhaps because an atypical significance threshold was chosen to illustrate a more consistent effect across time, although a conventional significance threshold ($p < 0.05$) would still indicate superiority of the pheromone product over placebo at days 21 and 42. The consistent positive outcome in these circumstances, as well as the specific behavior changes seen in each context, support the hypothesis that CAP also creates some form of bias toward an increased sense of safety in the environment.

It is worth noting that pheromone products are intended for use as an environmental adjunct to aid relaxation. As pheromone products only form part of the environmental input processed by an individual they can be counteracted by more overt threatening cues, and this might explain why, for many behavioral problems, they are generally recommended in combination with a behavioral modification plan. This may include psychopharmacological intervention when addressing an established behavior problem.

Both Adaptil™ and Feliway Friends™ are described as appeasing pheromones due to their origin and compositional similarities, but currently Feliway Friends™ is specifically marketed for conflicts and aggression whereas Adaptil™ has never been evaluated for use in conflict and is not promoted for use in these circumstances (26). The reason behind the different recommendations of these apparently similar products is not clear, but may be based on an assessment of risk and differences in typical cat and dog social behavior, with cats typically being more avoidant and exclusionary than dogs.

Within the cat-dog relationship, the behavior of the

cat may be particularly important. A recent study of 748 mixed species homes found that cats were observed to be uncomfortable with dogs or to threaten dogs more frequently than vice versa (9). The study concluded that "comfortability of the cat" was the most important prognostic indicator of the cat-dog relationship (9), however no indication was given as to whether it is the cat's temperament and behavior which underpins its comfortability, or the dog's. Given that many cats and dogs appear to live together in a state of some tension, but not deep hostility, this situation provides an excellent context in which to evaluate the effect and species-specificity of CAP and DAP, without other behavioral intervention. However, given the lack of information about the nature of the determinants of "cat comfortability" it was not possible to predict which product may be better.

To date there has been no scientific study investigating the potential efficacy of pheromone products in improving the cat-dog relationship in multi-species homes. Therefore, the aim of the current study was to undertake a blinded parallel randomized trial to evaluate and compare the effects of Adaptil™ and Feliway Friends™ on the cat-dog relationship in multi-species households where there was some tension in the relationship between the two species. It was hypothesized that both products would improve the cat-dog relationship, but that there should be some differences between the two products given their different compositions. No a priori assumptions were made as to specific effects.

Materials and Methods

Ethical approval for the study was provided by the delegated authority of the University of Lincoln's College of Science Ethics Committee.

Given the limited previous research on the cat-dog relationship, it was necessary first to design an appropriate survey instrument to capture the clinically important details of the relationship, before undertaking the double blinded parallel randomized study.

Design of Survey Instrument

Focus groups were used to capture the details of the cat-dog relationship that pet owners felt were most important. Separate focus groups were used to discuss cat behaviors and dog behaviors. The focus groups followed a basic template with group discussion encouraged after each question was asked (for template see Supplementary Material Table 4). Groups ran until redundancy on this topic was achieved (two rounds of focus groups for each species). Transcripts were analyzed and behaviors that were consistently considered to be important indicators of the relationship were identified from their frequency within and between groups. The focus groups recruited individuals with a special interest in the veterinary and/or behavior fields. For the veterinary group, inclusion criteria were ownership of both cat(s) and dog(s) and employment at a veterinary practice. For the behavior group, inclusion criteria were ownership of both cat(s) and dog(s) and at least an MSc level qualification in Clinical Animal Behavior. In order to ensure that the themes which emerged from these were understood by non-specialists, a comprehension assessment was undertaken using an interactive PowerPoint survey of the issues raised (27). This presentation was distributed to six volunteer members of the general public recruited through social media. Specifically, these "lay-volunteers" did not work in an animal-related profession or consider themselves to be experts in the field. These volunteers were also given the opportunity to raise any further issues that may have been missed by the expert focus groups. No further issues were raised. Based on the data collected from these activities a 34-item survey was created (See Supplementary Material Table 1). Seventeen items (10 relating to undesirable interactions and seven to desirable interactions) assessed the frequency of specific cat-dog interactions. The ten undesirable interactions were: cat blocking dog's path; dog chasing cat/cat running away (not in play); dog growling at cat; cat hiding from dog or up high; staring; cat swiping at dog; dog barking at cat; cat hissing at dog; dog interrupting fuss of cat (i.e., approaching and causing disruption when the owners fuss the cat); and cat interrupting fuss of dog. The seven desirable interactions were: playing (both pets enjoying play together); sleeping near each other; dog grooming cat; friendly greeting; cat grooming dog; sharing a bed; and both relaxed in the same room. All of these were scored by the owner using a 5-point Likert frequency scale (Several times a day, Daily, 3–6 times this week, 1–2 times this week, Not this week). Additional items assessed cat comfortability, dog comfortability (both scored subjectively by the owner out of ten), changes in owner routine, and only for households with additional pets, the behavior of these other animals in the household, especially in relation to the focal subjects.

Parallel Randomized Trial (PRT)

Participants for the PRT were recruited using online groups, social media, and poster advertisements in the waiting rooms of veterinary practices. Criteria for inclusion were that participants had to: be 18 years of age or older; own at least one dog and one cat, each of which spend >40% of their time in the home; feel that there was room for improvement in the relationship between one of their dogs and one of their cats; have a 6 week period in which to complete the trial with no holidays or changes in routine planned; and be willing to complete surveys on a weekly basis. Participants also had to confirm that in the 3 months prior to the trial they had not moved to a new house; nor acquired any new pets; nor started treating their pets with any medications which could influence behavior; nor used any Adaptil™ or Feliway Friends™ products.

During an initial telephone interview, qualitative information was collected describing the cat-dog relationships in each household based on a pre-defined list of questions but with room for owner elaboration. On this basis, the participant's animals' relationships were categorized into the following groups: dog interested—cat fearful; cat interested—dog fearful; indifferent; and avoidant. A suitable location for diffuser placement was also identified at this time: a floor-level plug socket in an area frequented by both pets and not obstructed by furniture or close to open windows/doors. Subjects were then allocated a diffuser based on order of recruitment. All diffusers were visually identical and randomly allocated a number for order of use, in batches of 10 (five of each product). The researchers were blind to the treatment groups as this process was undertaken by an individual otherwise independent of the study.

Data concerning the frequency of specific cat-dog interactions and a score of the owner's perception of their pets' overall level of relaxation were collected weekly using the survey instrument (Supplementary Material Table 1). Two weeks of baseline data were captured since it was thought that owners' observation abilities and thus perceptions of the problem might change with the introduction of the recording sheet. Diffusers were posted to each participant in time for them to be plugged in immediately after completion of the second "baseline" week survey.

Immediately after completion of the second week baseline survey, owners were instructed to plug in the diffuser which they had now been allocated, and surveys were completed weekly for a further 4 weeks. All trials were completed between 29th October 2018 to 5th March 2019.

Initial participant groupings (A vs. B) were revealed to the researchers only after all data had been gathered in order to eliminate the risk of bias during the trial. The researchers remained blinded to the specific identity of the groups (i.e., which product each group had received) until all statistical analysis was complete.

The primary outcome of interest was a change in total undesirable interactions over the test period, with the expectation that these would decrease with pheromone diffuser use. The total undesirable interaction score was calculated as the sum of the Likert-scale scores (0–4 for each) of the 10 undesirable interactions. The secondary outcome of interest was change in total desirable interactions, which were expected to increase with diffuser use. The total desirable interaction score was calculated in a similar way. Evaluation of specific behaviors making up each of these scores was only of interest if there was a significant change in these total scores. Additional outcome measures of interest discussed in this paper are "cat relaxation" and "dog relaxation." Data from the survey relating to the animals' interactions with the owner or wider demeanor are not presented here as they do not relate to the primary question of interest.

Unsolicited qualitative feedback from the owners was also collated in order to gain a deeper insight into any issues arising.

Statistical Analysis

Analysis was conducted using IBM SPSS version 25 for Windows. A data management and statistical analysis plan for the undesirable and desirable interaction outcomes was developed a priori as follows. Where <5% of data throughout the study was missing for a participant, estimated data were manually imputed based on the average of the values for that variable at the time points immediately before and after the missing time point for that subject. Any participant with more than 5% missing data would have been excluded, but this did not occur: missing responses were infrequent and there were only eight missing data points out of a total of the 3,876 recorded (0.2% missing data).

Demographic data were assessed for significant difference between the two groups using chi squared tests of association for categorical data and Mann-Whitney U tests for measures of duration (age of pets and duration of cohabitation).

For the primary outcome measure, total undesirable interaction scores, data were checked for normality and a repeated measures mixed ANOVA was used accordingly with week and treatment group together with their interaction as fixed factors (28, 29). Greenhouse-Geisser corrections were employed to correct for a lack of sphericity. In order to identify the source of differences for significant results post-hoc testing was undertaken using pairwise comparisons. For interpretive purposes, effect sizes were calculated (Partial eta squared).

Further testing to identify which specific behaviors were potentially contributing to the overall change was undertaken by comparing Week 2 scores (last baseline period) with Week 6 scores (end of treatment) for individual behaviors. Week 2 was chosen as a point of reference, since it was felt that this would provide a more conservative estimate, given the potential changes in owner perception while learning to use the weekly survey sheets. This comparison was undertaken using non-parametric tests on each of the 10 undesirable behaviors. In accordance with Feise (30) corrections for multiple testing were not made in the individual behavior analysis as this was designed to help elucidate where significant effects might lie and the risk of being overly conservative was considered to outweigh the risks of false-positive results at this stage of the analysis. To determine if there was a difference between the scores of these items for the two baseline weeks (Weeks 1 and 2), within subjects Wilcoxon tests were used, without

correction for multiple testing.

A similar statistical procedure was then used for the secondary outcome measure, desirable interaction scores, with a repeated measures mixed ANOVA used for assessment of total desirable interaction scores followed by non-parametric assessment of individual behavior frequencies.

Since there were two outcomes of interest (desirable and undesirable behavior) the significance threshold for evaluation of each of the related ANOVA models was subject to a Bonferroni correction, and revised to $p < 0.025$.

Data relating to the scoring of comfortability were not normally distributed and so were analyzed using non-parametric analyses. In order to reduce the number of analyses undertaken we considered only the data from the second baseline week (Week 2) and the final treatment week of the study (Week 6). Wilcoxon T-tests for within group analysis with a significance threshold of $p < 0.025$ were used for interpretative purposes given the simultaneous evaluation of two outcomes (relaxation of cat and relaxation of dog).

TABLE 1 | Participant demographics.

	Adaptil diffuser group	Feliway friends diffuser group
Total participants per group	17	17
Number of pets per household		
Multi-cat household	11	9
Multi-dog household	7	6
Multiple cats AND multiple dogs in household	6	3
Sex of pets		
Dogs—Female: Male	5:12	7:10
Cats—Female: Male	7:10	8:9
Neuter status		
Both neutered	12	14
Entire dog/neutered cat	5	3
Entire cat	0	0
Style of cat-dog relationship		
Dog interested; cat fearful	9	9
Cat interested; dog fearful	2	4
Indifference	2	0
Avoidance	4	4
Owner demographics		
Work in animal related profession	16	13
Female: Male	17:0	16:1

TABLE 2 | Age and duration cohabiting of pets (years) in each treatment group.

	Adaptil		Feliway friends	
	Mean ± SD	Median	Mean ± SD	Median
Age of dog	4.69 ± 3.94	3	4.62 ± 4.25	3.5
Age of cat	6.35 ± 3.02	7	6.91 ± 4.47	6
Duration of cohabitation	2.44 ± 2.40	1.5	2.65 ± 1.91	2.5

Results

Thirty-six participants were enrolled onto the trial, of which two participants failed to complete the trial: one due to acquisition of a new pet, one due to loss of an existing pet during the trial period, leaving 34 subjects for analysis. Details of the data generated at each stage of the study are given in the CONSORT Flowchart in Supplementary Material Table 2. Data are reported only for those subjects remaining in the final analysis. Unsolicited, qualitative comments received in emails alongside the survey responses were generally positive and included: "less chasing and more gentle play"; "my dog was his usual pesky self but the cats were much more chilled with each other and with him"; "the whole household has been more content"; "I have seen (the cat and dog) touch noses a few times which is definitely a new thing"; and "I will be going out to purchase one of each of the diffusers until your results are in." One participant highlighted a consistent increased proximity between her dog and cat which she felt was not adequately captured by the survey: whilst the cat and dog had always been relaxed in the same room of an evening, the cat historically always chose to sit on a cat tower but following diffuser use began to regularly sit on the edge of the sofa nearer to the dog. There were also reports of behavioral changes not directly related to the cat-dog relationship: a dog reported to be much calmer on walks; and another dog that had always been fearful of males taking treats after a couple of hours where previously he had been reported to hide for most of the day if male visitors arrived.

Participant Demographics

Results are summarized in Tables 1 and 2.

There were no significant differences between the two diffuser groups in the number of pets per household (multi-cat/multi-dog/both, all $p > 0.2$), the sex of pets (dogs, $p = 0.47$, cats, $p = 0.73$) or the neuter status of pets ($p = 0.42$).

There were no significant differences between the groups in age of cat, age of dog or duration cohabiting (all $p > 0.5$).

Data relating to changes in total desirable and undesirable interaction scores across the weeks of the study are summarized in Table 3, with main effects described in the following sections.

Undesirable Behaviors

Between Weeks 2 and 6, ≥50% reduction in undesirable behavior scores was seen in 8/17 (47%) participants receiving AdaptilTM and 5/17 (29%) participants receiving Feliway FriendsTM. A reduction ≥30% in undesirable behaviors was seen in 12/17 (71%) participants in both groups.

Total undesirable interaction scores significantly

TABLE 3 | Mean ± standard deviation total desirable and undesirable interaction scores by week.

Week	Adaptil		Feliway friends	
	Desirable	Undesirable	Desirable	Undesirable
1	3.65 ± 2.57	8.94 ± 5.93	5.24 ± 4.84	11.41 ± 5.28
2	3.54 ± 2.12	8.76 ± 5.38	5.00 ± 4.21	10.00 ± 5.91
3	4.24 ± 2.82	6.24 ± 5.65	5.47 ± 3.88	7.53 ± 4.89
4	4.53 ± 2.70	6.18 ± 4.71	5.88 ± 3.88	6.59 ± 4.60
5	4.53 ± 2.55	5.76 ± 4.84	6.59 ± 4.73	7.24 ± 3.90
6	4.41 ± 2.32	5.29 ± 5.18	7.06 ± 5.13	5.88 ± 4.65
Difference Week 6–2	**0.88 ± 2.14**	**−3.47 ± 3.87**	**2.06 ± 3.73**	**−4.12 ± 4.04**

Shaded rows represent baseline period, bold row describes difference between last baseline week (Week 2) and last week of treatment (Week 6).

TABLE 4 | Mean ± standard deviation cat and dog relaxation scores by week.

Week	Adaptil		Feliway friends	
	Cat relaxation	Dog relaxation	Cat relaxation	Dog relaxation
1	6.71 ± 1.21	7.94 ± 1.03	6.24 ± 1.95	7.59 ± 2.09
2	6.77 ± 1.56	7.77 ± 1.15	6.77 ± 1.86	7.47 ± 1.81
3	7.82 ± 1.13	8.24 ± 1.09	7.71 ± 1.65	8.18 ± 1.67
4	7.71 ± 1.16	8.29 ± 1.31	7.41 ± 1.94	8.35 ± 1.37
5	7.71 ± 1.45	8.18 ± 1.33	8.12 ± 1.17	8.77 ± 0.90
6	7.88 ± 1.32	8.29 ± 1.16	8.12 ± 1.69	8.59 ± 1.28
Difference Week 6–2	**1.11 ± 1.73**	**0.52 ± 0.80**	**1.35 ± 1.87**	**1.12 ± 2.00**

Shaded rows represent baseline period, bold refers to last baseline vs. last treatment week difference.

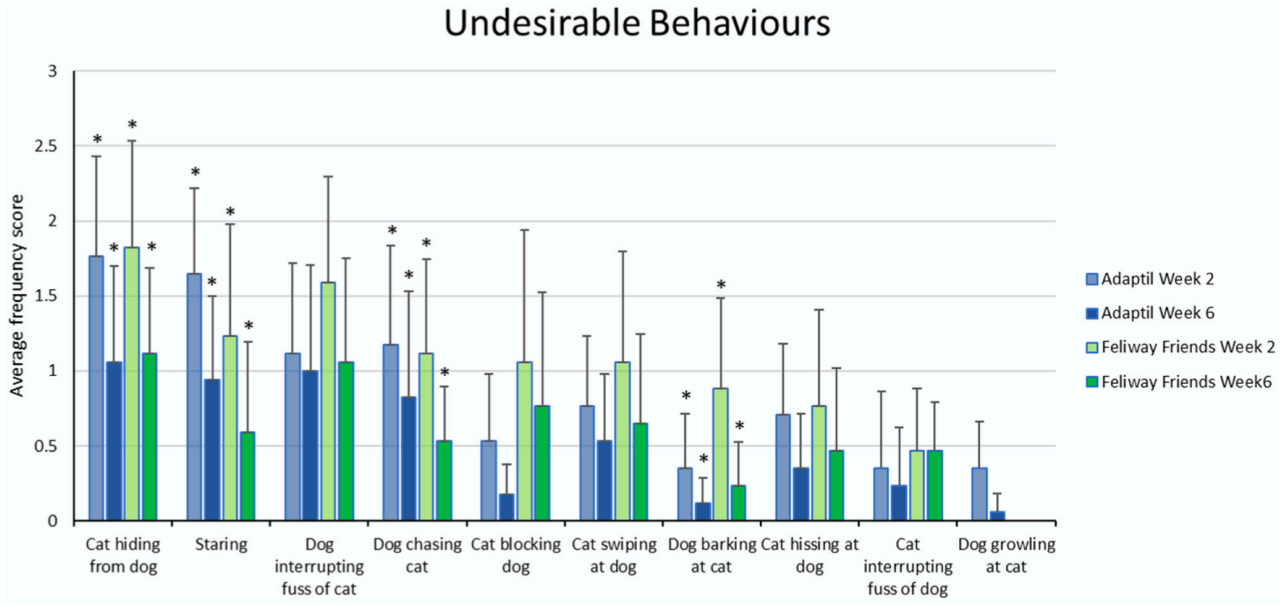


FIGURE 1 | Mean (± 95% confidence interval) behavior frequency scores for individual undesirable interactions at baseline (week 2) and end of trial (week 6). Frequency scores as per Likert scale, 0 = not this week; 1 = once or twice this week; 2 = three to six times this week; 3 = daily; 4 = several times per day. *indicates a significant difference ($p < 0.05$) between related week 2 and week 6 scores.

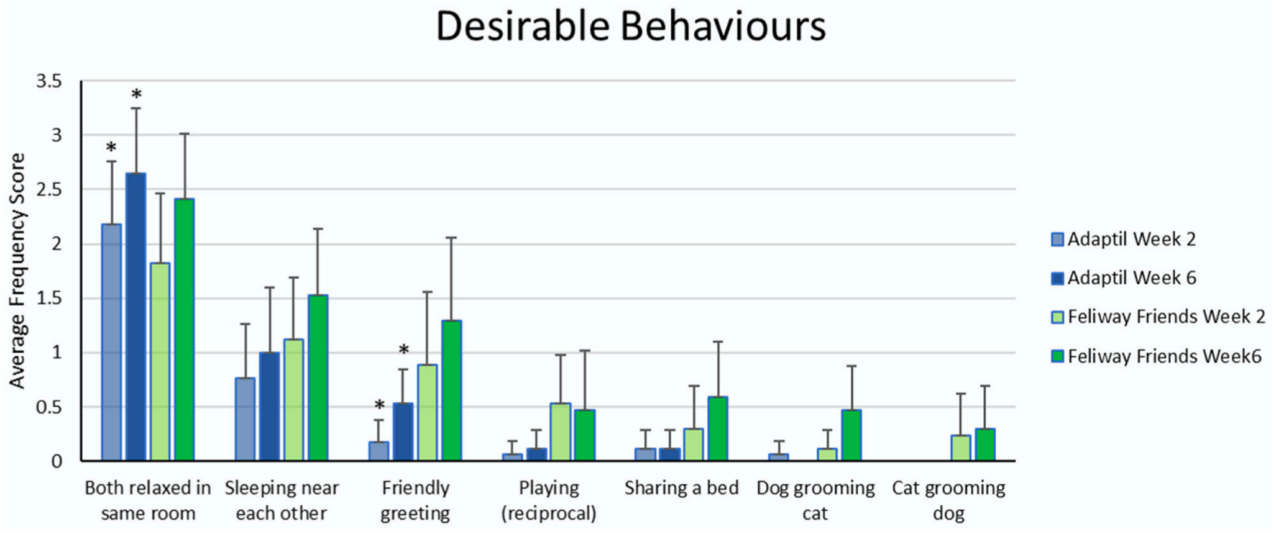


FIGURE 2 | Mean (± 95% confidence interval) behavior frequency scores for individual desirable behaviors at baseline (week 2) and end of trial (week 6). Frequency scores as per Likert scale, 0 = not this week; 1 = once or twice this week; 2 = three to six times this week; 3 = daily; 4 = several times per day. *indicates a significant difference ($p < 0.05$) between related week 2 and week 6 scores.

differed across the weeks $F(3.3, 105.3) = 21.086$, $p < 0.001$, $\eta 2p = 0.397$; there was no significant difference between the diffusers $F(1, 32) = 0.61$, $p = 0.440$, $\eta 2p = 0.02$, and no significant interaction between week and diffuser group was observed $F(3.3, 105.3) = 0.832$, $p = 0.488$, $\eta 2p = 0.025$. Post hoc pairwise comparisons showed that there was no difference between Weeks 1 and 2 (baseline period), but that both of these weeks differed from each of Weeks 3–6 (treatment period, all $P \leq 0.001$).

The data relating to the specific behaviors making up the undesirable interaction score, at baseline (week 2) and at the end of the trial (week 6) are illustrated in Figure 1 below (full dataset available in Supplementary Material Table 3). For those who received Adaptil™, there was a significant decrease in: dog chasing cat/cat runs away (Wilcoxon T = 4.5, p = 0.034); cat hiding from dog (T = 3.5, p = 0.012); cat/dog staring at the other (T = 3.5, p = 0.012); and dog barking at cat (T = 0, p = 0.046). For those receiving Feliway FriendsTM, there was a significant decrease in the same behaviors: dog chasing cat/cat runs away (T = 3.5, p = 0.034); cat hiding from dog (T = 0, p = 0.026); cat/dog staring at the other (T = 0, p = 0.014); and dog barking at cat (T = 0, p = 0.014).

See figure 1

Baseline individual undesirable behavior frequency scores did not differ significantly from each other (i.e., Week 1 vs. Week 2 for each of the 10 undesirable behaviors, all $P > 0.1$).

Desirable Behaviors

Between Weeks 2 and 6, ≥50% increase in desirable interaction scores was seen in 6/17 (35%) participants receiving Adaptil™ and 8/17 (47%) participants receiving Feliway Friends™. A ≥ 30% increase in desirable interaction scores was seen in 8/17 (47%) of participants in both groups.

Total desirable interaction scores differed significantly across the weeks $F_{(3.531, 112.990)} = 4.281$, $p < 0.01$, $\eta^2 p = 0.118$. No significant difference was observed between the two diffuser types $F_{(1, 32)} = 2.456$, $p = 0.127$, $\eta^2 p = 0.071$, and no significant interaction between week and diffuser group was observed $F_{(3.531, 112.990)} = 0.763$, $p = 0.537$, $\eta^2 p = 0.023$. Post hoc pairwise comparisons did not detect significant differences between any specific pairs of weeks, however analysis of within-subject contrasts showed a significant linear relationship between Week and desirable behavior score $F_{(1, 32)} = 11.231$, $p < 0.01$, $\eta^2 p = 0.260$, with a linear increase in total desirable interaction scores from Week 1 to Week 6.

The data relating to the specific behaviors making up the desirable interaction score, at baseline (week 2) and at the end of the trial (week 6) are illustrated in **Figure 2** (full data available in Supplementary Material Table 3). For those who received Adaptil™, there was a significant increase in: friendly greeting (T = 15, Z = −2.121, p = 0.034) and frequency of times spent relaxed in the same room (T = 32.5, Z = −2.126, p = 0.033). For those who received Feliway Friends™, none of the individual desirable behaviors demonstrated a significant change from Week 2 to Week 6.

Baseline individual desirable behavior frequency scores did not differ significantly from each other (i.e., Week 1 vs. Week 2 for each of the seven desirable behaviors, all $P > 0.1$).

Cat and Dog Relaxation Scores (Table 4)

In the Adaptil™ treatment group there was no significant (adjusted $p < 0.025$) difference in cat relaxation scores from baseline (Week 2) to the end of the trial (Week 6) (T = 66.5, p = 0.028) but a significant difference was seen in dog relaxation scores (T = 4.0, p = 0.021). Conversely, in the Feliway Friends™ treatment group there was no significant difference in dog relaxation scores from baseline (Week 2) to the end of the trial (Week 6) (T = 40.0, p = 0.037) but a significant difference was found in cat relaxation scores between Week 2 and Week 6 (T = 71.0, p = 0.011).

Discussion

There was a beneficial response to diffuser use with a significant decrease in undesirable interaction scores and a significant increase in desirable interaction scores across the trial period, regardless of the specific product used. By contrast, improved relaxation scores at the end of treatment compared to baseline, were species-specific. Response to treatment appeared to be rapid with the greatest decrease in undesirable behavior scores occurring during the first week of diffuser use. Partial η^2 values of above 0.14 are traditionally considered large, so the effect of the two treatments on undesirable behavior is very large, while the effect on desirable behavior is medium.

There are two obvious possible interpretations of the absence of a significant difference between the treatment groups in these outcomes: either both groups were subject to a similar placebo effect; or both diffuser products were similarly effective.

The placebo effect is greater when subjects are aware that there is a higher likelihood of receiving an active treatment in a trial, such as in comparative study designs like the current trial (31). For example, in an analysis of 48 placebo-controlled vs. 42 comparator studies on human treatments for depression, a 15% higher response rate for a particular medication was found in the comparator trials (32). Even so, the high response rate seen in the current trial, is beyond that expected for a placebo even in a comparative trial (32). Steps were also taken in the current trial to reduce owner subjectivity with the desirable and

undesirable interactions assessed from relatively objective measures of observation frequency (from never to several times per day) of specific events rather than with some form of subjective rating scale. Further evidence against the results being those of a placebo, comes from the differential effect reported on cat/dog relaxation scores, which were consistent with predicted product-specific effects. Thus, it seems that the common components to these products affect the tendency for undesirable interactions, but the species-specific elements may affect comfortability or relaxation of the individual in the presence of another. This hypothesis deserves further investigation.

The two groups were well matched and thus the different effects noted between the groups cannot be obviously attributed to any demographic factor; so the difference in the products offers the most parsimonious explanation.

Whilst it might be expected that Feliway Friends™ would be more effective in multi-species homes given the apparently stronger contribution of the cat's comfortability to the quality of the cat-dog relationship (9), this did not appear to be the case. Indeed, although there were no statistically significant differences in effect between the products overall on either total undesirable or desirable interaction scores, only the dog-specific product had a significant effect on increasing specific desirable behaviors. We suggest this apparent contradiction might be explained by the behavior of the dog being the primary determinant of the cat's quality of interaction with it. For example, a more relaxed dog may be less likely to disturb the cat (e.g., by chasing it), resulting in a cat that is less stressed and more willing to form some form of social bond with the dog, increasing the desirable interactions perceived alongside a reduction in undesirable interactions. By contrast a more relaxed cat may reduce the likelihood of undesirable interactions, but not necessarily increase desirable interaction so much as the dog may still engage in unacceptable interactions from the cat's perspective, even if they are playful from the dog's perspective and seen as acceptable by the owner. This is in keeping with the demographic split in this study, which showed that over half of the relationships at baseline could be described as "dog interested—cat fearful." It is likely that the cat's comfortability is indeed important, but that excessive interest from the dog may prohibit the cat from feeling comfortable around him.

Relationship categories of amicable, aggressive or indifferent have been suggested by Feuerstein and Terkel (7), but these do not consider which is the aggressor/victim in "aggressive" relationships, nor allow for relationships in which pets are fearful, but actively avoid one another. For the purpose of this study, descriptions of relationships were taken at induction and relationships were grouped into four categories: dog interested—cat fearful; cat interested—dog fearful; indifferent; and avoidant (there were no purely amicable relationships as these would not have met the inclusion criteria). Although ratios were similar between groups (Adaptil™ 9:2:2:4 and Feliway Friends™ 9:4:0:4) categorization was not straightforward: there was some overlap between categories and variation in the style of the behaviors described within categories. In particular, fearful cats were typically described as running away or showing aggressive behaviors such as hissing/ swiping, but often showed combinations of both, preventing separation into fearful-flee and fearful-aggressive categories. Nonetheless we propose that this classification system provides a useful basis for future studies. There is undoubtedly a need for more basic ethological research to describe cat-dog interactions and how these might group into particular styles of behavior, as has recently been done with separation related problems in dogs (33).

From a practical clinical perspective, client perceptions and feedback are very important, since they determine both the size of the problem but also the feasibility of the treatment. Overall, feedback from the trial was positive with participants reporting that they found the experience enjoyable and the survey straightforward to complete. Accordingly, we suggest that the survey instrument developed here (Supplementary Material Table 1) be used as a routine method of monitoring homes with this problem. The subtle, unsolicited observations of the behavior of pets in the home reported by some clients were an unexpected bonus, which may also have been facilitated by the use of the survey instrument to encourage closer observation of the pets in the home.

Unfortunately, the survey item which asked participants to decide whether the cat-dog relationship was "the same," "better" or "worse" than normal each week had to be excluded from analysis as it was found to be ambiguous. The ambiguity arose as it was not clear to some participants whether a consistent improvement with no new changes from when the diffuser had first been plugged in should be marked as "the same" (as the previous week) or "better" (compared with baseline). For future research it is advised to replace this item with a ten-point scale rating of the quality of the relationship each week, such that changes in the relationship across previous weeks do not impact the participant's rating.

It would be useful to further study the efficacy of these pheromone products in multi-species households using the revised survey instrument with a larger sample size and a four-group set up, with two diffusers per household comprising: placebo-placebo; placebo-Adaptil™; placebo-Feliway Friends™; Adaptil™-Feliway Friends™. It is possible that the use of both products together could increase efficacy since each product has a different composition and, as demonstrated here, efficacy profile. There are no data that the two

products counteract each other, and the manufacturer says both can be used in the home together.

Six participants (18%) subjectively reported no change at all with the diffuser use, and these responses corresponded quite well with the changes in undesirable behavior scores seen, with five of these participants seeing <30% decrease in undesirable behaviors: two had small decreases in undesirable behavior scores, two had no change at all, and one reported a slight increase in undesirable behaviors. Reviewing participant information for these individuals did not reveal any unequivocal predictive factor, although it should be noted that five of the six (83%) were multi-cat households, whereas only 15 out of the other 28 (54%) of the other households had multiple cats. A predominance of multi-cat households in this study obscured the ability to detect changes in a specific cat-dog relationship, as cat-cat interactions are likely to also have impacted on cat-dog interactions and vice versa. This may however be more representative of the more common situation encountered in practice where multi-cat and multi-dog households are common. The cat-dog relationships were classified as "dog interested, cat fearful" in five cases of these poor responders (83%) and while this was the most commonly reported relationship it had a prevalence of just 46% (13/28) among the remaining participants, the other case was classified as "avoidant" and thus had a similar prevalence to the remaining population (1/6 = 17%, 7/28 = 25%). Further research using larger sample sizes to potentially tease out predictive effects is warranted.

Unsolicited qualitative feedback provided a further richness to the data that helps understand the effect. In this regard comments like: "less chasing and more gentle play"; "my dog was his usual pesky self but the cats were much more chilled with each other and with him"; "the whole household has been more content," are very consistent with the idea that the chemical signal provides increased reassurance within the environment to the subjects, are non-sedating and not simply anxiolytic like a pharmacological agent.

Conclusion

Feliway Friends™ and Adaptil™ both improved cat-dog relationships in multi-species households. Although careful attention to the exact interactions affecting the relationship may help to determine the appropriate product, this appears to be of marginal clinical relevance in most cases. From a practical perspective, the evidence suggests that, in the absence of detailed behavioral assessment either appeasing pheromone diffuser product may be used with reasonable expectations of success in multi-species households experiencing tension between subjects. Further study is warranted to assess whether both products could be used together to maximize efficacy since each product has a different formulation and there is no evidence of the two products counteracting each other.

Data Availability Statement: All datasets presented in this study are included in the article/Supplementary Material.

Ethics Statement: The study was reviewed and approved by the delegated authority for MSc research of the University of Lincoln's College of Science Ethics Committee. The patients/participants provided their written informed consent to participate in this study and their comments to be quoted anonymously.

Author Contributions: MP and DM contributed conception and design of the study. MP collected all data, performed the statistical analysis, and wrote the first draft of the manuscript. DM wrote sections of the manuscript and developed the statistical analysis plan. All authors contributed to the article and approved the submitted version.

Funding: Ceva Animal Health provided the products free of charge without any restriction on their use or involvement in either design, execution or publishing the work. They have subsequently offered to pay for the work to be made available open access.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Acknowledgments: We would like to thank Julia Pounder of the University of Lincoln for independently assigning treatments their numbers and ensuring the authors remained blinded to treatment throughout. Our thanks to Heinz and Sara Meyer for their assistance with website design, Hilary and Michael Kaltz and Carol, John and Jonathan Prior for reading earlier drafts of this work and staff at the Veterinary Hospital, Lincoln, for facilitating the research within their practice.

Supplementary Material: The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fvets.2020.00399/full#supplementary-material

References: Available at; https://www.frontiersin.org/articles/10.3389/fvets.2020.00399/full

Edited by: Sabine G. Gebhardt-Henrich, University of Bern, Switzerland
Reviewed by: Emma Kathryn Grigg, University of California, Davis, United States Megan Renee LaFollette, Independent Researcher, St. Louis, United States
***Correspondence:** Miriam Rebecca Prior miribehaviourvet@gmail.com
Speciality section: This article was submitted to Animal Behavior and Welfare, a section of the journal Frontiers in Veterinary Science Received: 24 March 2020 Accepted: 03 June 2020 Published: 10 July 2020
Citation: Prior MR and Mills DS (2020) Cats vs. Dogs: The Efficacy of Feliway Friends™ and Adaptil™ Products in Multispecies Homes. Front. Vet. Sci. 7:399. doi: 10.3389/fvets.2020.00399

Recommended usage sheet below provided by Ceva Animal Health
Enquiries: ruanda.baak@ceva.com 011 312 4088 Ruanda Baak

ADAPTIL®	ADAPTIL® Junior Collar	ADAPTIL® Calm Home Diffuser & Refill	ADAPTIL ® Calm On-the-go-Collar	ADAPTIL® Transport Spray	RECOMMENDED duration of use
	Constant diffusion	Constant diffusion	Constant diffusion	Spray	
	Up to 30 days	Up to 30 days	Up to 30 days	4-5 hours	
	At all times	Indoor up to 70m²	Outdoor	In & out of home	
Adopting a puppy					
Crying at night	Yes				From day of adoption Activated by body heat Collar should remain on puppy at all times (except during shampoo). Use a new collar every month as needed. Up to 6 months old
Training and socialisation	Yes				
Home alone	Yes				
Loud noises	Yes				
In recurring situations					
Staying home alone		Yes			Minimum 1 month
Changes to Dogs Environment New arrivals (baby, pets...) Redecorating new home...		Yes			Begin use at least 24 hours prior to changes/events and use for minimum of 1 month
Visitors		Yes			Begin use at least 24 hours prior to events and use during a week after, or during the events period
Fearful situations, Loud noises, Thunderstorms,Fireworks...			Yes		
Training			Yes		Minimum 1 month
In specific situations					
Crating/Kenneling or Boarding				Yes	Spray 15 min before on crate/bandana/ bedding/car safety harnesses. Re-apply every 4-5 hours
Travel				Yes	
Vet visits				Yes	
Grooming				Yes	

FELIWAY®	Feliway® CLASSIC Diffuser and Refill	Feliway® CLASSIC Spray	Feliway® Friends Diffuser and Refill	RECOMMENDED duration of use
	Constant diffusion	Spray	Constant diffusion	
	Up to 30 days	4-5 hours	Up to 30 days	
	Indoor up to 70m²	In & out of home	Indoor up to 70m2	
Introducing a kitten or a new cat				
Prevention of unwanted scratching	Yes			Minimum 1 month
Prevention of urine spraying	Yes			
Helps settle kitten/cat in their new home and with other cat	Yes			
ONE CAT				
Urine spraying	Yes if multiple areas	Yes if single area		Minimum 1 month
Scratching walls or furniture	Yes if multiple areas	Yes if single area		
Hiding*	Yes			
Reduced appetite*	Yes			
Over grooming*	Yes			
Changes at home: moving home, renovating, redecorating, new pet, new family member	Yes			Begin use at least 24 hours prior to changes/events and use for minimum 1 month
Travel		Yes		15 min before putting the cat into the sprayed carrier or kennel. Re-apply every 4-5 hours.
Vet visits		Yes		
Cattery stays		Yes		
Unwanted scratching				
Unwanted scratching AND urine marking	Yes			
Unwanted scratching AND tension between cats			Yes	
SEVERAL CATS				
Conflicts WITH urine marking	Yes		Yes	
Conflicts WITHOUT urine marking			Yes	
Tension			Yes	
Fighting			Yes	
Chasing			Yes	
Blocking			Yes	
Staring			Yes	

To Enucleate or not to Enucleate?

Dr Izak Venter
BVSc, MMedVet(Ophthal)
Digital Veterinary Ophthalmology
izak@dvos.co.za

Unfortunately, one of the most common ocular surgical procedures performed by the veterinary general practitioner is an enucleation. This is obviously a very drastic step, and it is essential to know that this is truly required. However, on the flip side, it is also a procedure which is definitely indicated in certain cases for the wellbeing of the patient.

The main reasons to enucleate an eye are a permanently blind, painful eye or an eye suffering from a painful condition where the recommended treatment cannot be administered by the owners. An example of this would be a patient with severe non-responsive keratoconjunctivitis sicca requiring very regular treatment with a tear replacement product.

Common indications for enucleation

Corneal/scleral lacerations and perforating corneal foreign bodies

The following prognostic factors should be established to determine if an enucleation may be required:

- Lens and ciliary body involvement.
- Extension of the laceration beyond the limbus..

Full thickness wounds with globe rupture have a poorer prognosis because of intraocular damage and greater tissue disruption at the wound edge. The lens should be examined for lens capsule lacerations. In cases with lens capsule lacerations larger than 1.5 mm, the lens should be immediately removed with phacoemulsification. If this is not possible an enucleation would be indicated as the continual release of lens proteins will lead to severe painful and blinding phacoclastic uveitis [Figure 1].

Lacerations extending beyond the limbus will in most cases have led to ciliary body damage, hyphaema and retinal detachment. Ocular ultrasound is the diagnostic modality of choice to examine the posterior segment in these patients. In patients with vitreal haemorrhage and retinal detachment the prognosis for vision is hopeless and enucleation is indicated. Trying to salvage a globe like this will require surgery, intensive post operative medication and the most likely long term end result is phthisis bulbi or glaucoma [Figure 2].

Proptosis

Proptosis is the traumatic displacement of the globe from the orbit and is usually associated with stretching and tearing of extraocular muscles and/or the optic nerve. Brachycephalic breeds are predisposed because of their large eyes relative to the head as well as their shallow orbits. More force is required to produce proptosis in cats as well as mesocephalic and dolichocephalic dogs. Proptosis in these last-mentioned animals usually have a poorer prognosis and frequently require an enucleation.

A thorough clinical evaluation of the patient and globe is essential before the owner can be given a prognosis or treatment regimen is initiated. If there is any doubt as to whether the globe can be salvaged, an attempt should be made to replace it. Proptosis is a true ophthalmic emergency, and the globe should be replaced as soon as possible.

Having said that replacing a globe with no viability is only postponing the eventual enucleation as well as causing discomfort for the patient in the meantime. A viable globe does not mean that functional vision will be guaranteed. In the following instances the viability of the globe is poor, and an enucleation is indicated:

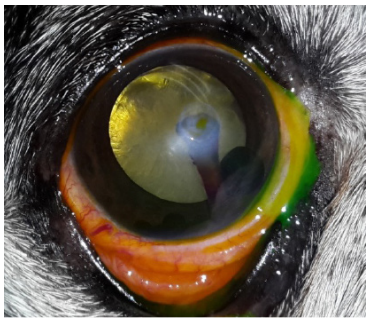


Figure 1. Large foreign body penetrating cornea and lens capsule.

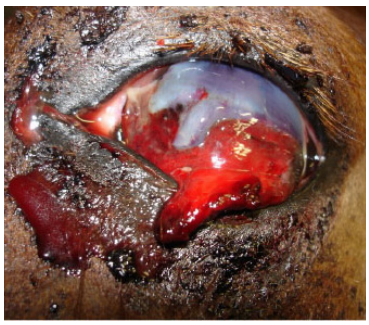


Figure 2. Severe corneal and eyelid laceration in a horse with collapsed anterior chamber and iris prolapse. Pthisis bulbi will most likely occur if this eye is not enucleated..

- **Scleral lacerations** with vitreous leaking and lens rupture.
- **Severe corneal dehydration.** (Fig 5) During the time that the eye is prolapsed the cornea is not lubricated, and this may result in severe corneal disease.
- Look at the degree of strabismus and **extra-ocular muscle damage.** Dorsolateral strabismus is most common as a result of the short medial rectus and ventral rectus muscles rupturing. The eye has a blood supply to the ciliary body via the rectus muscles and should more than three be ruptured the blood supply will be affected. This alone would lead to phthisis bulbi over time.
- **Hyphaema and secondary glaucoma.** Hyphaema generally indicates damage to the ciliary body. Anterior lens luxation may also be present. Ultrasound is indicated in these cases to confirm possible lens luxation as well as vitreal hemorrhage and retinal detachment.
- **Intraocular pressure (IOP)** [hypotony] is usually an indication of globe rupture. The rupture may affect the posterior aspect of the globe not visible during the clinical examination.

Chronic glaucoma

A full discussion on glaucoma falls outside the scope of this article. The definition of glaucoma has changed a lot and is still being adapted as more and more is learned about this condition. A very abbreviated summary of the definition of glaucoma is that it a group of ocular diseases that exhibit increased levels of IOP that are detrimental to the maintenance of vision and health of the eye. A common feature of all the different forms of glaucoma is the progressive death of retinal ganglion cells and their axons leading to irreversible blindness.

Clinical sign	Favorable	Poor
Duration	**Short**	**Long**
Damage to extra ocular muscles	<3	>3
Hyphema	Absent	Present
Corneal dehydration	Absent	Present
Pupil size	Miotic	Mydriatic / normal
PLR	Consensual present	Absent
Retrobulbar haemorrhage	Minimal	Severe
IOP	Normal	Hypotony [possible ruptures globe] Glaucoma

Table 1: . Summary of prognostic indicators in patients with proptosis.

Clinical signs of chronic glaucoma include:

Pain: Traditionally chronic glaucoma was considered not to be painful, however the severe pain and blepharospasm seen in acute glaucoma are replaced by signs of chronic pain that may not be recognised as being attributable to glaucoma. The animal just becomes less active, sleeps more, and is less playful. This behaviour improves if IOP is normalised/eye is enucleated.

Buphthalmos or enlargement of the globe: This may occur within days especially in young animals but typically develop very slowly over months. It is correlated to the magnitude of increased IOP. (fig 6)

Corneal oedema: The extent of the corneal oedema may somewhat parallel the elevation in IOP. If the IOP increases to 40 mmHg and higher, the corneal endothelial cells pump mechanism decompensates leading to corneal oedema. With sustained increased IOP some of the endothelial cells die leading to hypertrophy and sliding of the remaining cells to cover these areas. This leads to increased demand of the remaining cells and eventually a level of critical endothelial cell loss is reached leading to permanent corneal oedema.

Haab's striae: Corneal enlargement leads to ruptures in Descemet's membrane. This will allow small amounts of aqueous humour to enter the posterior corneal stroma. Haab's striae appear as white lines in the cornea.

Exposure keratitis: Exposure keratitis and corneal ulceration occur secondary to buphthalmos. The

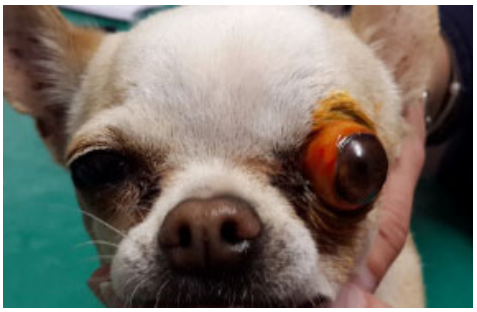


Figure 3. Proptosis, with minimal strabismus, miotic pupil and healthy appearing cornea. The prognosis for this eye is good and should be replaced surgically.

Figure 4. Pekinese with proptosis of the left eye. Scleral laceration and severe damage to the extraocular muscles are visible. The prognosis for this eye is hopeless.

Figure 5. Cat with proptosis. Rupture of the extraocular muscles and corneal dehydration is present. The prognosis for this eye is hopeless

exposure keratitis and corneal ulceration is caused by lagophthalmos, impaired blink reflexes, and increased evaporation of the precorneal tear film. Pigmentary keratitis and corneal vascularization may also occur.

Episcleral congestion: Episcleral congestion is one of the more consistent signs of glaucoma. These vessels appear as large, deep straight veins coursing posteriorly from the limbus. (fig 7)

Fixed dilated pupil.

Lens subluxation / luxation.
Mechanical avulsion of the zonules may occur due to globe enlargement.

Cataract.

Optic nerve atrophy.

Retinal atrophy.

Vision Loss.

Biochemical and ultra-structural changes in the iridocorneal angle.
Although this is not clinically evident it is important to note that this may be associated with impaired aqueous outflow leading to increased IOP. Secondary changes in the iridocorneal angle and sclerociliary cleft involve progressive narrowing and eventual closure of the angle and collapse of the cleft.

Due to the fact that these chronic glaucomatous eyes are permanently blind as well as causing discomfort for the patient an enucleation should be recommended in most cases. Due to the change in the iridocorneal angle traditional antiglaucoma drugs for example carbonic anhydrase inhibitors as well as prostaglandin analogues tend to be less effective in these cases. Alternatives to enucleation in these patients include ciliary body ablation as well as evisceration and intraocular prosthesis. These alternatives however hold no benefit to the patient and are for cosmetic reasons only.

Conclusion

Offering an enucleation for patients with permanently blind and painful globes nonresponsive to other treatments is in the patient's best interest. This may be an emotional discission for the pet owner especially in bilateral cases [Figure 8]. As veterinary surgeons one should be led by what is in the patient's best interest. Most owners will not elect for euthanasia in a dog that is blind due to non-painful progressive retinal atrophy. Patients with experiencing pain due to their blindness should be allowed to experience an improved quality of life. They will remain blind but will at least be pain free.

Quality of life after enucleation

Younger animals are remarkable in how they can adapt to a life without vision. Owners and veterinarians should not compare an animal without vision to a human without vision. Animals have a vastly superior olfactory and hearing capability than people and their nonvisual world is much richer. Older patients showing some senility however do not adapt as easily to blindness as they do not learn that easily. These patients will have a quieter more confined lifestyle within a familiar surrounding

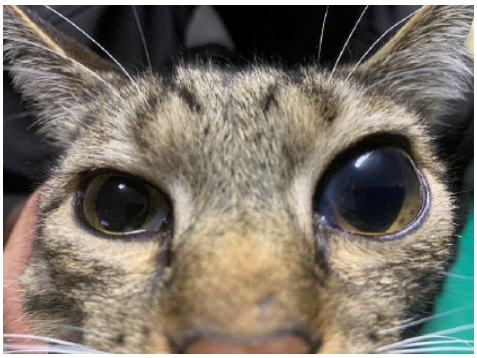


Figure 6. A cat with chronic glaucoma and marked buphthalmos.

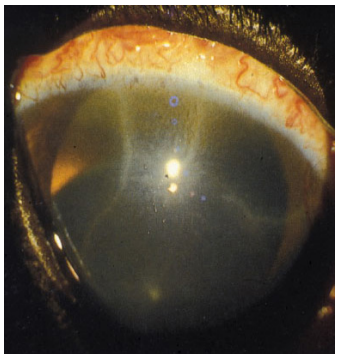


Figure 7. Episcleral congestion, posterior lens luxation and Haab's striae visible in a patient with chronic glaucoma

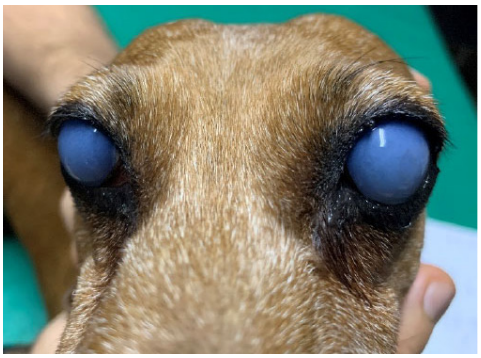
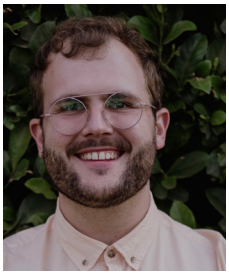


Figure 8. A dog with bilateral chronic glaucoma. Corneal oedema and buphthalmos are visible.

Complications Associated with Pelvic Fractures in Dogs and Cats



Dr Sybrand B. Harris, BVSc
Small Animal Intern, Onderstepoort Veterinary Academic Hospital
Edited Dr L L van der Merwe BVSc MMedVet(Med) Small Animals

This article is to be read in conjunction to the previously published article: An approach to pelvic fractures in clinical practice by Dr Ross Ellio -.Feb Mar 2021

Patients with pelvic trauma from blunt force impact trauma due to motor vehicle accidents present commonly in veterinary practice. In one study 90% of all fractures in cats, and 77% in dogs were a result of motor vehicle accidents.

The pelvis is supported by a relatively large amount of muscle. The force required fracture the pelvis must also be expected to cause other non-orthopaedic injuries. Unlike humans which have a high mortality due to massive bleeding, dogs and cats rarely succumb acutely as a result of pelvic fractures, but morbidity and/or mortality can be significant due to adjacent soft tissue injuries.

Immediate complications

Intra-abdominal injury

Patients diagnosed with pelvic fractures frequently have associated intra-abdominal injury (37% in dogs and up to 59-72% in cats) due to the large forces required to cause pelvic fractures. Clinical examination findings that warrant further investigation for intra-abdominal injury includes dyspnoea, cardiac arrhythmias, free fluid in the abdomen, haematochezia, and haematuria

1. Haemorrhage

Areas or spaces where clinically significant haemorrhage can occur due to blunt trauma are the thoracic cavity, the abdominal cavity, the retroperitoneal cavity and tissue compartments of the thigh (e.g., femur fracture). The amount of blood lost externally should be established if possible.

After initial stabilisation, the decision for medical or surgical intervention needs to be made. Conservative treatment of haemorrhage includes external counterpressure. For abdominal bleeding this can be done by an abdominal and hindlimb bandage. In these cases, diaphragmatic herniation needs to be excluded first to prevent further respiratory compromise.

Intra-abdominal haemorrhage is most commonly from an organ (spleen 58%, liver 50% and kidneys 23%, respectively) or a blood vessel. It is the second most common complication, following pulmonary trauma, resulting from vehicular trauma.

Haemoabdomen can be diagnosed by blind or ultrasound guided centesis (accuracy of 50%-62%) or diagnostic peritoneal lavage (accuracy 80%-100%).

An abdominal fluid PCV similar to that of the patients' blood indicates, current/ active haemorrhage. An intra-abdominal PCV which is higher than a that of the patients' blood indicates haemorrhage which has occurred a few hours previously and has stopped, or possibly a slower more chronic bleed, where sufficient time has elapsed to allow fluid to move back into the vasculature.

When a patient is unresponsive to fluid resuscitation, continues to bleed into the abdominal cavity based on ultrasound or physical examination findings, or has an increasing intra-abdominal PCV, surgery is indicated.

2. Urinary tract injury

Uroabdomen cannot be excluded by the fact that the urinary bladder can be palpated or by the absence of haematuria. Urethral tears/avulsion unilateral ureteral leakage will still result in the presence of some urine

in the bladder. The bladder mucousa bruises easily and urine passed post blunt trauma is generally blood tinged so haematuria *per se* has no diagnostic value immediately post trauma.

In a study evaluating 100 dogs with pelvis fractures, 39% had urinary tract injury including bladder rupture (7%), urethral rupture (5%) and urethral avulsion (4%). In a retrospective study of 23 cats with uroabdomen, 13 had a uroabdomen due to vehicular trauma of which 11 had a ruptured bladder.

Abdominal free fluid must be collected to determine the creatinine of the fluid in conjunction with the creatinine of the peripheral blood. If the creatinine of the abdominal fluid is $\geq$ 2 times that of the peripheral blood is considered diagnostic of an uroabdomen.

This frequent complication is explained by the position of the urinary tract in the pelvic canal and is seen as a medical emergency. Sequelae of uroabdoem include azotaemia, metabolic acidosis, hyponatraemia, hypocalcaemia, and life-threatening hyperkalaemia which can cause bradycardia, ventricular fibrillation and asystole.

If the patient is hyperkalaemic, which will generally only occur a few days post injury, fluid resuscitation and management of the hyperkalaemia with glucose to encourage intracellular movement of the potassium or calcium gluconate as a direct antagonist to the effects of potassium will be indicated.

In the acute emergency situation a plan must be made to drain the urine from the abdomen/ bladder until corrective surgery can be performed.

The bladder can be catheterised if at least one kidney and ureter are intact and the bladder does not have a large defect. If a bladder catheter cannot be passed due to urethral injury or the injury is cranial to the bladder, cystocentesis or abdominocentesis, to be repeated as necessary, can be performed. Ongoing drainage should preferably be by placement of a drain into the abdomen or placement of a cystostomy tube if possible until the patient can undergo surgical repair.

Non-surgical healing of small urethral and bladder injuries can be attempted with an indwelling catheter for 7-21 days. It is important to take radiographs after catheter placement to ensure that the catheter did not pass through the urethral defect..

Due to its accessibility in most private practices, abdominal radiography, with retrograde positive contrast, is the modality of choice to localise the disruption in the urinary tract. Ultrasonography can also be used but has its limitations in detecting urinary tract deficits: the ureters are difficult to visualise due to their small size, the bladder is best evaluated when moderately distended (bladder is usually collapsed when urinary tract leakage occurs) and imaging the caudal portion of the urethra is interfered with by the pubic bones. CT scan with contrast is the diagnostic modality of choice if available.

3. Abdominal wall Herniation

Herniation occurs when there is a disruption or weakening in the abdominal wall muscles where intra-abdominal organs can protrude through the defect. Although a traumatic herniation can occur anywhere, most of these defects are found at specific regions: off the caudal rib margin (paracostal hernia), ventral to the lumbar transverse processes (dorsal lateral hernia) and caudal hernias (pre-pubic and femoral hernias).

The success of a hernia repair depends on the functionality alteration of the organs entrapped in the hernia, the degree of tissue damage and the chronicity. Abdominal evisceration (with or without a defect in the skin) can occur in severe cases and must be treated as a surgical emergency. During surgery, a full explorative evaluation of all organs must be performed to assess the extent of abdominal organ trauma.

4. Less common abdominal complications

Another organ at risk of injury due its proximity to the pelvis is the colon. Although rare, colon or rectal trauma can lead to life-threatening septic peritonitis. Septic peritonitis can also be caused by direct introduction of bacteria into the abdominal cavity by penetration of the abdominal wall during impact.

Blunt trauma has been reported to cause rupture of the bile ducts, and less commonly the gall bladder. Bile causes a severe peritonitis due to its acidic nature and surgical intervention is imperative. Bile peritonitis can be diagnosed if the bilirubin concentration of the abdominal effusion is >2 times that of the serum bilirubin. The characteristic blueish granules are also visible on cytological evaluation of any abdominal free fluid.

Nerve root injury

1. Tail pull injury

Tail pull injuries, where the sacro-coccygeal nerve roots are bruised, stretched or torn are characterised clinically by a flaccid tail, weak hind limbs progressing to urinary incontinence or bladder paralysis and faecal incontinence with increasing severity of injury. Urinary incontinence can be due to an upper or lower motor neuron bladder and depends on the type of neurological injury present. Faecal incontinence occurs concurrently with urinary incontinence in pelvic and pudendal nerve injury. The presence of an anal reflex and pain sensation at the base of the tail are positive prognostic indicators. Recovery is slow and may take several weeks. Lack of sensation in the tail necessitates amputation due to possibility of unwitting trauma.

2. Lumbosacral nerve root injury

Peripheral nerves which are anatomically close to the sacrum and pelvis are also at risk and injury to them may be temporary or permanent in pelvic fracture trauma, especially when associated with iliac fractures

and sacroiliac dislocation. Nerve entrapment between facture ends will cause severe pain.

The lumbosacral nerve is affected most commonly (91%) showing signs of lumbosacral pain, hindlimb weakness, stiff gait, proprioceptive deficits, hyporeflexia of especially the flexor reflexes and a normal or pseudohyperreflexic patella reflex (femoral nerve). Urinary and faecal incontinence may also be present.

Less commonly, entrapment or injury of the sciatic nerve (6%) is seen. Clinically the withdrawal reflexes of the hindlimb, mediated by the sciatic nerve, will be absent or reduced. Although these patients are weight bearing (if the femoral nerve is intact) and can walk, the paw is misplaced on the dorsal surface and the tarsus is dropped when compared to the normal side.

Although 15% of animals with peripheral nerve injury can have permanent loss of limb function, most (81%) cases recover within 16 weeks.

Thoracic trauma

1. Pulmonary contusions

Pulmonary trauma occurs commonly after vehicular trauma (29%) in dogs . In cats, thoracic injuries are more common than abdominal injuries following a motor vehicle accident.

Pulmonary contusions are the most common type of pulmonary trauma followed by pneumothorax. Contusions are the result of intrapulmonary haemorrhage and inflammation. This may lead to a ventilation-perfusion mismatch which may be fatal, depending on the extent of parenchymal consolidation. Immediate thoracic radiography is often negative, as radiographic signs of pulmonary contusions lag the clinical signs.

Clinical signs of dyspnoea generally worsen for up to 12-24 hours after acute injury as post haemorrhage inflammation occurs. This must be taken into account when establishing prognosis and monitoring criteria for the patient.

Treatment should be aimed at maintaining adequate perfusion and supplement oxygenation. It is crucial to keep these patients calm and to let them rest. Anxiolytics such as butorphanol are generally indicated. Use fluids with caution in these patients as they are prone to develop pulmonary oedema/ ARDS due to the lung damage. Resuscitation and fluid therapy must be tailored to individual patient requirements.

2. Haemo- and pneumothorax

Pneumothorax can occur from a penetrating wound to the thorax (e.g., rib fracture) or from a laceration or rupture in the pulmonary parenchyma causing air to accumulate in the pleural space which normally maintains a negative pressure gradient for adequate lung expansion and ventilation. Apart from various degrees of dyspnoea on presentation, a severe pneumothorax can cause cardiovascular collapse due to inadequate cardiac filling (termed a tension pneumothorax).

Thoracic radiographs (a DV view may be adequate ed) and TFAST can confirm the diagnosis of a pneumothorax but mostly these patients are severely compromised and a thoracocentesis can be diagnostic as well as therapeutic. On thoracic auscultation lung sounds will be decreased or absent on the affected side.

Oxygen supplementation is helpful but treatment should be aimed at reducing the amount of free air in the pleural cavity as ventilation of the lung is required for oxygen supplementation to be effective. The lung must be able to expand to allow air and the supplemental oxygen to access the alveoli.

The amount of free air which will cause dyspnoea in an individual patient differs depending on concurrent injuries such as pulmonary contusions which decrease diffusion are for oxygen and rib or muscle injuries which result in decreased expansion of the thorax due to pain. In some cases with mild to moderate pneumothorax the free air can be left, whereas in others it will need to be draned to prevent severe dyspnoea, If it is required to do three or more thoracocentesis in 24 hours a thoracostomy tube is indicated. Most traumatic pneumothorax cases do not require surgery and heal spontaneously within 72 hours.

Trauma to the lung, mediastinum, heart or major vessels can result in a haemothorax. Lung sounds will be decreased on thoracic auscultation. Radiographs, TFAST and thoracocentesis can diagnose dyspnoea due to a haemothorax.

In dyspnoeic patients therapeutic thoracocentesis will ease respiration. Usually removing 10ml/kg fluid is adequate to relieve clinical signs.

3. Diaphragmatic Rupture

Diaphragmatic rupture should be suspected in any trauma case presented with or without obvious respiratory distress. Patients could first be stabilised and oxygenated for 12-24 hours but if respiratory stability cannot be achieved or if sections of the gastrointestinal tract, especially the stomach, can be seen in the thoracic cavity, emergency surgery is indicated to repair the hernia.

Diaphragmatic hernias can readily be diagnosed on thoracic radiographs showing loss of the diaphragmatic line and cardiac silhouette, displacement of the lungs

dorsally, evidence of an effusion and/or presence of gas-filled viscera or liver lobes in the thoracic cavity. On ultrasonography a diaphragmatic hernia can also be diagnosed as a tear in the diaphragm (a step-sign in the diaphragmatic line) and possible visualisation of an organ herniation. This could also be detected in an AFAST scan.

4. Less common thoracic complication

Traumatic bruising or myocarditis resulting in cardiac arrythmias (mostly tachyarrhythmias) can be expected. Treatment is focused on supportive care and controlling the arrythmias.

Trauma has also been reported to be a cause of chylothorax (triglyceride and mononuclear cell effusion). *(I've noticed this especially in cats - it is often self-limiting Ed)*

Systemic and long term complications

Possible systemic complications to keep in mind include systemic inflammatory response syndrome, disseminated intravascular coagulation, acute traumatic coagulopathy, and multiple organ failure.

Some complications might only become prominent sub-acutely or chronically and therefore follow-up consultations for periodic monitoring are recommended in pelvic trauma cases. Pelvic canal narrowing when bone healing occurs may lead to obstipation, constipation, megacolon and dystocia. Callus formation may result in sciatic nerve impingement and neuropraxia (blockage of nerve conduction), coxo-femoral osteoarthritis, persistent neurological deficits, chronic lameness, and permanent gait alteration.

References:

1. Boag A, Hughes D. Fluid therapy. BSAVA Manual of Canine and Feline Emergency and Critical Care: British Small Animal Veterinary Association; 2018. p. 29-43.
2. Boysen SR, Lisciandro GRHCVSEPCISATXUSA. The Use of Ultrasound for Dogs and Cats in the Emergency Room:AFAST and TFAST. Veterinary Clinics of North America: Small Animal Practice. 2013;43(4):773-97.
3. Culp WTN, Silverstein DC. Thoracic and Abdominal Trauma. In: Silverstein DC, Hopper K, editors. Small Animal Critical Care Medicine. Second edition. ed. St. Louis, Missouri: Elsevier; 2015. p. 728-33.
4. De Rosa SM, Drobatz KJ. Hit by Car. In: Cohn LA, Côté E, editors. Côté's Clinical Veterinary Advisor Dogs and Cats. Fourth edition. ed. St. Louis, Missouri: Elsevier; 2020. p. 477-8.
5. Gianotti G, Steagall P. Anaesthesia, sedation and analgesia of the critical patient. BSAVA Manual of Canine and Feline Emergency and Critical Care: British Small Animal Veterinary Association; 2018. p. 334-53.
6. Herold LV, Devey JJ, Kirby R, Rudloff E. Clinical evaluation and management of hemoperitoneum in dogs. Journal of Veterinary Emergency and Critical Care. 2008;18(1):40-53.
7. Hoffberg JE, Koenigshof AM, Guiot LP. Retrospective evaluation of concurrent intra-abdominal injuries in dogs with traumatic pelvic fractures: 83 cases (2008-2013). Journal of Veterinary Emergency and Critical Care 2016;26(2):288-94.
8. Meeson R, Corr S. Management of pelvic trauma: neurological damage, urinary tract disruption and pelvic fractures. Journal of feline medicine and surgery. 2011;13(5):347-61.
9. Mison MB. Diaphragmatic Hernia. In: Cohn LA, Côté E, editors. Côté's Clinical Veterinary Advisor Dogs and Cats. Fourth edition. ed. St. Louis, Missouri: Elsevier; 2020. p. 256.
10. Moens NMM, DeCamp CE. Fractures of the Pelvis. In: Johnston SA, Tobias KM, editors. Veterinary Surgery : Small Animal. Second edition. ed. St. Louis, Missouri: Elsevier; 2018.
11. Reinke EL. Trauma Overview. In: Drobatz KJ, Hopper K, Rozanski EA, Silverstein DC, editors. Textbook of Small Animal Emergency Medicine
Hoboken, NJ: Wiley-Blackwell; 2019. p. 1041-9.
12. Robinson DA, Kiefer K, Bassett R, Quandt J. Autotransfusion in dogs using a 2-syringe technique. Journal of Veterinary Emergency and Critical Care. 2016;26(6):766-74.
13. Rozanski EA. Pneumothorax. In: Cohn LA, Côté E, editors. Côté's Clinical Veterinary Advisor Dogs and Cats. Fourth edition. ed. St. Louis, Missouri: Elsevier; 2020. p. 797-8.
14. Sathya S. Fractures of the Pelvis. In: Cohn LA, Côté E, editors. Côté's Clinical Veterinary Advisor Dogs and Cats. Fourth edition. ed. St. Louis, Missouri: Elsevier; 2020. p. 365-6.
15. Schatzberg SJ. Neurologic Examination and Neuroanatomic Diagnosis. In: Ettinger SJ, Feldman EC, Côté E, editors. Textbook of Veterinary Internal Medicine : Diseases of the dog and the cat. Eighth edition. ed. St. Louis, Missouri: Elsevier; 2017. p. 1368-79.
16. Smeak DD. Abdominal Wall Reconstruction and Hernias. In: Johnston SA, Tobias KM, editors. Veterinary Surgery : Small Animal. Second edition. ed. St. Louis, Missouri: Elsevier; 2018. p. 1564-91.
17. Stafford JR, Bartges JW. A clinical review of pathophysiology, diagnosis, and treatment of uroabdomen in the dog and cat. Journal of veterinary emergency and critical care (San Antonio, Tex : 2001). 2013;23(2):216-29.
18. Thomas E, Boller E. Assessment and treatment of shock. BSAVA Manual of Canine and Feline Emergency and Critical Care: British Small Animal Veterinary Association; 2018. p. 17-28.
19. Trenholme HN. Hemothorax. In: Cohn LA, Côté E, editors. Côté's Clinical Veterinary Advisor Dogs and Cats. Fourth edition. ed. St. Louis, Missouri: Elsevier; 2020. p. 436-7.

Crash Course:
Basics of Avian Radiography

Dr Kirstin Dinham BVSC MRCVS

Introduction

The unique anatomy of birds grants radiography special diagnostic value in this species. Radiolucent air sacs throughout the body can be evaluated and provide a high contrast medium to soft tissues, thereby improving radiographic visualisation of coelomic organs. Additionally, avian anatomy makes digital coelomic palpation and airway auscultation challenging, increasing reliance on imaging for diagnoses.

Equipment

Due to the typically small size of the patient, high resolution radiographs illustrating fine detail are required. To produce high quality images, a high output generator is ideal; 300 milliamperes (mA) in combination with 40 – 90 peak kilovoltage (kVp) range.[1] Fine detail films similar to those used in human mammography and high definition intensifying screens help to achieve better detail.

Grids are not necessary due to small patient size and the presence of air sacs, which reduce scattered radiation. Digital radiography is of great value in avian practice because of advances in the development of species-specific algorithms as well as the speed of development, which reduces general anaesthetic time for these sensitive patients.

Radiographic Technique

To create a wide grey-scale range, a low kV technique (40 – 55kV) combined with a high mAs (5 – 7mAs) and a short exposure time is recommended.[1] Short exposure times are critical in reducing motion artefact caused by the rapid respiratory rate of birds. Collimation is important to minimise scatter. Dental x-ray systems can be useful for imaging the extremities of small birds, but due to the low mA capacity of the generator and inability to utilise a short exposure time, they have limited value for imaging the coelomic cavity.

Positioning and practicalities

Orthogonal views in avian species should include ventro-dorsal and right lateral projections. Whole body versus collimated coelom views are dependent on clinician preference. Radiographs exhibiting poor positioning are of limited diagnostic value.[2] Patient fasting is recommended prior to radiography; 2 hours for small birds and 3 – 5 hours for larger birds.[1,4] General anaesthesia using isoflurane is widely used to achieve correct positioning and minimise stress of handling to patients. Avian restraint boards or paper adhesive tape (which is less damaging to feathers) can be used to position the patient. See Fig. 1 and 2 for guide to positioning.

Exploratory 'bird in a box' radiographs (horizontal beam utilised, bird sitting in a box with cassette positioned vertically and perpendicular to the x-ray beam) reduces handling and negates the need for general anaesthesia. Conditions such as metal ingesta or calcified egg binding can be visualised on these projections.

Contrast administration (barium sulphate solution) via gavage tube can aid visualisation and further assessment of the gastrointestinal tract.

Special thanks
Dr Minh Huynh DVM DECZM (Avian) DACZM, Sarah Hochgeschurz and the Family Vet Clinic in assisting with the production of this article.

References

1. Silverman S, Tell L.A. (2012) Radiology of Birds: An Atlas of Normal Anatomy and Positioning, 1st edn., Saunders Elsevier, Missouri.
2. Donelly B. (2011) Avian Medicine and Surgery in Practice: Companion and Aviary Birds. Manson Publishing Ltd, London.
3. Morrisey J.K. (2004) Avian Radiology. 76th Western Veterinary Conference Proceedings. Veterinary Information Network. Viewed 11 January 2019, https://www.vin.com/doc/?id=3849303
4. Cassell N. (2014) The Basics of Avian Radiology. In: Proc. 39th WSAVA Congress. p594-596
5. Straub J., Pees M., Krautwald-Junghanns M.E. (2002) Measurement of the cardiac silhouette in psittacines. J. Am. Vet. Med. Assoc. 221: 76-79.

6. Rosenthal V., Miller K., Orosz M., S. et al. (1997) Cardiovascular system. In: Avian Medicine and Surgery. 1st edn., Eds: Altman R.B., Clubb S.L., Dorrestein G.M., W.B. Saunders, Philadelphia, p 489 - 500
7. Jones, R. (2014) Avian Radiology. British Small animal Veterinary Congress Proceedings. Veterinary Information Network. Viewed on 11 January 2018, < https://www.vin.com/doc/?id=6161284 >
8. Naldo J., Saggese M (2015) Radiography. In: Avian Medicine, 3rd edn., Ed: Samour J., Elsevier, New York, pp 131 – 135

Fig. 1 - Ventro-dorsal positioning of an African green pigeon
Photo credit: Sarah Hochgeschurz

- *Dorsal recumbency.*
- *Red dot indicates centre beam.*
- *Spine and keel vertically aligned.*
- *Head and neck extended.*
- *Wings extended symmetrically to sides.*
- *Legs extended caudally.*
- *Acetabula and scapulae symmetrically aligned.*[8]

Fig. 2 - Right Lateral positioning of an African green pigeon
Photo credit: Sarah Hochgeschurz

- *Right lateral recumbency with wings extended dorsally, dependent wing positioned slightly cranially if required*
- *Red dot indicates centre beam.*
- *Vertically aligned hip and shoulder joints*
- *Vertically aligned pectoral girdle*
- *Legs extended caudally – dependent leg may be positioned slightly cranially.*[8]

Ventro-dorsal Projection of an African Grey Parrot*

*Due to anatomical variations between avian species referral to an avian anatomy textbook is recommended. To view the lateral projection of the African grey parrot, please visit our website www.imv-imaging.co.za/blog

Assess the **trachea and syrinx**, especially in patients with inspiratory dyspnoea. Aspergillus granulomas and foreign bodies can sometimes be visualised radiographically.

Assess the **lungs**. Normal lungs are described as having a 'honey comb' appearance. Assess for changes in radiopacity or the presence of masses. Masses are commonly fungal granulomas but can also be neoplastic or bacterial in origin. A proportion of the lung field is superimposed by the cardiac silhouette in the VD view so obtaining an orthogonal view is important.

Assess the **hepatic silhouette** for widening or asymmetry (hepatopathy, compressive pathology in caudal coelom including effusion, space occupying lesions and enlarged proventriculus). Generally, on the VD view, the liver should not extend laterally beyond an imaginary line connecting the coracoid and acetabulum (see dotted line 'a'), but this is species dependent[4].

Urogenital system. The kidneys are assessed most easily on a lateral projection. The gonads are rarely visualised on either view but in reproductively active birds can increase quite dramatically in size. Radiologically detectable pathology can include neoplasia, renal calcinosis, egg binding and ovarian cysts[7].

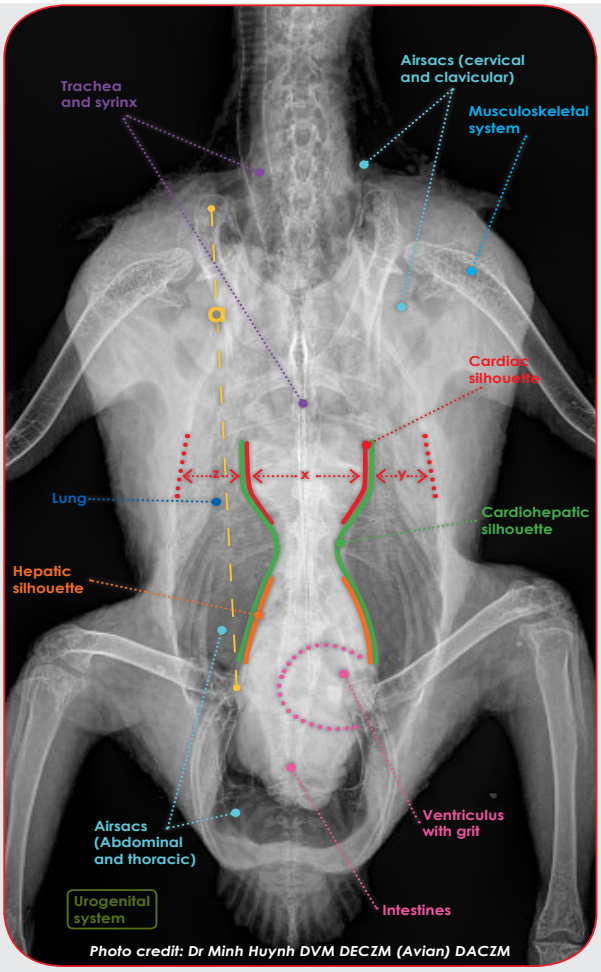


Photo credit: Dr Minh Huynh DVM DECZM (Avian) DACZM

Air sacs are radiolucent in the normal patient[4]. Changes in radiopacity, and the presence of radiopaque lines are indicative of pathology.

Assess the **musculoskeletal system** for trauma and abnormal radiopacity.

Assess the **cardiac silhouette** for size and shape. In medium-sized psittacines the width of the cardiac silhouette on a VD view (dotted line 'x') should be between 51-61% of thoracic width when measured at the widest point (dotted line 'x+y+z'). An increased width may be due to conditions such as pericardial effusion or cardiomegaly. A decreased width and an angular and retracted shape may indicate a microcardia associated with hypovolemia and dehydration[6].

Assess the **cardio-hepatic silhouette**. In most psittacine species, the silhouette is an hour glass shape on the VD view with the hepatic waist being marginally wider than the heart[3].

Gastrointestinal tract and spleen are better visualised on the lateral projection due to superimposition on the VD view. The presence of grit can facilitate locating the ventriculus. Intestines are not as obviously visualised as in mammals because they are usually devoid of gas.

Right Lateral Projection of an African Grey Parrot*

*Due to anatomical variations between avian species referral to an avian anatomy textbook is recommended

Assess the **musculoskeletal system** for trauma, arthritis and abnormal radiopacity.

Assess the **crop** for abnormal distension, gas or foreign bodies.

Assess the **trachea and syrinx**, especially in patients with inspiratory dyspnoea – aspergillus granulomas and foreign bodies can sometimes be visualised radiographically.

Assess the **lungs**. Normal lungs are described as having a 'honey-comb' appearance. Assess for changes in radiopacity or the presence of masses. Masses are commonly fungal granulomas but can also be neoplastic or bacterial in origin.

Air sacs are radiolucent in the normal patient[4]. Changes in radio-opacity, the presence of radiopaque lines or loss of coelomic detail is indicative of pathology.

Assess the **urogenital system**. Assess the **kidneys** for size, shape and radiopacity. Radiologically detectable pathology in this system can include neoplasia, renal calcinosis, egg binding and ovarian cysts. In reproductively active birds, the **gonads** can increase quite dramatically in size[7] .

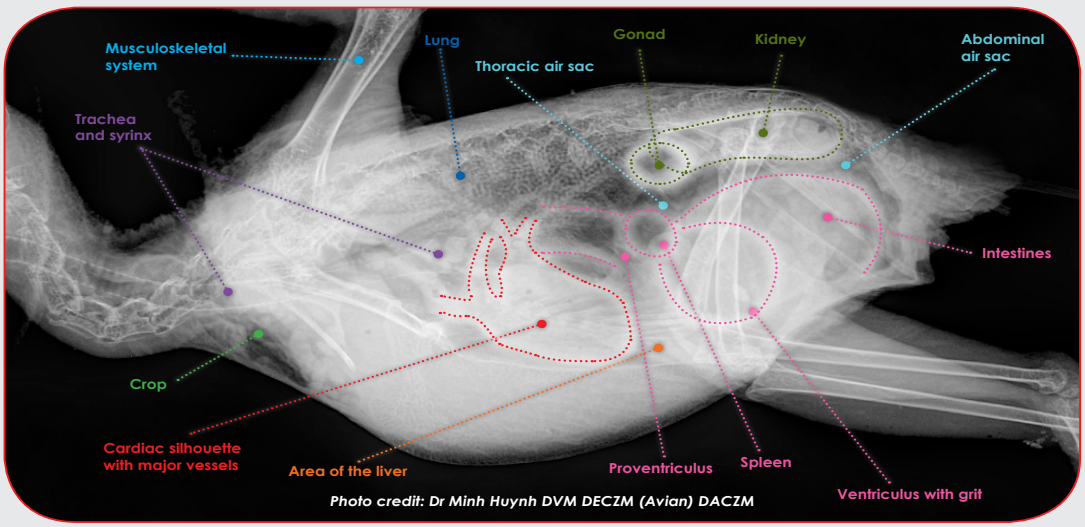


Photo credit: Dr Minh Huynh DVM DECZM (Avian) DACZM

The **proventriculus**, **ventriculus**, **intestines** and **spleen** are better visualised on the lateral projection. The presence of grit can facilitate locating the ventriculus. The normal spleen can sometimes be visualised as a spherical organ on the lateral view, an enlarged spleen can indicate infection[7]. The normal proventriculus is sometimes visible on the lateral view, and can distend pathologically in conditions such as proventricular dilatation disease or lead toxicity[7]. Intestines are not as visible as in mammals because they are devoid of gas in the normal bird.

Assess the **area of the liver**. Generally, in adult birds, the caudal margin of the hepatic silhouette should not extend past the caudal tip of the keel[9]. A decrease in the size of the air sacs may indicate an organomegaly.

Assess the **cardiac silhouette and major vessels** for size and shape. An increase in size may be due to conditions such as pericardial effusion or cardiomegaly. A decreased size and an angular and retracted shape may indicate a microcardia associated with hypovolemia and dehydration[6]. Artherosclerosis can sometimes be visualised by an increased radiopacity or calcification of the great vessels on lateral view[6] .

CPD ARTICLE PROUDLY
BROUGHT TO YOU BY VIRBAC
https://za.virbac.com/

Use of Laboratory Diagnostics in Dermatology for Veterinary Clinicians

Part II - Microbiology and Serology

Dr Rick Last – Consulting Specialist Veterinary Pathology

MICROBIOLOGY

Veterinary microbiology should form part of the routine laboratory analyses for all dermatology investigations, and not just be limited to individual difficult cases that are poorly responsive to initial empirical antibiotic therapy. Routine use of bacterial and fungal culture in conjunction with antimicrobial sensitivity should form the basis on which the clinician selects antimicrobials for therapy, promoting antimicrobial stewardship and reducing the risks of emerging multi-drug resistant bacteria in companion animals. With the increasing emergence of multi-drug resistant bacteria, performing culture and antimicrobial sensitivity, is of extreme importance.

Bacterial Culture

1. Superficial pyoderma.

- Preferred diagnostic samples: Sterile biopsies transported on ice (4ºC).

Swabs of the skin surface and crusts result in higher risk of contamination of cultures with normal commensal skin surface bacteria.

Canine recurrent superficial pyoderma poses diagnostic and therapeutic challenges due to a varied clinical presentation, and the frequent presence of underlying diseases that impair immunity or compromise skin barrier-function. Failure to recognise these underlying diseases will result in relapses, even if the superficial pyoderma responds to initial treatment. Repeated antibiotic prescriptions will then increase the risk of selecting for multidrug resistant bacteria. Underlying diseases, which have been associated with canine superficial recurrent pyoderma, include demodicosis, sarcoptic mange, hypersensitivity dermatoses, endocrinopathy, immune mediated/ autoimmune cutaneous disorders, trauma and any chronic skin disease.

The causative bacterium in most cases of superficial pyoderma in dogs is *Staphylococcus pseudintermedius*. Other staphylococcal species, such as S. *schleiferi* and S. *aureus*, *Escherichia coli*, Pseudomonas spp, Bacillus spp and Proteus spp, are less frequently isolated.

2. Superficial bacterial folliculitis.

- Preferred diagnostic samples: Sterile biopsies or charcoal medium swabs from follicular exudate transported on ice (4ºC).

Clinically and histologically the condition can closely mimic the pemphigus autoimmune skin conditions. The causative organism is *Staphylococcus pseudintermedius* which induces a bacterial "hypersensitivity-like syndrome" with immune targeting of intercellular junctions of keratinocytes by bacterial toxins and subsequent follicular pustule formation with acantholytic keratinocytes. The immune mediated basis of the condition explains the poor response empirical antibiotic therapy and highlights the critical importance of culture and sensitivity in these cases, to enable specific antibiotic therapy targeting the actual causative bacterium.

3. Feline superficial bacterial pyoderma.

- Preferred diagnostic samples: Sterile biopsies or charcoal medium swabs from follicular exudate transported on ice (4ºC).

Supericial bacterial pyoderma of cats is a cutaneous bacterial infection classically involving the epidermis and/or follicular epithelium. The most common bacteria involved include *Staphylococcus intermedius, Staphylococcus aureus, Staphylococcus felis* and *Staphylococcus simulans*. Pyoderma in cats is frequently secondary to hypersensitivity, trauma, drug/disease induced immunosuppression and autoimmune skin disease. Lesions of the eosinophilic granuloma complex (eosinophilic plaques, linear granulomas and rodent ulcers) are also frequently reported with superficial pyoderma.

4. Deep bacterial pyoderma.

- Preferred diagnostic samples: Sterile biopsies obtained after initial debridement and cleaning

of the wound site. Collection of aseptic fluid samples from cavity lesions, should be decanted into sterile, sealable screw top tubes prior to transport to the laboratory. Submitting of fluids in sterile syringes with needle and hub, should be avoided, to reduce the risks of sample leakage and needle stick injuries. Samples transported on ice (4ºC).

Due to the risk of picking up commensal or contaminating bacteria, use of swabs for sampling, even from cleaned wounds, is not the ideal diagnostic sample.

Deep pyoderma with bacterial folliculitis and furunculosis is a relatively common disease of the skin in dogs. *Staphylococcus pseudintermedius* is usually the primary pathogen but secondary invaders such as Proteus sp, Pseudomonas sp. and *E.coli* are frequently isolated. Other forms of deep pyoderma include actinomycotic mycetoma (associated with filamentous bacteria) and bacterial botryomycosis (associated with non-filamentous bacteria).

Actinomycotic mycetoma is associated with infection by the filamentous bacteria Nocardia and Actimomyces. Actinomycosis occurs most commonly in young adult to middle age large-breed dogs, especially retriever and hunting breeds that have access to the outdoors. Actinomyces spp are common commensals of animals, and disease and occurs due to exposure to plant material, especially grass awns, which then carry the Actinomyces bacteria with them, inoculating the bacteria into the subcutaneous tissues. The most common clinical features of cutaneous and subcutaneous actinomycosis includes abscess formation, cellulitis, draining fistulous tracts and ulcerated dermal and subcutaneous nodules.

Nocardia spp. are ubiquitous saprophytes occurring in soil, straw, grasses, decaying vegetable matter, and water. Unlike Actinomyces spp., they are not part of the normal flora of mammals. They are opportunistic pathogens that cause infection by wound contamination, inhalation, or ingestion, particularly in immunocompromised animals. Cutaneous nocardiosis is reported most frequently in cats, dogs, horses, and cattle, with very rare occurrence in goats. In cats, nocardia panniculitis is clinically indistinguishable from panniculitis caused by rapidly growing mycobacteria. Lesions consist of abscesses, cellulitis, ulcerated nodules, draining tracts, and dense fibrous masses.

The causative organisms of botryomycosis are usually coagulase positive Staphylococcus spp, but in some cases other bacteria, alone or in combination with staphylococci, are believed to play a role. Other bacteria which have been associated with this condition include *Streptococci, Pseudomonas aeruginosa, Actinobacillus lignieresii, Proteus,* Rhodococcus spp and *Bibersteinia trehalosi.*

5. Multi-drug resistant bacterial pyoderma.

- Preferred diagnostic samples: Sterile biopsies obtained after initial debridement and cleaning of the wound site. Collection of aseptic fluid samples from cavity lesions, which are decanted into sterile, sealable screw top tubes prior to transport to the laboratory, to reduce the risk of leakage and needle stick injuries. Samples transported on ice (4ºC). *Work under sterile conditions due to zoonotic implications of these multi-drug resistant bacteria.

The emergence of methcillin resistant strains of *S. pseudintermedius* (MRSP), *Staphylococcus schlieiferi* (MRSS including the coagulase negative variant), *Staphylococcus epidermidis* and *Staphylococcus aureus* (MRSA) has become a major issue in veterinary medicine due to multi-drug resistance expressed by many of these isolates, with risk of zoonotic infections. Empirical drug selection for systemic therapy is one of the major contributing factors to the development methicillin-resistant Staphylococci.

Multidrug resistance (MDR) and extended spectrum beta lactamase (ESBL) producer Gram negative bacteria (E.coli, Enterobacter, Klebsiella, Pseudomonas, Proteus, Salmonella and others) are becoming all the more common bacterial isolates from animals. ESBLs are the enzymes that have the ability to hydrolyze and cause resistance to various types of newer β-lactam antibiotics. A major risk factor for colonization or infection with ESBL producing organisms are long term antibiotic use, particularly with ceftazidime and other third generation cephalosporins.

6. Acral lick dermatitis associated pyoderma.

- Preferred diagnostic samples: Sterile biopsies taken from the deep central non-ulcerated portion of the lesion and transported on ice (4ºC) to the laboratory.

Samples collected deep within the lesion produce positive cultures, which differ, from superficial cultures, that often contain contaminants and commensals. The cutaneous sample site should be clipped and surgically scrubbed. After removal of the biopsy the epidermis should be aseptically dissected from the dermis, and dermis submitted for culture.

7. Bacterial cutaneous abscess.

- Preferred diagnostic samples: sterile fluid samples (± 3 ml) from exudate and scrapings from wall of abscess (filled to brim of sample tube to maintain anaerobic conditions). Sterile biopsies (at least 1 cm tissue block to maintain anaerobic conditions) and charcoal medium swabs (able to perform aerobic and anaerobic culture) can also be used. All samples transported on ice (4ºC) to the laboratory.

Pus at the centre of an abscess is often sterile due to extensive necrosis and liquefaction. Pus from the periphery of recently formed abscesses will yield the best cultural results. Anaerobic bacteria are frequently involved with cutaneous abcesses and therefore, for all abscess samples submitted, both aerobic and anaerobic culture should be requested.

8. Mycobacterial cutaneous infections.

- Preferred diagnostic samples: Sterile biopsies for mycobacterial culture transported on ice (4ºC) and formalin-fixed cutaneous biopsies for histopathology H&E and ZN staining.

Mycobacteria are extremely slow growing requiring 12 weeks plus for isolation and some infections are caused by various fastidious mycobacteria that do not grow on routine culture. Therefore, the diagnosis of mycobacterial cutaneous infections is frequently presumptive and made according to the histopathology and the demonstration of intra-lesional acid fast bacteria within macrophages and multinucleated giant cells.

Canine leproid granuloma characteristically presents as single or multiple circumscribed dermal to subcutaneous nodules in haired skin. Anatomical predilection sites include the head and dorsolateral pinnae.

Cutaneous mycobacterial infections in cats include feline leprosy (caused by *M. lepraemurium* or novel mycobacterium species that cannot be grown in culture) and atypical mycobacteriosis caused by non-tuberculous mycobacteria (NTM), which are generally saprophytes or opportunistic pathogens. Feline leprosy is restricted to the skin where it produces localized and rarely disseminated cutaneous nodules. Atypical NTM infections in cats typically involve skin and subcutaneous tissues (either focal, multifocal or diffuse lesions), rarely progressing to systemic disease.

9. Sterile Pyoderma.

- Preferred diagnostic samples: Sterile biopsies for bacterial culture transported on ice (4ºC) and formalin-fixed cutaneous biopsies for histopathology.

These dermatoses resemble deep pyoderma clinically but are sterile conditions arising due to suspected aberrant immune mediated mechanisms and not the direct result of bacterial infection. Diagnosis is made on characteristic histopathology and failure to isolate pathogenic bacteria on culture.

Canine Juvenile cellulitis (juvenile pyoderma, puppy strangles, juvenile sterile granulomatous dermatitis and lymphadenitis) is a suspected immune mediated condition characterized by the development of granulomatous and pustular lesions, particularly of the face, pinnae and submandibular lymph nodes associated with marked regional lymphadenopathy/ lymphadenitis. Increased incidence in certain breeds and familial lines suggests a heritable component. Most pups are affected between three weeks and four months of age, although clinical cases in dogs up to 5 years of age are being reported with increasing frequency.

Sweets-like syndrome (sterile neutrophilic dermatitis) in dogs has been associated with drug therapy, shampoo reactions, arachnid bites, snake bites, hypersensitivity responses, immune mediated reactions and infectious agents. Multiple cases have been described following a suspected adverse reaction to carprofen.

Canine severe eosinophilic dermatitis is an acute eosinophilic dermatitis with vasculopathy / vasculitis. Skin lesions usually develop within 7 days or sooner following institution of treatment with multiple drugs for gastro-intestinal disease (vomiting and/or diarrhea). Cutaneous lesions are characterized by erythematous to hemorrhagic macules or plaques through to ulcerated nodules, distribution being predominantly ventral abdomen and limbs.

Fungal Culture.

1. Superficial mycoses.

Dermatophytosis.

- Preferred diagnostic samples: hair plucked from the lesion and scrapings from the edge of the lesion, collected with a blunt scalpel blade until blood begins to ooze. The plucked hair, skin scrapings (including the scalpel blade used) and any scab material that is present should be submitted.

Dermatophytosis is an infection of the skin by a group of related specific fungi of the genera Microsporum, Trichophyton and Epidermophyton. *Microsporum canis* is the most common species involved (cats being sources of infection). Over 20 species have been reported to infect domestic dogs. Some spp (*M.persicolor*) are mainly derived from wild rodents and termed sylvatic ringworm, usually affecting farm dogs or animals living in rural areas. *T.mentagrophytes* and *M.gypseum* are common soil inhabitants and therefore commonly initiate lesions on the face and nose of dogs that dig and burrow "nasal dermatophytosis". *T.verrucosum* has been incriminated in cases where dogs have had direct or indirect contact with cattle.

Feline dermatophytosis is very variable in its clinical presentation and should be considered in the differential diagnosis of all feline skin conditions. Due to its highly contagious nature and public health risk, this condition needs to be ruled out early and quickly.

Malassezia.

- Preferred diagnostic samples: Cellotape samples of the surface crust, are considered best for both

cytology and fungal culture. Collect 2 tape strips – one to be stained for cytology and the second to be pressed against the media of the fungal culture plate.

In dogs Malassezia has been associated with otitis and dermatitis with the 2 syndromes frequently occurring concurrently. This yeast commonly complicates underlying atopic and ectoparasitic allergies, where it acts as a flare factor.

Malassezia associated dermatitis appears to be far less common in cats than dogs. Malassezia when reported in cats is usually associated with a black and waxy otitis externa, recalcitrant feline chin acne, refractory paronychia or a generalized erythematous waxy dermatitis. The presence of Malassezia like yeasts in multifocal or generalised skin lesions of cats should prompt a thorough workup for metabollic disease and internal neoplasia as Malassezia overgrowth has been documented with thymoma associated dermatitis and para-neoplastic alopecia. There is emerging evidence that Malassezia is a complicating factor in some cases of allergic dermatitis in cats.

2. Deep mycoses.

Subcutaneous dermatophytosis.

- Preferred diagnostic samples: Sterile full thickness skin biopsies.

Dermatophytic pseudomycetoma is a rare manifestation of dermatophytosis, usually *Microsporum canis i*nfection, where dermatophytes escape from the epidermis and follicular epithelium and invade the dermis and subcutis. This subcutaneous variant of dermatophytosis is reported most commonly in cats (Persian's) and humans, but infrequently in dogs (Yorkshire Terriers) and horses.

Cutaneous cryptococcous.

- Preferred diagnostic samples: Sterile full thickness skin biopsies or charcoal swabs from subcutaneous exudate.

In cats, the nasal cavity, respiratory, cutaneous, central nervous system and ocular are the most commonly affected sites. It is an uncommon disease in cats but the most common deep mycosis seen in this animal species. It can occur anywhere but most commonly involves the face, pinnae and paws. Siamese, Birman and Ragdoll cats appear to be over-represented.

Cutaneous histoplasmosis.

- Preferred diagnostic samples: Sterile full thickness skin biopsies or charcoal swabs from subcutaneous exudate.

Primary skin forms resulting from wound infection have been described dogs and cats, but are far less common than the systemic forms of the disease.

Cutaneous sporothricosis.

- Preferred diagnostic samples: Sterile incisional skin biopsies, charcoal swabs from exudative lesions and aspirated content from non-ulcerated abscesses.

Sporotrichosis occurs in 3 forms namely cutaneous, cutaneolymphatic and disseminated. Cutaneous sporothricosis is most commonly recorded in domestic cats usually arising as a consequence of contamination of claw wounds, auto-inoculation during grooming or by bites from other cats. Zoonotic potential of sporotrichosis, especially in cats, must be seriously considered and respected, as there are large numbers of infectious organisms in feline lesions. Cutaneous sporothricosis on the other hand is rare in the dog and usually related to puncture wounds from thorns and wood splinters. Clinically it is characterized by nodules, ulcerating plaques or annular crusted alopecic areas, especially on the head, pinnae and/or trunk.

USE OF SEROLOGY IN DERMATOLOGY

The primary uses of antibody serology in dermatology include allergy serology and the food reaction test (FRT). At the outset, it is important to remember that allergy serology is not a diagnostic test used for the confirmation of a diagnosis of atopic dermatitis (AD). Only once the clinical diagnosis of atopic dermatitis has been made, is allergy serology considered and then only as a test to identify potential triggering allergens to include in an allergen specific immunotherapy (ASIT) vaccine. Equally, the food reaction test is not a diagnostic serological test to identify specific adverse food reactions (AFR), it is merely an indicator of the animal's immune reactivity to selected food proteins and so is used for the selection of food components to be used in an exclusion diet trial, which remains the gold standard diagnostic test for adverse food reactions.

1. Allergy Serology.

Atopic dermatitis is a common diagnosis in veterinary dermatology. A key factor in the pathogenesis of the clinical manifestations of atopy is the presence of high levels of allergen specific IgE. However, allergy serology targeting allergen specific IgE, should not be used as front line diagnostic tests for atopy, the clinical diagnosis of atopic dermatitis needs to have been made prior to any serological testing being performed. The results of the allergy test are used to identify offending allergens to enable formulation of allergen specific immunotherapy (ASIT) vaccines.

The following situations would warrant that allergy testing (allergy serology or intradermal skin testing) be considered, if ASIT was being considered as a therapy option.

- Severe clinical signs of atopic dermatitis.
- Prolonged clinical signs of atopic dermatitis that last for more than 3 months of the year.
- Poor control of atopic dermatitis with

symptomatic therapy.
- Occurrence of side effects to drugs being used in the therapy program.
- Poor owner compliance.

Allergy serology has several advantages over intradermal skin testing including no patient risk (as no sedation or general anaesthetic required), it is more convenient (for owner and animal), does not require repeated injections, serology is objective and reproducible and there is lower risk of drug interactions interfering with test results.

Various allergen specific IgE serology testing assays are available including monoclonal, mixed monoclonal and polyclonal anti-canine IgE assays plus the high affinity IgE receptor alpha subunit assay (Fc-epsilon receptor test/mast cell receptor test). Normal serum IgE levels are extremely low compared to IgG, in fact for every IgE antibody there are more than 10 000 IgG antibodies. It should be appreciated that IgG also binds with allergens and therefore, there is opportunity for binding to detection sites in serological tests. Hence, serological assays based on the use of monoclonal or polyclonal anti-IgE antibodies are complicated by IgG binding, increasing the risk false positive results.

The Fc-epsilon receptor test (mast cell receptor test) shows a strong and highly specific affinity for canine and feline IgE and does not recognize IgG. Therefore, serological assays based on this Fc-epsilon receptor technology are currently the preferred serological assays for the selection of antigens to include in ASIT vaccines.

There is still a lack of standardization of the currently employed allergy tests (allergy serology, intradermal skin testing) and it is suspected that false negative and false positive results do occur. Allergy testing is also unable to detect dogs with atopic like dermatitis, which is a condition clinically identical to canine atopy, but in which an IgE response to environmental or other allergens cannot be demonstrated.

2. The Food Reaction Test.

Adverse food reaction (AFR) mimics many other pruritic dermatoses and so diagnosis of "food hypersensitivity" cannot be based on clinical presentation alone. Dietary elimination trials followed by dietary provocation remains the gold standard diagnostic test for adverse food reaction. There are currently no serological tests available for the diagnosis of AFR, this can only be achieved by food elimination trials.

The food reaction test (FRT) is a serological assay used as an indicator of the animals immune reactivity to food proteins. Based on the results of the FRT, selection of alternative protein sources for an elimination diet (hydrolyzed scientific diet or home cooked diet) is possible.
- Preferred diagnostic samples: Serum blood samples submitted in plain or clot-activator blood tubes.

Haemolysed blood samples significantly interfere with the testing efficacy of both allergy serology and the FRT. Therefore, taking precautions to avoid haemolysis is extremely important in providing a testable sample to the laboratory. Ideally if a centrifuge is available at the practice, samples should be spun off and serum decanted into a new tube and this serum submitted through to the laboratory for testing, avoiding any risk of hemolysis. If samples arrive at the laboratory haemolysed these serological tests are not run and replacement samples from a re-bleed are requested. Factors causing haemolysis can occur both during sample collection and sample handling in preparation to send to the laboratory.

Errors during sample collection that lead to haemolysis include:
- Prolonged application of the limb tourniquet (no longer than 2 mins.)
- Not ensuring that alcohol applied to the venipuncture site has dried prior to collection.
- Using needles that are either too small or too large in gauge. 20 – 22 gauge needles should be used except for small puppies, kittens and birds where 23 gauge needles may be used.
- Connections between vacutainer and needle or syringe and needle to prevent influx of air which causes turbulence and subsequently haemolysis.
- Vacutainer tubes should be stored between 4°C - 25°C and blood must be collected into tubes at room temperature.
- If using a syringe and needle for venipunture, excessive force on the plunger during aspiration or when ejecting into the vacutainer tube must be avoided.
- If blood flow slows or stops during collection, an alternative venipucture site should be selected rather than persisting with a "slow draw".
- Errors during sample handling and transport that might lead to haemolysis include:
- Incomplete clot formation. In clot activated tubes, the sample must be allowed to stand vertical for at least 20 – 30 mins allowing the clot to solidify. In serum gel barrier/separator tubes 30mins should be allowed for the clot to form before centrifuging.
- Gel separator tubes should preferably be centrifuged once the clot has solidified. For swinging bucket horizontal centrifuges 10 mins centrifuging time is recommended; for fixed angle bucket centrifuges 15mins is ideal.
- Refrigeration of gel separated tubes may impede complete barrier formation
- Samples should not be handled roughly during transport (try to pack securely and request gentle handling from the couriers).

REFERENCES:Available at www.vel360.vetlink.co.za

CPD Questions

AC/0800/21

Go to www.vet360.vetlink.co.za or download the new Vet360 App to answer the questions
CPD reserved for Vet360 subscribers (R360 per annum) Call 012 346 1590 or visit www.vet360.vetink..co.za to sign up

1. Which bacteria are most commonly associated with superficial recurrent pyoderma in dogs?

a. *Staphylococcus pseudintermedius.*
b. *Escherishia coli.*
c. Pseudomonas species.
d. Bacillus species.
e. Proteus species.

2. Which of the following factors would not be considered a predisposing factor for the development of pyoderma in cats?

a. Hypersensitivity dermatitis.
b. Cutaneous trauma.
c. Feline Eosinophilic granuloma.
d. Immunosuppression.
e. Feline asthma.

3. Which of these clinical features would you expect to see in a case of cutaneous actinomycotic mycetoma?

a. Surface epidermal crusts.
b. Cutaneous abscesses with draining fistulous tracts.
c. Eosinophilic granuloma.
d. Alopecia.
e. Hyperkeratosis with follicular casts.

4. Which of the following bacteria are not associated with cutaneous botryomycosis?

a. Staphylococcus species.
b. Streptococcus species.
c. Pseudomonas aeruginosa.
d. Nocardia species.
e. Rhodococcous species.

5. Of the listed bacteria, which has not been associated with methicillin resistance?

a. *Staphylococcus pseudintermedius.*
b. *Staphylococcus aureus.*
c. *Streptococcus canis.*
d. *Staphylococcus epidermidis.*
e. *Staphylococcus schlieiferi.*

6. Which of these anatomical sites are a predilection site for the lesions of canine leproid granuloma?

a. Forelegs.
b. Rump.
c. Pawpads.
d. Ear pinnae.
e. Tail.

7. Which of the following etiologies are believed to be central in the development of canine severe eosinophilic dermatitis?

a. Drug reaction.
b. Vasculitis/vasculopathy.
c. Arthropod bite hypersensitivity.
d. Tracting foreign body.
e. Shampoo reaction.

8. Which of the following dermatophytes have been implicated in canine dermatophytosis with dogs have contact with cattle?

a. *Microsporum canis.*
b. *Microsporum gypseum.*
c. *Microsporidian persicolor.*
d. *Trichophyton mentagrophytes.*
e. *Trichophyton verrucosum.*

9. Which of the following cutaneous mycoses would be considered a significant zoonotic risk?

a. Feline dermatophytic pseudomycetoma.
b. Canine histoplasmosis.
c. Feline sporothricosis.
d. Canine sporothricosis.
e. Feline cryptococcosis.

10. Which of the following procedures most effectively reduces the risk of hemolysis during blood sample collection and sample handling in preparation to send to the laboratory?

a. Limb tourniquet applied for less than 2 minutes.
b. Separation of serum from blood clot by centrifugation.
c. Collecting blood into tubes which are at room temperature.
d. Allowing blood tubes to stand vertically 20 to 30 minutes post collection.
e. Only refrigerating samples after standing 30 minutes post collection at room temperature

Forever Young

Pituitary Dwarfism in Canines

Many of us pet owners will look at our puppies wishing that they could remain small and cute for just a while longer. In the case of dogs affected by pituitary dwarfism, these four-legged companions are forever encased in their puppy forms.

The deficiency in pituitary hormones can be caused by a defect in the endocrine cell differentiation process. These cells normally follow a distinct order in which they arise from their progenitor cells. In dogs with pituitary dwarfism, however, this differentiation order is disrupted. This causes the pituitary gland to be underdeveloped, which in turn reduces the gland's ability to secrete vital hormones such as prolactin, growth hormone, gonadotropins, and thyroid-stimulating hormone. The adrenocorticotrophic hormone secretion remains unaffected in these dogs.

The condition is most commonly found in German Shepherd dogs, but has also been identified in the Wolfdog and Karelian Bear dogs. Owners can usually start noticing clinical manifestations of pituitary dwarfism from as early as 8 to 16 weeks.

Clinical signs can include the following:

- Marked growth retardation
- Legs will appear shorter than expected with a longer than normal body
- Bowed front legs
- Renal failure due to underdeveloped kidneys
- Dull/slow intelligence
- Swollen abdomen
- Underbite and shorter jaw
- Bulging eyes
- Larger than normal head

- Retaining puppy hair (secondary hairs)
- Inability to grow guard hairs
- Bald patches
- High pitched bark
- Swollen joints
- Prone to bacterial skin infections
- Sterility

Pituitary dwarfism can have many causes, including tumours, cysts, infection, or genetic predisposition. In German Shepherds, wolfdogs, and Karelian Bear dogs, pituitary dwarfism can be caused by a deletion of one of six 7bp repeats in intron 5 in the LHX3 gene, which shortens the intron to only 68bp.

Although pet owners will visually be able to tell that something is not quite right, the veterinarian will still have to perform a string of tests to confirm the diagnosis. This will include a physical assessment (focusing on palpation, pulse, and auscultation, the dog's height and weight as well as breathing), hormone level tests (such as adrenocorticotropic hormone, growth hormone, plasma insulin-like growth factor-1, follicle-stimulating hormones, thyroid-stimulating hormone, and prolactin), blood panels to rule out underlying diseases such as infections or cancers, scans to check for cysts or a genetic test to confirm the causative mutation.

Treatment will depend on the cause of the disorder. Tumours and cysts can be surgically removed, whereas inherited pituitary dwarfism can only be managed, with management mostly involving the replenishment of the missing hormones. Although there is no canine growth hormone available to use as a treatment, there are other alternative options, such as porcine growth hormone, thyroid hormones, and progestins.

Porcine growth hormone: Can be used as an alternative to canine growth hormones but are very expensive to procure. Results can vary from patient to patient but are generally unreliable.

Thyroid hormones: Some treatment success has been obtained by using Synthetic levothyroxine. Absorption and metabolism of the hormone can vary between patients and must therefore be carefully monitored and adjusted by the veterinarian.

Progestins: The production of growth hormones in the mammary duct cells can be stimulated through the use of steroids such as progesterone or medroxyprogesterone acetate. These steroids should be administered every three weeks for several months and then gradually be reduced to every six weeks. There has been some success with using steroids, although the use of them can result in the patient developing an allergic reaction or diabetes mellitus.

Dogs who do not receive treatment will usually not live past the age of four years, with their quality of life being greatly reduced. With the correct treatment strategy, lifespan and quality can be increased. It is, however, important to note that treatment can be expensive and will have to be administered for the remainder of the dog's life.

Hill's
Transforming Lives

FOOD + ENVIRONMENTAL ALLERGIES

Also available in a smaller kibble for mini dogs

LET'S MAKE ITCHING A THING OF THE PAST

Hill's Prescription Diet Derm Complete is the only clinically proven nutrition for both food *and* environmental allergies*.

Derm Complete helps to address two primary causes of itching with:

1. Novel protein that avoids 96% of food allergies[1]
2. A breakthrough formula with bioactives and phytonutrients to reduce the signs associated with environmental alleries

Ask your Hill's Territory Manager about allergy care that's
A STEP AHEAD FOR THEIR BEST LIFE

[1]Mueller RS, Olivry T, Prélaud P. Critically appraised topic on adverse food reactions of companion animals (2): common food allergen sources in dogs and cats. *BMC Vet Res.* 2016;12:9.
*The only dietetic nutritional solution for both food and environmental allergies in dogs supported by 3 clinical studies.

V32802, V32800

Helicopter/DermComplete/V360

pet remedy

natural de-stress & calming

KYRON
30 Years
SERVING THE VETERINARY INDUSTRY

Works immediately!

Aggression
Nervousness
Noise phobia
Separation
Anxiety
Fear

Available at selected Vets, Vet shops and online stores

www.kyronlabs.co.za
facebook.com/KyronLabs

KYRON
Health and beauty for all animals®
Kyron Laboratories (Pty) Ltd. Co. Reg. No. 1990/004442/07
29 Barney Road, Benrose 2094 South Africa
Tel +27 11 618 1544 | kyron@kyronlabs.co.za