

# C&T



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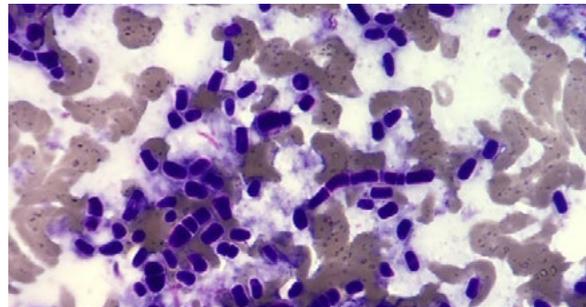
Centre for  
Veterinary  
Education

## Control & Therapy Series

Issue 307 | June 2022



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Dr Claire Adams

Online now



Dr Henry Jones

I hear you guys switched to a mucosal vaccine?



Dr Claire Adams

Yes, we're using Bronchi-Shield 🐾 Oral



Dr Henry Jones

What prompted the change?



Dr Claire Adams

We all agreed the benefit of increased mucosal immunity to protect against respiratory disease was worth it!



BTW, mucosal vaccines are also strongly recommended by WSAVA for high risk environments such as shelters<sup>1</sup> 🏠

Dr Henry Jones

We considered it but it's a hassle to change protocols



Dr Claire Adams

We got the rep in, they sorted out the vaccination protocol and trained our staff. The new protocol worked out to be more cost effective too! 👍



Dr Henry Jones

We're also not sure if our clients would like it... 🤔



Dr Claire Adams

Hmmm...if the flu vaccine came out as an oral mucosal form, how many people would still stick with injections?



Dr Henry Jones



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# C&T

Issue 307 | June 2022

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Australia's Leading Veterinarian Forum

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**Terry King**

Veterinary Specialist Services, QLD

## Thank you to all contributors

The C&T Series thrives due to your generosity. If you're reading this and have been contemplating sending us an article, a reply or comment on a previous C&T, or would like to send us a 'What's YOUR Diagnosis?' image and question or seek feedback from colleagues, please don't hesitate to contact us.

The C&T is not a peer reviewed journal. We are keen on publishing short pithy practical articles (a simple paragraph is fine) that our readers can immediately relate to and utilise. And the English and grammar do not have to be perfect—our editors will assist with that.

## Join in—write up that interesting case

C&T authors agree that it is extremely satisfying to read their articles in print (and the digital versions) and know they are contributing to veterinary knowledge and animal welfare.

## Winners

### Major Winner

Prize: A CVE\$400 Voucher

### Use of Intralipid to Prevent Myocardial Necrosis Post Persin Toxicity in an Indian Ring Neck

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### Best Visuals

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Prize: A CVE\$100 voucher

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# FROM THE DIRECTOR



Animal welfare is a concept on which most of us would agree we've based our careers. As someone who spent many years championing animal welfare and involved in prosecuting breaches of legislation designed to uphold standards of welfare, I found Andrea Harvey's article in this edition of C&T thought-provoking and educational.

In particular, I've been reflecting on the concept of welfare as not just the absence of negative experiences, but the opportunity to experience positive affective states. This is an idea I've contemplated and discussed often, such as during pet end-of-life discussions with owners. Through her articulation of the science and objective parameters associated with assessing welfare, Andrea is providing a scaffold—and the language—we can use to integrate welfare more holistically into clinical practice. I'm looking forward to her WebinarPLUS in July.

On another note, like most people, I'm a sucker for a before and after photo – and we have some absolute crackers in this edition of the C&T. There are the two kittens – 'Sugar' and 'Spice' with *Nannizzia gypsea*; 'Penny' with canine leproid granuloma and my personal favourite, the 13-year-old cat with aggressive nasal plane squamous cell carcinoma.

And although I've never been particularly confident with birds, I found Joe Herbert's article on a novel approach to the treatment of avocado toxicity in a parrot fascinating – not just in terms of the case but as a refresher on the physiological basis of intralipid therapy.

Happy reading.

Simone

## Small

# CASE OF *NANNIZZIA GYPSEA* (FORMERLY *MICROSPORUM GYPSEUM*) IN RESCUE KITTENS

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C&T No. 5929

'Sugar' and 'Spice' (named because they were found at Sugarworld water park) were brought into the clinic after staff on the grounds found them abandoned under a water slide.

Both kittens were thought to be about 6 weeks-of-age. They had multiple cream-coloured thick crusts (Figure 1A) over their body ranging from 1 to 3cm in diameter. The rest of their physical examination was unremarkable and they appeared to be well fed.

Underneath the scabs were ulcerated raised lesions (Figure 1B). All scabs were removed from the kittens. Due to the nature of the lesions and how severe they were, coupled with reports of recent animal abuse in the area, it was uncertain whether they were infectious or had been the victim of Zoo sadism.

Impression smears of the lesions were made and examined in clinic (Figure 2 A & B) and a diagnosis of fungal skin disease was made. The type of fungus was unknown at this stage.

Kittens were isolated from all other animals and their foster carer began daily Malaseb baths coupled with topical application of 'Fungafite' (miconazole nitrate 20mg/g) twice daily. Both kittens were clipped so that the carer could assess the lesions easily. Oral itraconazole was suggested, although never started.

The lesions rapidly became less ulcerated and resolving in nature. Cytology and culture samples were sent out and a definitive diagnosis of *Nannizzia gypsea* was made.

*Nannizzia gypsea* (formerly *Microsporium gypseum*) is a free-living saprophyte found in soil worldwide.

It can often be found in lesions on dogs which dig/bury objects in soil and may manifest as classical ringworm lesions, serious generalised lesions which may be complicated by other organisms, or nodular lesions (tumour-like).

Sugar and spice are now fully recovered, well-adjusted kittens and can be adopted through the Cairns and Tablelands Animal rehoming group ([perfectpets.com.au/p/animal-rehoming-cairns-and-tablelands-district/QLD/3061](http://perfectpets.com.au/p/animal-rehoming-cairns-and-tablelands-district/QLD/3061)). Apart from a few white hairs where the lesions were present, they have no other health issues.



Figure 1A. Close up of a crusty lesion



Figure 1B. Ulcerated raised lesions under crusts

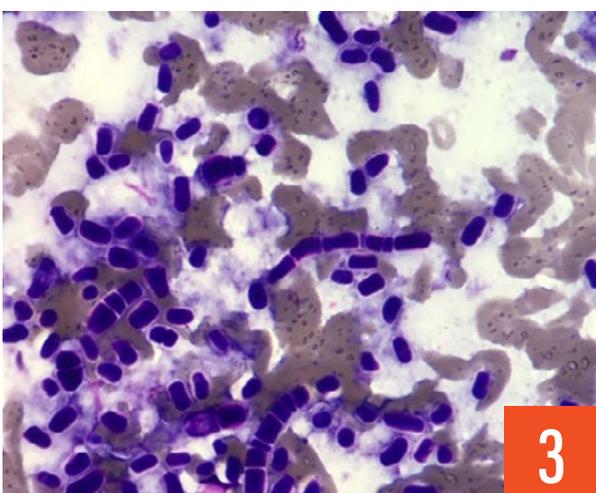
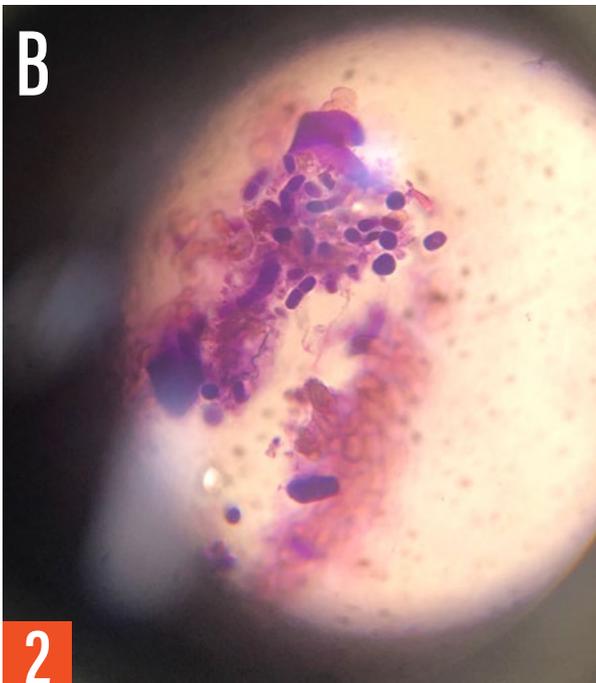
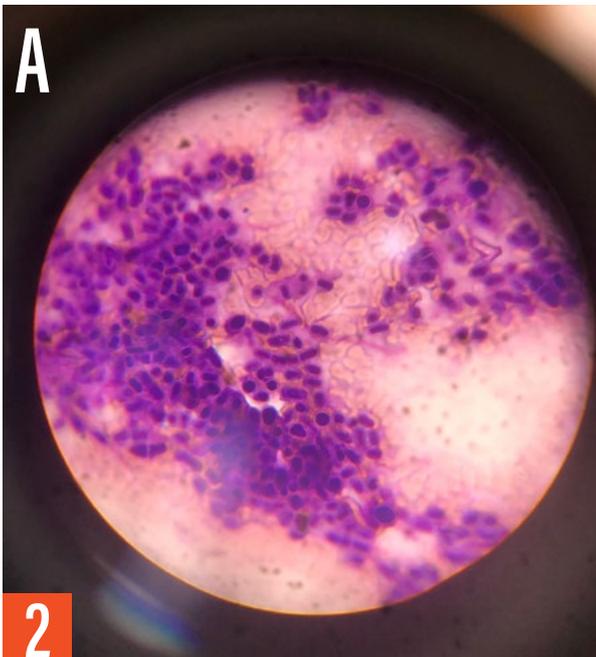


Figure 2. DiffQuik stained smears from the ulcerated skin lesions in Figure 3. Arthrospores  
 Figure 4. Daily Malaseb bath  
 Figure 5. Both kittens were clipped so that the carer could assess the lesions easily  
 Figure 6. White hairs where the lesions were present  
 Figure 7. Sugar and Spice fully recovered



Small

# DIAGNOSING RESPIRATORY AND SYSTEMIC FUNGAL DISEASE IN GENERAL PRACTICE

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C&T No. 5930

Although the genera of fungi that can infect dogs and cats is numerous, the two most prevalent organisms in Australia are cryptococcus and aspergillus. These organisms affect dogs and cats typically through the respiratory system, or systemically through multiple organ systems.

Frequently, animals with these infections present with vague signs and/or overlapping symptoms with other disease processes (neoplasia, immune-mediated disease, chronic disease). Although culturing these organisms is an important diagnostic tool, especially for further classification and targeting with specific anti-fungal treatments, turnaround times for results can be long. This is the case for both cryptococcus and aspergillus. It's important for clinicians to be aware of alternatives to culturing to diagnose these conditions to ensure treatment is initiated early to give pets the best possible outcome.

## Alternatives to fungal culture for the diagnosis for cryptococcosis in dogs and cats

1. The value of cytology (even in-house) should not be overlooked in these cases. From conjunctival smears to fine needle aspirations of subcutaneous masses, lymph nodes, cavity fluids and even main cavity masses. The yield of organism is often high. India Ink is the classic stain of choice for diagnosis in CSF, however in-house stains can often identify the organism, such as DiffQuik or Wright-Giemsa. Typically, these yeasts are 5-15µm and will be blue / pink with a non-staining thick capsule. Some yeast may display narrow budding. See above (Figure 1) for an example with DiffQuik cytology. Although diagnostic

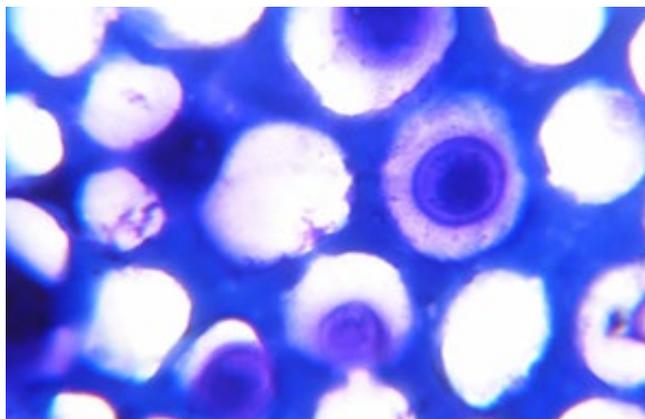


Figure 1A. DiffQuik cytology preparation of an abdominal cryptococcal granuloma. Note the thick polysaccharide non-staining capsule.

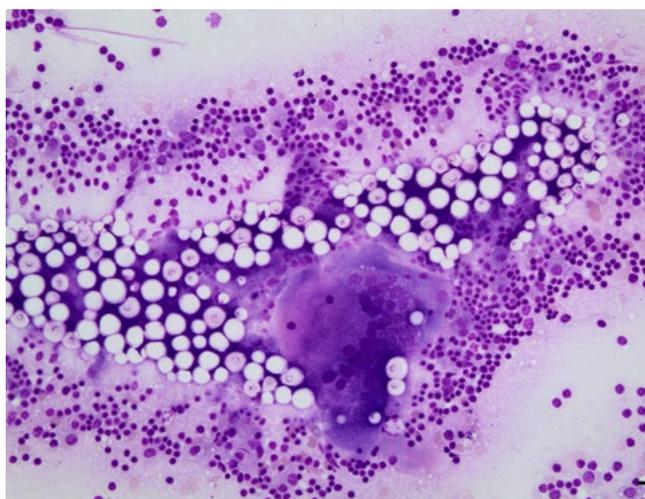


Figure 1B. Granulomatous inflammation can be present with multi-nuclear giant cell macrophage formation

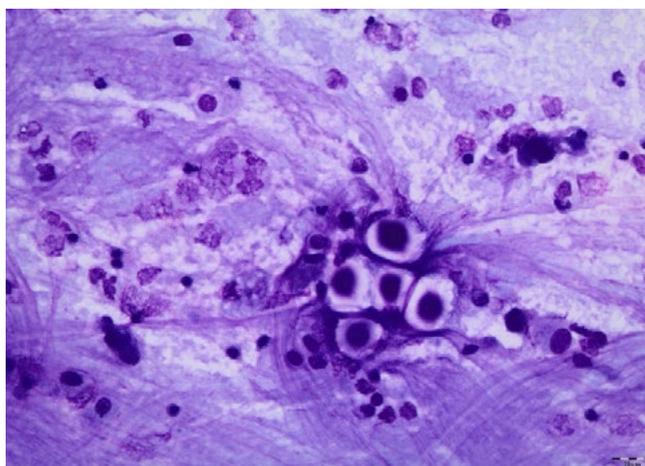


Figure 1C. This cytology is from a trans tracheal wash in a horse

yield is generally high, false negatives are still possible, especially as noted with CSF cytology.

2. Serological diagnosis via LCAT (latex cryptococcal antigen agglutination test) through a laboratory (CALAS) detects the capsular antigen of the organism on serum or plasma (most used) or CSF after serial dilutions of the specimen. This test has important utilization in the diagnosis AND monitoring of cryptococcosis

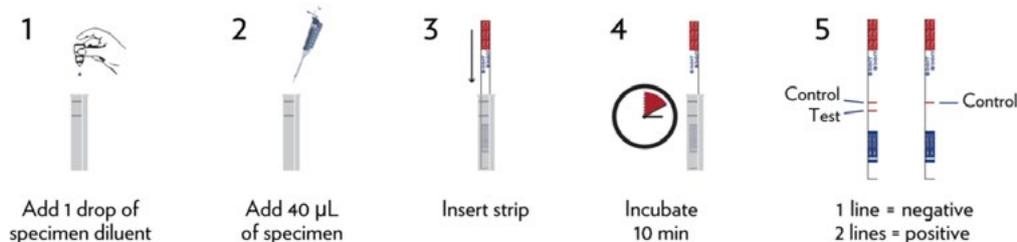
**QUALITATIVE – BASIC PROCEDURE**

Figure 2: CrAg (IMMY) kit instructions  
Imaged obtained from [immy.com/crag](http://immy.com/crag)

in dogs and cats. Studies have shown the high sensitivity (95–98%) and specificity rates (100%) of this test (Medleau L *et al.* 1990, Malik R *et al.* 1996, Trivedi SR *et al.* 2011). Results are returned as a titre value but do not indicate the burden of the disease. Therefore, a value of 1:2 is still considered a significant finding. Despite the test carrying a high sensitivity rate, a negative titre cannot completely rule out the condition. This is more relevant in dogs than cats where the occurrence of false negatives is said to occur more frequently. Despite its reliability there is often a lag time of several days between submission of test and acquisition of the titre value. LCAT (serum) titres have the added value in monitoring response to treatment, clearance of organism and recurrence of disease. Although no consensus exists, typically I will continue anti-fungal therapy for 3 months after two negative titres are obtained and regular (q3–6month) titre monitoring lifelong is advised once a ‘cure’ is achieved.

3. Point-of-care tests are being investigated in veterinary medicine. These tests are cheap, easy to run and quick to return a result (<15minutes). They are typically performed on serum but can be performed on blood, urine, or CSF in humans. Reagan *et al.* 2019 recently investigated 2 lateral flow cryptococcal serum antigen tests IMMY (Norman, OK) and BIOSYNEX (Strasbourg, France). Compared to the commercial LCAT antigen test (CALAS), IMMY had a sensitivity of 92% and a specificity of 93%. BIOSYNEX achieved a lower sensitivity rate (80%) but a slightly higher specificity (95%). Similar sensitivity rates have been reported in dogs and cats by other authors (Krockenberger *et al.* 2020). The recommendation from the research is that a negative result from an IMMY (Norman, OK) can be typically believed, however a positive result should be confirmed with an LCAT through a laboratory (CALAS). This is the approach we currently take at our practice. Although in humans CSF and urine can be utilized with the IMMY as a diagnostic aid for neurological cryptococcus infections, this has



Figure 3: CrAg (IMMY) packet and contents

not been looked at thoroughly in dogs and cats and thus serum is the preferred specimen to analyze until further studies are conducted.

### Alternatives to fungal culture for the diagnosis of aspergillosis in dogs and cats

In aspergillosis cases the main point to make is that the approach to diagnosis (and treatment) for local and systemic disease varies dramatically.

#### Sino-nasal aspergillus in dogs:

- i. Typically, diagnosis is achieved through advanced imaging such as CT or MRI of the nasal cavity and sinuses and rhinoscopy with fungal plaque visualization and biopsies with fungal culture. Often for many owners this may be a cost prohibitive approach, although it is the only way to reliably diagnose the condition.
- ii. Serology (antibody) can be utilized to aid in the diagnosis. In a 2009 study dogs with sino-nasal aspergillus, nasal tumors and lymphoplasmacytic rhinitis were compared on serum against two serology tests. Results of the study indicated that detection of aspergillus specific antibodies with either the Agar-gel double immunodiffusion (AGID) OR the anti-aspergillus IgG ELISA had a high specificity rate (96–100%) with a good sensitivity. As with all diagnostic tests false positives and negatives are possible. Furthermore, the reliability of these tests depends on the patient’s immune

response to the organism presence. In summary a positive result supports a diagnosis however a negative result does not rule it out.

- iii. Galactomannan testing (see below) on serum or urine is of little–no value in these cases given the localized nature of disease.
- iv. Nasal cytology or fungal culture on blind biopsies or nasal discharge is often of little use unless the fungal plaques are visualized. Randomly obtained samples are not advised.

### Nasal/sino–orbital aspergillus in cats:

- i. Like dogs, diagnosis is best achieved on identification of fungal plaques, advanced imaging and/or guided tissue/fungal plaque biopsy and fungal culture.
- ii. Similar studies, as with dogs, looking at serology (antibody) in cats have been performed and the IgG ELISA has had similarly rewarding high specificity and sensitivities. AGID in cats has a high specificity (100%) but a lower sensitivity than IgG ELISA (43%). Thus, again in summary a positive result via IgG ELISA or AGID supports a diagnosis however a negative result does not rule it out.
- iii. Like dogs, galactomannan testing is noted to have low sensitivity and specificity rates in cats with nasal/sino–orbital aspergillus.
- iv. Most cats with invasive aspergillosis have involvement of tissue in the oral cavity behind the last molar—when abnormal tissue is present in this location—a biopsy can often provide a quick and easy way to make a diagnosis.

### Disseminated aspergillosis in dogs:

- i. In disseminated/systemic disease, aspergillus galactomannan antigen (GMA) ELISA assay tends to be most reliable. The test can be performed on urine OR serum. Typically, a galactomannan index (GMI)  $\geq 1.5$  is considered positive. In one study in dogs, sensitivity and specificity on serum were 92% and 93% respectively with similar results for urine (sen 88%, spec 93%). False positive results have been recorded in dogs administered Plasmalyte prior to testing, dogs and cats with other systemic mycoses, young cats (typically <1YO), and patients receiving beta–lactam based antimicrobials. In human medicine, an assay (Platelia aspergillus BioRad) has been utilized in other body fluids from bronchoalveolar lavage to CSF fluid and may provide a more sensitive diagnostic tool than culture with the added advantage of diagnosing earlier in the course of the disease. Further investigation is needed in dogs and cats for such samples.

It is important to note that the sensitivities and specificities of serology tests may vary depending on your lab and assay type used. A discussion with your local pathologist regarding the accuracy and validation of the assays they utilize is advised.

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Small

# WHAT IS YOUR DIAGNOSIS?

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C&T No. 5938

A 6-year-old, male desexed Domestic Shorthair cat was presented for re-evaluation of a urolith.

Six weeks prior, the cat had presented for dysuria (specifically, increased frequency of small volume urinations). Urinalysis had shown copious struvite crystals with urine pH of 8 and urinary tract inflammation. A distal urethral urolith was recognised radiographically. The bladder was easily expressed (i.e., the cat was not obstructed). The cat had been started on a urine modifying diet and treated with NSAIDs. The clinical signs reduced notably but the cat continued to dribble after urination for some weeks (attributed to the urolith). After the urine dribbling also reduced, the cat presented to assess if the urolith was still present.

The radiograph from 6 weeks prior was assessed:

## Questions:

- i. What is your diagnosis?
- ii. How would you proceed?

## ANSWER TO C&T NO. 5927

The 'alleged' urolith, circled in blue in this image was recognised to be this cat's *os penis*, i.e., normal anatomy. The ongoing dribbling urine may have been from residual urethritis or cystitis.

The radiographic characterisation of the feline *os penis* has been described in a study from the UK that compared 50 digital radiographic images to 50 analogue images (99 cats with one cat being assessed with both forms of radiographic processing).<sup>1</sup> The *os penis* was recognised in 19/50 (38%) digital images but only 8/50 (16%) of



analogue images; the one cat with both forms of processing had the *os penis* recognised by digital but not analogue processing. There were too few intact cats to make any conclusions about the effect of desexing. No associations were found with breed or lower urinary tract disease.

**Editor's note:** It would be interesting to repeat this in Australia, as we tend to do earlier neutering than in the UK, and it might be that early castration makes mineralisation of the *os penis* less common or less evident.

The *os penis* has also been characterised with CT in a recent study that found an *os penis* in 20/23 (87%) cats.<sup>2</sup> No correlation was found with its presence and age or desexing status but, a negative correlation was found between body weight and attenuation (i.e., lower attenuation with higher body weight).

## How would you proceed?

Repeat radiographs were not performed. The cat became stressed in hospital and chemical restraint would have been needed. It was judged that no benefit to the cat would be gained so we chose not to sedate the cat. Repeat urinalysis showed reduced struvite and urine pH=6. Urinary modification diets were continued.

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2. Tobón Restrepo M, Altuzarra R, Espada Y, Domínguez E, Mallol C, Novellas R. CT characterisation of the feline *os penis*. *Journal of feline medicine and surgery*. 2020;22(8):673-7.

# ANSWERS FROM C&T READERS

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## REPLY 1

**Holly Yang**

Unusual Pet Vets Osborne Park  
Unit 4, 325 Harborne Street  
Osborne Park WA 6017

Diagnosis - Normal radiographic anatomy of a male cat, *os penis*.

How would you proceed? - Continue with medical management on urinary diet and monitor closely for CS, repeat UA as needed.

## REPLY 2

**Jane Ryan**

'Some tomcats will have an *os penis*, a small bone (3–5 mm) within the glans portion of the penis. Unlike in dogs, the development of the *os penis* is an age-related change that is due to the ossification of the distal end of the septum between the penile corpus cavernosum; an *os penis* is therefore rarely seen in young cats. If present, it can be observed on radiographs as a sliver of bone pointing caudally within the penis.'

Aime K Johnson *JFMS* 2022-03, Vol.24 (3), p.212-220

Small

# CANINE LEPROID GRANULOMA

**Caryn Wun BVSc**

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C&T No. 5931

Penny, a 5-year -old female spayed Staffy X dog was attained as a young adult from the RSPCA.

Penny presented with raised hairless nodules ranging from 3 to 12mm in diameter on the outer dorsal pinna of both ears. Lesions had been present for at least five weeks and had gradually been increasing in size and number. Although this dog had presented in the past with urticaria, allergic dermatitis and superficial pyodermas where pruritis is common, these lesions did not seem to be irritating to Penny at all and she was not showing any signs of self-trauma.



Figure 1. Penny's ear on presentation

Fine needle aspirate examined in house showed mixed inflammatory cells and multiple round to spindle-shaped cells with cytoplasmic inclusions.

A second opinion was sought from Vetnostics Laboratories. The cytology results are as follows

and in retrospect the cytoplasmic inclusions seen by me in-house were negatively stained bacteria.

‘The smear was accompanied by an increased population of mixed inflammatory cells comprising neutrophils (some of which appear degenerate), macrophages (some of which appeared reactive and some of which contained variable numbers of negatively staining bacilli within their cytoplasm), small lymphocytes and scant eosinophils as well as scant plasma cells.’



Figure 2. Reproduced with permission Candice Chu, DVM, PhD, DACVP from

[facebook.com/Vet.Clin.Path.Resident](https://www.facebook.com/Vet.Clin.Path.Resident)

## A Diagnosis of Canine Leproid Granuloma (CLG) was Made

These lesions typically present as single or multiple well circumscribed subcutaneous nodule(s) typically ranging from 2mm to 50mm and can be found anywhere on the body but having a predilection for the dorsal pinna. Small nodules are detected as hard subcutaneous bumps whereas the larger lesions become alopecic and may become ulcerated with secondary infection. CLG lesions are confined to the skin and subcutis, do not involve the regional lymph nodes, nerves or other organs and as such the dogs are usually unaffected systemically.

CLG is considered the most common Mycobacterial disease in dogs in Australia and has been reported in Sydney, coastal and country New South Wales, Tasmania, Victoria, Queensland, Western Australia and New Zealand.

They are typically seen in large breed short haired dogs with over representation of Boxer and Boxer-cross dogs. In New Zealand, Foxhounds are the predominant breed.

The aetiopathology of the disease is not known but there are suspicions of insect vectors inoculating Mycobacteria from an environmental niche into susceptible tissue. However, in New Zealand, the bacteria were also detected in faecal material (in the absence of any gastrointestinal signs) in affected dogs and skin contamination through abrasions were also postulated. The unknown incubation period makes it difficult to correlate the dogs' activities and occurrence of disease. Restriction of lesions to the lateral body, head and limbs and absence of them on the softer, ventral skin suggests a cutaneous route of infection in exposed skin.

## Diagnosis

Diagnosis is based on location of lesions, and DiffQuik Stained fine needle aspirates of the lesions. Typically, numerous macrophages with variable numbers of lymphocytes and plasma cells and lower numbers of neutrophils are seen. Usually few to moderate numbers of negatively-stained, medium length bacilli can be detected within macrophages or extracellularly.

Histopathology can be performed and typically a pyogranulomatous reaction is seen with the presence and number of acid-fast bacilli seen (stained with Ziehl Neelsen) being highly variable and probably dependent on the maturity of the lesion and the corresponding host immune response.

Culture of organisms has been problematic with this organism being difficult to grow in vitro.

PCR studies have been performed and the species of Mycobacteria is yet to be identified. However, if biopsies are taken, a fresh sample should be submitted for PCR testing in an attempt to assist in identifying the causative species. There is thought to be no public health risk to the owners of affected dogs.

## Treatment

Most dogs with CLG have self-limiting disease that self resolves, with regression after 1-6 months. This complicates assessment of efficacy of empiric antimicrobial regimes. In one study of CLG in dogs, 57% of cases recorded a favourable response to doxycycline, 63% had a favourable response to amoxicillin-clavulanic acid, while spontaneous regression occurred in 86% of untreated dogs.

Many clinicians believe drug therapy against secondary *Staphylococcus pseudintermedius* is helpful, less expensive and has fewer side effects than drugs used for specific combination antimycobacterial therapy. Persistence of



Figure 3. Two weeks after presentation showing reduction in size of nodules.

lesions over a timeframe exceeding that for which spontaneous regression commonly occurs (three to six months) warrants further treatment. Cell mediated immunity may be compromised in these patients, perhaps due to inherited immunodeficiency affecting major histocompatibility complex expression, innate immunity or the development of adaptive immunity.

A combination of rifampicin (10-15 mg/kg PO q 24hr) and clarithromycin (7.5-12.5 mg/kg PO q 8-12hr) is recommended for treating severe or refractory CLG. Hepatotoxicity has been reported at higher doses of rifampicin and base line and monitoring of biochemical parameters is recommended.

Clarithromycin may give rise to colic, inappetence, vomiting, diarrhoea or other clinical signs of gastrointestinal irritation.

Clofazimine suspended in petroleum jelly can be applied topically to lesions twice daily. The topical clofazimine formulation can be prepared by crushing (with a hammer) 40 clofazimine 'capsules' (50mg) within a plastic bag. The extracted liquid dye was subsequently mixed into an ointment with 100 g of petroleum jelly.

Silver sulphasalazine cream has also been advocated for topical use.

#### Thanks to:

Dr George Reppas of Laverty Vetnostics and his article in Vetnostics newsletter winter 2012

Dr Richard Malik – personal communication

#### Update 11 Weeks later



Figure 4. A and B. 11 weeks after initial presentation the lesions are nearly fully resolved.

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- Smits B, Willis R *et al*, Case clusters of leproid granulomas in foxhounds in New Zealand and Australia; *Vet Dermatol* 2012; 23: 465-e88.

Small

# GASTRIC DILATATION & VOLVULUS IN CATS

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Working in feline-only specialist practice means that I generally avoid the inevitable Friday evening gastric dilatation and volvulus (GDV) walking through the doors.

Gastric dilatation with or without volvulus can occur sporadically in cats. Non-productive retching—one of the most common signs in dogs with GDV—does not seem to be a feature in cats.

My experience has been in cats with a traumatic diaphragmatic hernia where the stomach herniates through the diaphragm and dilates (see radiographs adjacent). This has also been reported in 3 cats with acute dyspnoea and sudden abdominal enlargement (Formaggini *et al JFMS* 2008). Gastric decompression by needle gastrocentesis or a nasogastric tube (or both) were performed. One cat also had a gastropexy. All cats ultimately did well at follow up.

An early Scandinavian paper reported 10 cases of acute gastric dilatation in cats and found a mortality rate of 30% (Bredal *et al Acta Veterinaria Scandinavica*, 1996). Three of the 10 cats had a diaphragmatic hernia. Treatment consisted of stabilisation and gastric decompression or surgery. Recurrence only occurred in one cat.

A more recent paper discussed spontaneous GDV in 2 Persian cats (Leary *et al JVECCS* 2018). Both presented with respiratory distress and a distended and painful abdomen. Both had exploratory laparotomy and gastropexy and were ultimately discharged. That both cats were Persian was interesting and perhaps changes in pressure associated with brachycephalic anatomy (e.g. stenotic nares) could result in increased forceful movement of the diaphragm against the stomach in addition to more aerophagia.

Radiographic findings include a markedly distended stomach in both GDV and dilatation alone. A right lateral view is often the most helpful. Typically, the pyloric antrum will be displaced dorsally and cranially with GDV rather than ventral and fluid filled. Many dogs with GDV have compartmentalisation of the stomach (soft tissue opacity dividing the gastric fundus and displaced pylorus—the so called 'bum' sign) but this is frequently absent in cats.

Most cases of spontaneous GDV in the literature did not appear to have gastrointestinal biopsies to assess for underlying gastrointestinal pathology such as inflammatory bowel disease or small cell lymphoma. For any veterinarians seeing future cases requiring surgical intervention, performing gastrointestinal biopsies would seem sensible.

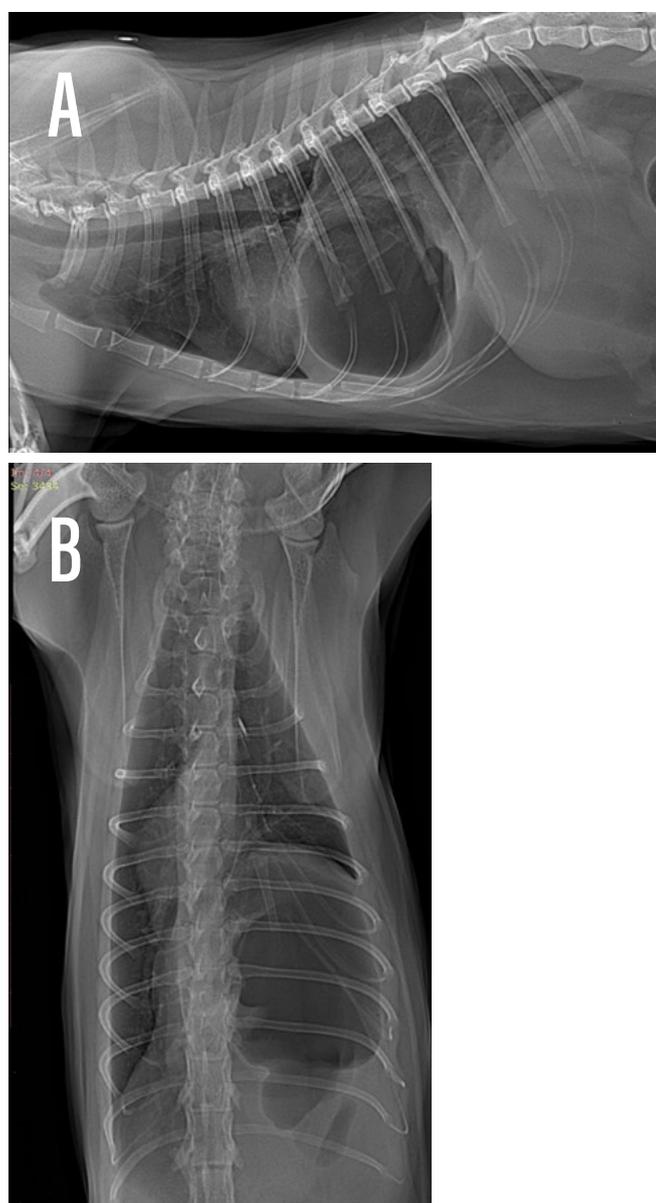


Figure 1A and 1B. Lateral and dorsoventral radiograph of a cat diaphragmatic hernia where the stomach has herniated through the diaphragm and dilated

Small

# GASTRIC DILATION IN A 13-YEAR-OLD CAT

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C&T No. 5933

Eliza, a 13-year-old desexed female Domestic Longhair cat, was presented for ongoing inappetence as well as vomiting a little fluid when the owner picked her up. This was in spite of the fact that she had been seen by a colleague the previous evening, found to be normal on physical exam and blood tests, and sent home after being given maropitant (Cerenia®), which would have still been active. This last fact prompted me to admit her for abdominal radiographs, then an ultrasound as needed, fluids, supportive care etc.

The radiographs performed by our nurses during a busy consultation morning were as follows:

The large amount of fluid and gas in the stomach being the most striking feature, I suspected

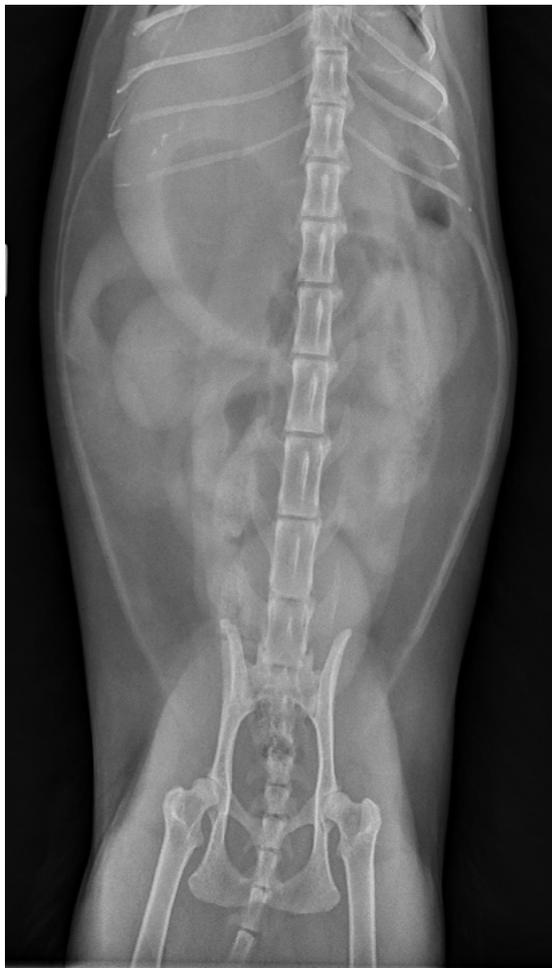


Figure 2. DV radiograph of the cat in this report

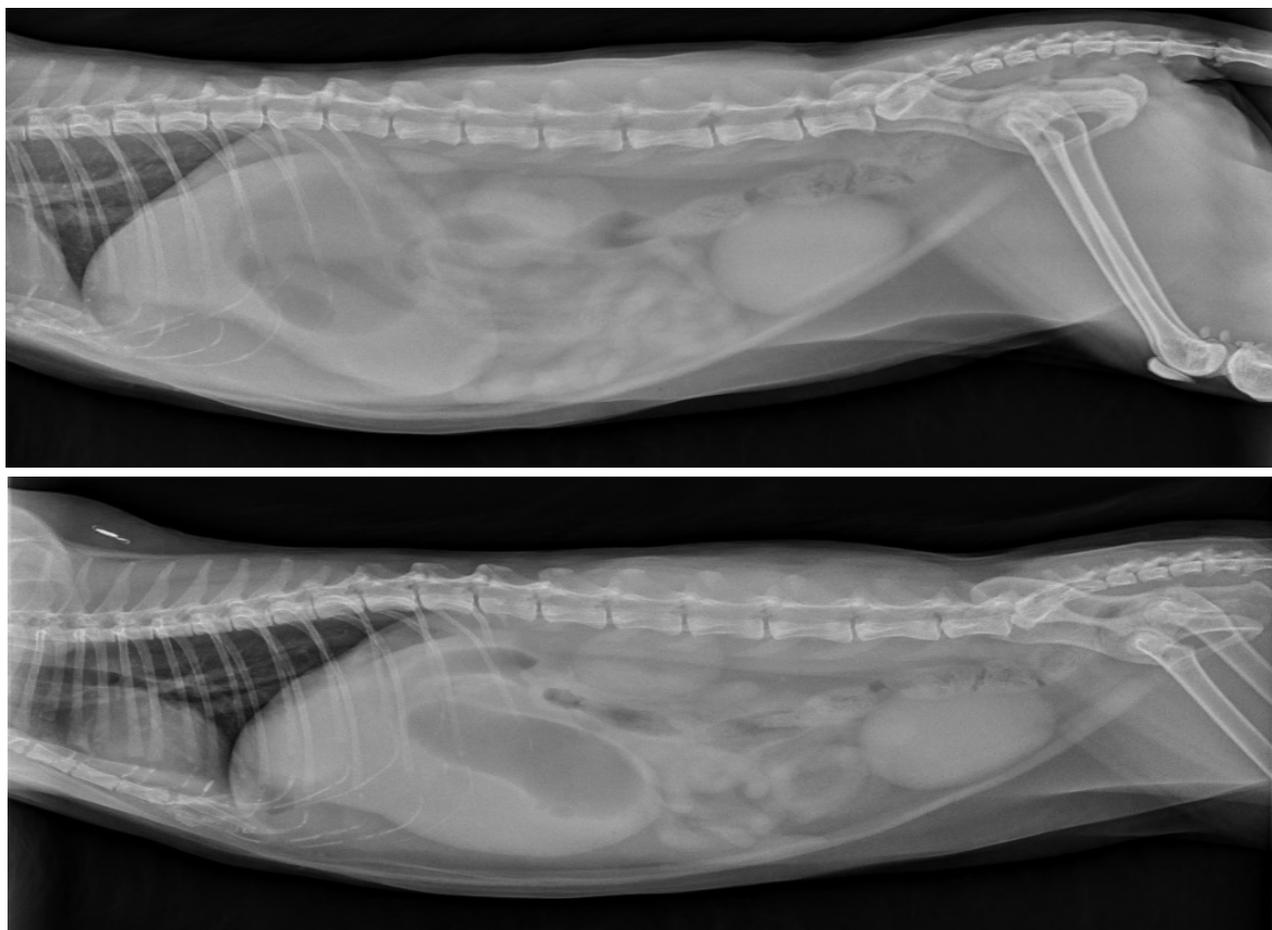
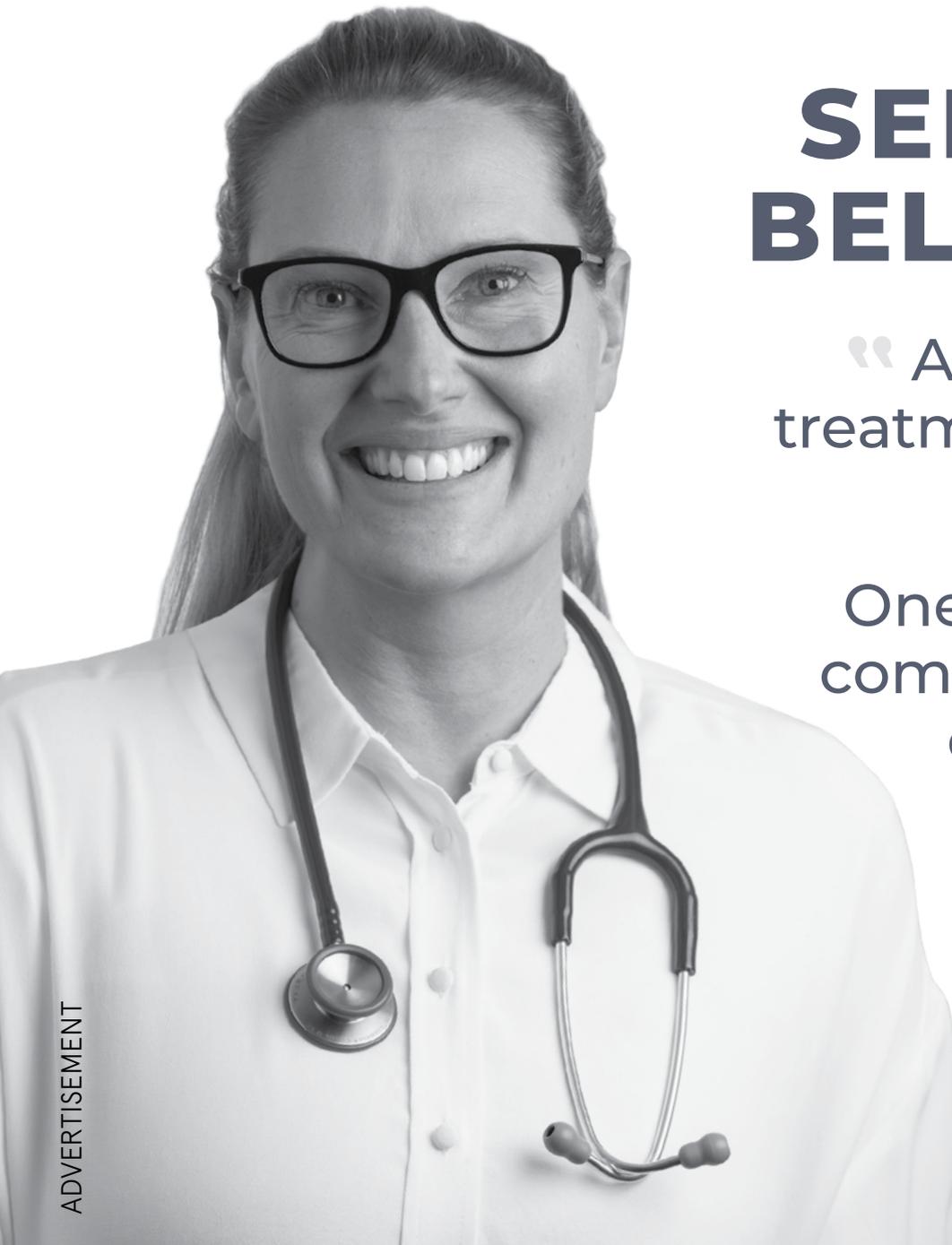


Figure 1: Lateral radiographs of the cat in the report



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DAY 28



**Reference:** 1. APVMA number 88412. 2. De Ridder, T., Campbell, J., Burke-Schwarz, C., et al. Randomized controlled clinical study evaluating the efficacy and safety of intratumoral treatment of canine mast cell tumors with tigilanol tiglate (EBC-46). *J Vet Intern Med* 2021;35(1):415-429

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# Clinical case; 12-year-old crossbreed

## Signalment

Breed: Crossbreed  
Age: 12 yrs, 3 mths  
Weight: 37.3 kg



## Treatment

Tumour volume: 2.7 cm<sup>3</sup>  
Tumour size: 1 cm x 3 cm x 1.8 cm  
Calculated dose: 1.4 mL (0.038 mg/kg)



## Tumour location

Cutaneous, non-metastatic MCT on thigh



Complete response achieved with one treatment



Day 0

MCT on the right hind thigh



Day 1

Mild inflammation on shaved area around tumour site



Day 7

Non-pitting oedema around wound  
Haemoserous exudate



Day 28

Full wound resolution



Day 42

No tumour evident at treatment site



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a gastric outflow obstruction and placed the ultrasound probe on the abdomen to look for the cause. During this handling, Eliza had been placed in many positions and started to show signs of discomfort. I placed her back on her feet, decided to re-palpate the abdomen, and she immediately projectile vomited a large amount of bile-stained fluid.

On review of the radiographs, I saw what I hadn't registered initially: the abnormal positioning of her stomach. I unfortunately didn't repeat them post-vomit because this clearly was a surgical case, but it would have been an interesting exercise. It was the first time I'd had what looked like a GDV in a cat! I'm still grateful for the fact that with all the turning her over for imaging we may have decreased the degree of torsion. She was then able to evacuate fluid which might have caused aspiration pneumonia when placed in dorsal recumbency for surgery.

Indeed, after an uneventful anaesthetic induction, preparation, and midline incision I found the

stomach in a completely normal position, no longer full of fluid, and with no foreign body palpable in its antrum and fundus. Examining the rest of the gastrointestinal track from the distal duodenum to the descending colon with no abnormalities, I then returned to the pyloric area and proximal duodenum, which is where the problem was: a foreign body in the very proximal duodenum. On enterotomy, a severely matted fur ball was removed. I tried to cut it later and it was as dense as felted fabric. The rest of the surgery was routine, and no intestinal pathology was noted.

To date she seems to have made a full recovery. Gas in the stomach of cats is rare and should make us consider an obstruction. The 'vomiting when picked up' was likely vomiting or regurgitation after compression of a fluid-filled stomach. I discussed with the owner the possibility that she had been over grooming from stress, but I guess we'll never know why a 13-year-old long haired cat suddenly came to be in this situation.



Figure 3. Barium study radiographs of a normal cat for comparison.



Figure 4. Removing the hairball obstruction from the duodenum.



Figure 5. The offending trichobezoar

Small

# MINIMAL STRESS CAT ANAESTHETIC

**Pete Coleshaw**

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C&T No. 5934

I believe the most important part of anaesthetic safety is having a patient that is not excited on self-generated adrenaline. So how can we blood sample, cannulate, and intubate an anaesthesia patient with virtually no stress with just one single potentially painful needle-prick? Being a cat-only practice offers many advantages—and I am not sure our technique works in a noisy doggy environment. But if you can achieve this, here is perhaps a different way of working, for your consideration.

## Starting at the owner's home

The stress-assessment should start at home and be continued through to its hospital cage:

1. Give 50–100 mg gabapentin 2 hrs pre-journey if the patient is a car-stressed cat.
2. Avoid all contact with dogs, visual, vocal, and olfactory throughout, as best your practice permits. (A chair in the corner of a busy mixed species waiting room does not count! Peace and calm must descend—humans too, so lowered voices, no shouting.)

## Venepuncture and blood tests

Do you really need to collect bloods before anaesthetising the patient?

*Personally, it is very rare that I would alter my approach to a G/A based on the blood results for a known stable patient that looks outwardly normal.*

Wait till the cat is sedated/asleep before venepuncture and then run tests immediately. Ditto insertion of an I/V cannula.

*Surely, cannulation is the most stressful of all the stages of an anaesthetic?*

Cats just hate having their forelegs forcibly restrained! I do not care how many times you have done it but no matter how efficient you are there will be some cats who resist this under mild premedication.

## Sedation

We favour domitor/butorphanol for the healthy young-middle-aged cats, swapping to midazolam/butorphanol for the potentially compromised/senior patients. For the freakier ones we add in a tiny dose of ketamine approx. 5 mg (0.05mL). Whilst I/M speeds up the process we find S/C injection in the 'scruff' entirely satisfactory with a little patience—it obviously needs a bit longer, but this reduces the discomfort factor even more.

1. Once the patient is well-sedated, we gently introduce a facemask. This is a clear, soft, silicon model, allowing the cat to see, reducing any panic.
2. Starting with pure 100% oxygen, Isoflurane is introduced and increased by 0.5% steps once 4 nice breaths occur at each concentration. If any breath-holding or shallow-breathing occurs, hold at this dose till proper breathing resumes. This usually takes the form of big, determined breaths allowing the concentration to be notched up quite rapidly.
3. Complete calm is needed at this stage—no loud talking or banging doors.
4. After a short period on 5% isoflurane, routine laryngeal spraying with lignocaine and intubation can normally be achieved without further intervention.
5. For the cat that will not go to sleep we then add propofol to effect (usually 0.5–1mL for a 4kg cat) via a 25g needle carefully inserted distally into the cephalic vein. Squeeze tightly on withdrawal and you still have an un-spoilt vein higher up for cannulation.

Once anaesthetised go ahead and catheterise, phlebotomise, and proceed. I much prefer a wee nick in the skin with a new size 15 scalpel blade prior to inserting my catheter, pulling the skin laterally and incising to the side of the vein. It makes the whole process so much more precise and saves a lot of wasted plastic.

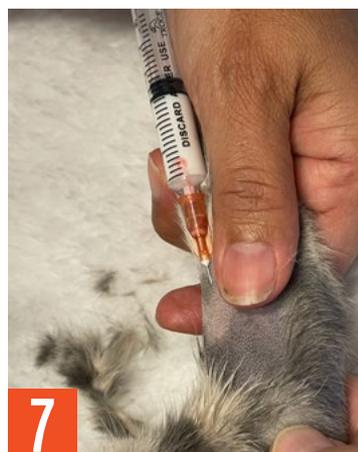
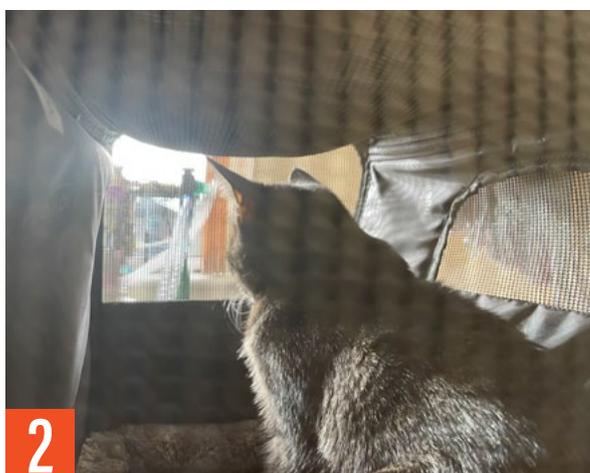
## For our neuters we adopt a similar approach

Subcutaneous domitor/butorphanol, mask down with isoflurane, no intubation, and Atipam to recover. There is never a problem with intubation and laryngospasm! Suction, a laryngeal lignocaine spray and a cuffed tube and laryngoscope are always close to hand. The only problem we ever had was a kitten that decided to go into pulmonary oedema on recovery with frothy blood spewing from his lungs. Had the suction been in the cupboard I am sure we would have lost him.

So, for neuters the G/A bit is easy, and recovery quick. This means lots of de-sexing can be done in a short space of time. So why not de-stress your feline workload even more by doing castrate-while-you-wait. Or spay with no delay? Instead of programming all your admittances for early doors you can schedule them in at an allotted time, do the job immediately, and ship them home within the hour. Clients who have to travel will appreciate it, the cats spend a minimum time with you (in what may be a less-than-optimal environment) and it frees up valuable cage-space. It's not for every client and every cat on every occasion for sure—and maybe you guys do it anyway—but it's certainly not the norm in Blighty.



Figure 1. Chilled  
 Figure 2. Room with a view  
 Figure 3. The most stressful part  
 Figure 4. Sedation starting to work  
 Figure 5. Applying mask  
 Figure 6. Nil stimulus  
 Figure 7. Propofol top-up (not required for this cat)  
 Figure 8. Suction on standby

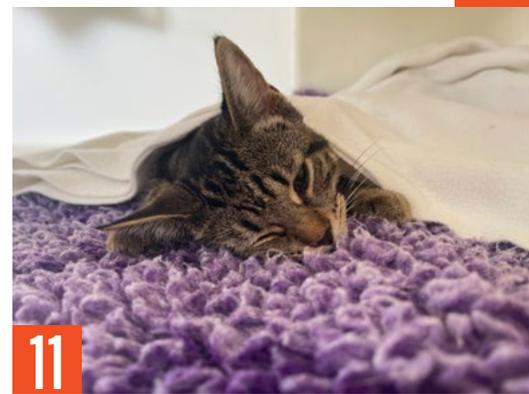




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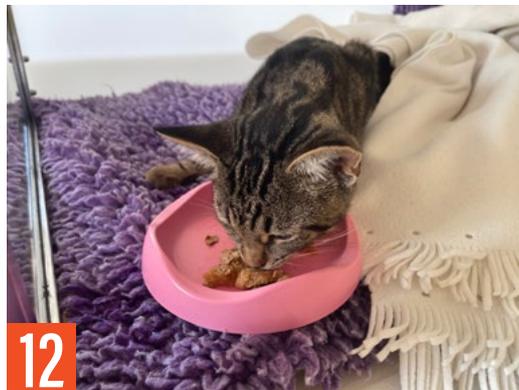


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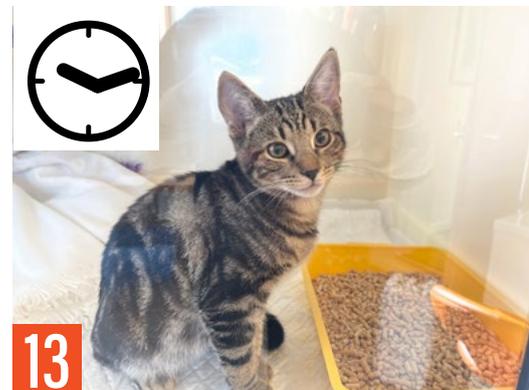


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Figure 9. Upping isoflurane  
 Figure 10. Reversing sedation  
 Figure 11. In recovery  
 Figure 12. Breakfast  
 Figure 13. Take me home



12



13

## CALL FOR CASES – FELINE INJECTION SITE SARCOMA

Dear Colleague

A group of researchers including Dr Mark Westman (EMAI), Professor Jacqui Norris (Sydney School of Veterinary Science) and Richard Malik (Centre for Veterinary Education) are progressing a project funded by the Australian Companion Animal Health Foundation from the Australian Veterinary Association.

### Purpose to determine:

- The prevalence of injection site sarcomas (ISS) in Australian cats, and
- If there is a link between ISS and particular vaccines or drugs injected into the scruff (or other sites); and
- If, and why, ISS cases are anecdotally less common in Australia

### Like to be involved?

If so, we require the patient details of animals with this diagnosis in order to tease out the underlying epidemiology.



Figure 1: Injection site sarcoma in a cat

All information will remain confidential.

Please e-mail the following to the lead researcher, Dr Mark Westman at [mark.westman@sydney.edu.au](mailto:mark.westman@sydney.edu.au)

1. The patient's medical record
2. OR List the vaccination history of the cat and document any other drugs given near the ISS
3. Provide details of the histology report from the pathology laboratory
4. Provide the age, breed and sex of the cat and whether it has a microchip
5. Advise if you vaccinate cats into the subcutaneous cervical region (scruff), or other sites used more commonly now in the USA, such as the distal

Thank You

Yours sincerely

**Mark Westman** BVSc PhD MANZCVS



Figure 2: CT of an ISS (arrow) in a cat

Entitled to a CVE\$100 voucher

**Small**

# RESTRICTIVE HARNESES: RESTRICTING MORE THAN A DOG'S PULLING ABILITY

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C&T No. 5935



Figure 1. An example of a restrictive harness, correctly fitted, but still a problem for the dog

I am developing major concerns about the increased popularity of restrictive leading harnesses—the one that has a solid band horizontally across the front of the chest and anterior shoulder joint.

Yes, these harnesses do work as described, the dog can't pull the owner along as easily on a walk, but at what cost to the proper skeletal development and function of the dog?

I truly believe no actively growing puppy dog should ever wear this restrictive style of harness; due in no small part to its potential to place abnormal negative forces on growing bones and joints.

If an owner has to use a restrictive harness on an adult dog, then seriously consider counselling them to either consider group training classes or private one-on-one dog training sessions, so as to train their dog to walk normally on a lead or Y-harness.

*Next time you see or indeed fit a dog with one of these restrictive body harness—watch the dog from side-on, to see how they move in this device.*

You don't have to be a vet to realise the dog is being effectively hobbled...

The dogs are unable to fully extend their shoulders and elbows out into a normal stride gait.

Additionally, the dog's neck is held higher and the head more rigid than when fitted on a Y shaped old-style harness.

The pet's neck appears to bob up and down more around the C6-C7 articulation.

C6-C7 is not a good anatomical place to place abnormal wear-n-tear on in general, but especially not wise at all in puppies and in larger breed dogs.

Often the tail is held down tight into the body, perhaps in order to counterbalance the higher and extended head position at the other end?

The toes are often over-extended and end up splayed-out to provide balance. As a result, the side toes, usually the non-major weight bearing toes are now weight-bearing. Given that canine skin is 1/20th the thickness of human skin, even the slightest sustained off-balance wear can trigger an issue—a friction pressure that might not even be detected on a pressure plate reading.



Figure 2. UK Rehab Specialist centre video showing imaging of the gait issues

Members view the video here: [cve.edu.au/c-and-t-ebook](http://cve.edu.au/c-and-t-ebook)

We began to see the appearance of disease and odd deformity of the pad and web skin disease that kept relapsing, until we realised that these were the result of abnormal stance and contact. Any dog with horseshoe shaped pad lesions induced by inappropriate weight-bearing needs to have the manner and method of how they are walked investigated. Not all of these pad lesions will be caused by the wrong harness but many will be. Thanks to Dr David Robson and Dr Milagros Rosales for sharing their images of aberrant weight-bearing lesions on their patients.

The Restrictive harness allows owners to walk their dogs farther and for longer as it is now easier on the owner, but harder on the poor hobbled creature walking beside them.



Figure 3. Photo courtesy of David Robson



Figure 4. Photo courtesy of Dr Milagros Rosales

This means the dogs are now walked for longer and on different terrains resulting in a perfect storm for lesions to occur due to increased contact and increased exposure to different surfaces.

In addition to the pressure sores on the ventral aspect, we see interdigital cysts between the lateral and adjacent toe.

The lateral toe itself is often very swollen. If you don't make the connection—as we didn't initially, the dogs may go on to present with an unusual run of broken/avulsed toenails, first on one foot, then another foot. These nails are trauma shattered or avulsed in a very different manner to SLOD (Symmetrical Lupoid Onychodystrophy) nails.

Perhaps these broken nails are just more of the collateral damage of altered forces wherein the main weight bearing legs (the 2 front ones) that take 66% of the weight bearing load in a non-obese pet—these front legs can't get the full range of

movement through the joint, so the back legs start to incur abnormal forces as well.

There is no 'popping the hood' appearance of the nail as in SLOD. (C&T No. 5117) The nail itself is not diseased as in SLOD. Often the nail beds in the harness injuries are swollen and painful in a way you don't see in SLOD.

## Prevention

### Y-shaped harnesses are our preference

Initially, in some dogs, these harnesses may temporarily restrict the range of joint movement, often simply because the dog has to get used to the odd feel of walking on any harness. However, should the dog really need to fully extend its front limbs for whatever reason, on a corrected fitted Y-harness, it can do so.

The head, neck, toe and tail gait on a Y-harness more closely resemble that of a normal walking gait.

The Y-harness must have the front band neat and snug against the sternum and neck. It must not hang down loose over the shoulders otherwise this loose, low-slung position will act as a defacto restrictive harness.

It is better to have an open-and-clip adjustable close set-up on the harness, rather than a fixed frame that fits over the head.

The larger fixed frame harnesses often sit too low down on the shoulders and are often over-heavy, especially for the smaller breeds. We prefer the softer, light seat-belt material type of Y-harness than these heavier solid, almost saddle-like versions, that dogs often present wearing.





Figure 5. Tyson wearing a correctly fitting Y shaped harness. The point of the lead is at the centre of gravity—which sits mid shoulder so the pull is from there the strongest part of the body—not encircling the neck nor trapping the shoulder, nor focused on the anticlinal vertebrae—the latter area I would not like to have pressure on in any dog, regardless of its I.V.D.D risk

## Conclusion

Since choker-chains fell out of favour, we have forgotten the impact that the wrong restraint can have on our canine patients.

So, when presented with a dog with a musculoskeletal issue—especially of the neck and front legs and /or with dermatological conditions of the paws and digits—first stand back and look at what restraint the owner is using on the animal.

Equally, if a chronic patient is not responding to therapy the way you expect or keeps relapsing—i.e. the Laser sessions or drug therapies are not working like you would normally expect, where the dermatological conditions on paws and axilla improve then relapse, best to stand back and assess the how and the way this dog is exercised.

## Plan B

### What happens if no safe body harness works for your pet?

If the dog still plays up on a more traditional harness, my personal preference is to use a Halti. I have used Haltis for over 30 years and just can't fault them.

I first used one on the canine love of my life, a Rescue German Shepherd (GSD). Walking a manic dog not far off one's own body weight is an exercise in logistics and tendon damage limitation. I had to wear spiked football boots so that I didn't become

airborne in the grass park whilst walking him. In desperation, I placed him for 3 weeks in a boarding training kennels at a cost of several thousand UK pounds—the same training establishment that could make even the most recalcitrant Pitbull walk on a lead calmly under any condition.

Having watched my GSD complete his training with flying colours, I stopped on the way home in a lovely park with a river. 10 seconds after fitting his lead to his collar, he and I were in the river; much to his joy and my consternation—being Irish, swimming at any time is not my forte and not in a cold English swampy river.

I hung on, we clambered back out. I marched into the local pet shop, purchased a £13 Halti and we never looked back. Walks went from stress and pulling and worry to be a dream where the slightest finger pressure check and I was back in control of the situation. I still have that same 33 yr. old Halti to this day.

You do have to give the dog time to adjust to the device. I recommend 5 min sessions in the backyard first with lots of treats and pats. When walking, the lead has to be slack, almost held by fingertip pressure, so that the any correction is felt fast.

Too often I see people walk their dogs on a Halti with a tightly held taut lead—that is not how this device works. I have been seen walking around the streets of my clinic with a myriad of dogs with walking issues whose issues disappear within 100metres of our front door. Success is determined by a properly fitted Halti and a correctly held lead.

Once the owners see you walk their manic dog on virtually a one finger hold with dropped shoulders and a straight back—they get why they were failing the device and their dog.

We are so passionate about getting it right that we offer a free service to fit the Halti to the pet properly Day 1.



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Small

# STEREOTACTIC BODY RADIATION THERAPY OF A NASAL PLANUM SQUAMOUS CELL CARCINOMA ON A CAT

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A 13-year-old, female spayed domestic short-haired cat was presented to the primary care vet for a small, red ulcerative lesion in January 2018. An excisional biopsy involving a partial nasal planectomy was performed early February 2018 and histopathology confirmed an actinic squamous cell carcinoma (SCC) with incomplete margins.



Figure 1: 13-year-old cat with aggressive nasal planum SCC.

The patient was represented to the vet the following month for recurrent disease at the surgical site. Due to the extent of the lesion, repeat surgery was not recommended, and the patient was referred to the oncology service of a specialist practice. Here, thoracic radiographs and cytology

of the regional lymph nodes were performed and were negative for metastatic disease. The lesion was treated with stereotactic body radiation therapy, consisting of 3 fractions of 9 Gy to total 27 Gy. The tumour volume had substantially reduced after one week and there was no evidence of disease at examination, six weeks post completion of therapy. The patient lived another 2.5 years and was very recently euthanised for a comorbidity unrelated to the neoplasia.



Figure 2. 6 weeks post treatment. The defect in the nasal planum is secondary to the nasal planectomy that had been performed prior to radiation therapy

SCC of the nasal planum is a common malignancy seen in Australian cats. It is a malignant neoplasia arising from epidermal cells with differentiation to keratinocytes. Most are thought to occur after an ultraviolet (UV)-B-induced keratosis or carcinoma *in situ* undergoes malignant transformation. Cats with light-coloured coats are overrepresented. Solar-induced SCC lesions can also arise on any sparsely haired, non-pigmented areas such as the pinnae, palpebra and temporal areas. These lesions can be locally aggressive, but uncommonly metastasise, generally late in the course of disease, with the most common sites of metastasis being the regional lymph nodes.

Early SCC lesions appear as erythematous craters or scabs and are often initially mistaken for a non-healing cat scratch by the owner. Due to field cancerisation, in which large areas of skin are chronically exposed to a carcinogen such as UV-B, it is not uncommon for numerous lesions to be present with a spectrum of histologic changes, ranging from actinic dysplasia to invasive carcinoma. Diagnosis is best performed by punch,

excisional or incisional biopsy. Multiple samples are recommended to increase the likelihood of an aggressive lesion being identified. Classification is based on the World Health Organisation staging system for feline skin tumours, with Tis and T1 defined as small (<2 cm in diameter) and superficial lesions, T2 defined as small (2–5 cm in diameter) lesions showing minimal invasion of deeper tissues, and T3–T4 defined as larger tumours (>5 cm in diameter) invading the subcutis and deeper tissue.<sup>1</sup>

Given the low propensity for metastasis, treatment of facial SCCs in the cat has been primarily directed at local disease control. Surgical excision has been the best characterised treatment for feline nasal planum SCC, from which long-term control or curative outcomes are achievable. It is recommended that the lesion be removed with a minimum lateral margin of 4 to 5 mm and one fascial plane deep,<sup>2</sup> which often necessitates a nasal planectomy, with or without a rostral maxillectomy.<sup>3</sup> A local advancement flap technique has recently been described to improve post-surgical cosmetic appearance, avoid stenosis of the nares, and reduce the incidence of chronic rhinitis secondary to exposure of the nasal conchae.<sup>4</sup>

Recurrence is still feasible following even aggressive surgery. Adjuvant (post-surgical) external beam radiation therapy (RT), or even RT as a primary treatment can be effective in controlling nasal planum in cats, although results have been disappointing in dogs. Strontium-90 plesiotherapy, a form of brachytherapy in which radioactive strontium Sr 90 (90Sr) is directly applied to the surface of a lesion, has been demonstrated to result in long term control of early, superficial lesions.<sup>5,6</sup>

In conventional RT, radiation is administered from a source that is distant from the patient over a large number (for example, twenty) of treatments with a small radiation dose each treatment (for example, 2 Gy) and may be suitable for more deep-seated lesions. With the advent of highly precise radiation delivery systems and superior imaging technologies that allow the positioning of patients to the nearest millimetre, stereotactic body radiation therapy (SBRT) has enabled larger doses of radiation to be administered per treatment, whilst greatly reducing the number of treatments. In a recently published pilot study of five cats undergoing SBRT for facial SCC, all cats were alive after a median follow up period of 459 days and all but one cat had no evidence of disease. The remaining cat developed a small recurrent lesion which was successfully excised surgically.<sup>7</sup>

Systemic chemotherapy agents, such as cisplatin and bleomycin, have been administered to cats with advanced stage disease, generally with underwhelming results. However, they can be administered locally together with short, high-voltage electric pulses to enhance permeability of the drugs through the tumour cell membrane to induce cell death. This treatment modality, known as electrochemotherapy, has shown promise as a safe and effective treatment option for lower stage lesions.<sup>8–10</sup>

To date, no randomised control trials have been published to compare the efficacy of nasal planectomy, conventional RT, SBRT or electrochemotherapy. The aforementioned treatment modalities are currently available across Australia, in select referral hospitals. Other reported strategies aimed at local control include cryotherapy, photodynamic therapy<sup>11</sup> and curettage with diathermy.<sup>12</sup> Topical imiquimod, a topical immune response modifier and stimulator, has been reported for treatment of superficial lesions.<sup>13</sup> Finally, cyclooxygenase-2 (COX-2) has been identified immunohistochemically in feline cutaneous SCC<sup>14</sup> and COX-2 inhibitors may have an anti-neoplastic role to play in the treatment of feline nasal-planum SCC, in addition to analgesia.

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## Small

# PLATELET RICH PLASMA INJECTIONS FOR TREATMENT OF OSTEOARTHRITIS IN CATS

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## Introduction

Osteoarthritis (Degenerative joint disease) is a major cause of chronic pain and reduced mobility in cats. Symptomatic osteoarthritis has been noted in cats beginning before the age of 1-year-old and has been estimated to affect over 70% of cats by the time they reach middle age. Many perceived behavioural problems in older cats are related to the pain they have due to joint disease. In many cases, problems with poor litter box use or night vocalization due to pain from osteoarthritis cause owners to opt for euthanasia.

Traditional treatments for arthritis have focused on pain alleviation and possible improvement of joint function, but offer only minor relief from pain and often require daily administration of medication by mouth or up to weekly injections, which lowers the quality of life for both the cat and the owner.

In our practice, we have begun to use regenerative types of treatments for arthritis that actually repair the joint.

The two modalities available at this time are autologous stem cell treatment and platelet rich

plasma (PRP) treatment. Stem cell collection by surgical collection of fat and culture can be quite expensive and is highly invasive. Some cats that have foamy virus also do not have stem cells that can be cultured because of the infection. Platelet rich plasma treatment, on the other hand, is relatively inexpensive, easy and very low risk. While the repair is not permanent if the original cause of the arthritis is still present, the relief is marked and long lasting enough to justify the expense.

It is expected that most cats with early arthritis will have at least 1 to 2 years of relief from a single treatment based on anecdotal evidence. PRP or platelet rich fibrin are useful in all wound healing, however, in cats most wound healing is very rapid so its use may not be needed very often.

## Use and Mechanism of Platelet Rich Plasma

A great deal of research has been done with PRP in humans, horses and dogs, but little has been done in cats. What has been done has shown good response and some kits for collection have been validated for use in cats. Our practice is currently starting work on a preliminary case study series of platelet rich plasma treatment in cats using client observed improvement (CSOM, FMPI) scales validated by Duncan Lascelles *et al* at North Carolina State University, as there is little in the literature that focuses on felines. With platelet rich plasma treatment, risk is very low with the only major risks being sedation/anesthesia and that associated with injection into the joint space.

PRP treatment functions takes advantage of growth factors and adhesive proteins to promote healing and regeneration of damaged tissues in the joint using the body's natural healing mechanisms. High concentrations of platelets accelerates local healing of both bone and soft tissue. The major growth factors secreted by activated platelets are platelet derived growth factor beta, vascular endothelial growth factor and epithelial growth factor as well as fibrin, fibronectin and vitronectin. The growth factors cause target cells to initiate activity which speeds healing and attracts and activates stem cells as well as increasing production of hyaluronic acid, while the proteins increase adherence to the damaged joint surfaces.

## Method

The method is quite straightforward. We use a kit that requires only a single spin to reduce the chances of contamination and the cost to the client. Many kits require removing the platelet rich portion of the plasma, then spinning that down to a pellet and re-suspending the pellet to inject the

resulting platelet rich product. While the later kits have a more controlled amount of platelets per mL, the optimum platelet concentration is not yet known, so we have opted for the more cost and time effective approach.

1. Collect 10 to 20 mL whole blood with sodium citrate anticoagulant (supplied with the kit we use). We anesthetize the cat to draw blood and monitor blood pressure and vitals closely during collection. (Figure 1) Care must be taken to be aware of how much blood can be safely harvested considering the cat's size, hydration status and PCV. IV fluids should be given to help offset the loss of blood volume. Healthy 4.5 kg cats can safely donate up to 60 mL of blood for use in transfusion, so most cats will have no problem with a 20 mL sample.
2. After thoroughly mixing anticoagulant, transfer blood to tubes for centrifugation at the recommended G-force. (Figure 2) The



Figure 1. Collecting blood from the jugular vein using a 23-gauge butterfly needle.

company supplying kits gives a calculator to determine what RPM is needed for your tabletop centrifuge. For our practice and kit, we use 500 G which translates to 2260 rpm for our rotor size. We use a fixed angle rotor; however, a swinging bucket is also acceptable. Rotors must not be stopped with any braking to avoid remixing of the tube contents. (Figure 3)

3. While the blood is being centrifuged, supplemental heat is provided to the patient and the joints that have been selected for treatment are prepped for aseptic injection.
4. Once the blood is fractionated, the platelet rich portion is drawn off carefully with a spinal needle and 3 to 5 mL syringe. (Figure



Figure 3. Centrifuging the blood after collection.

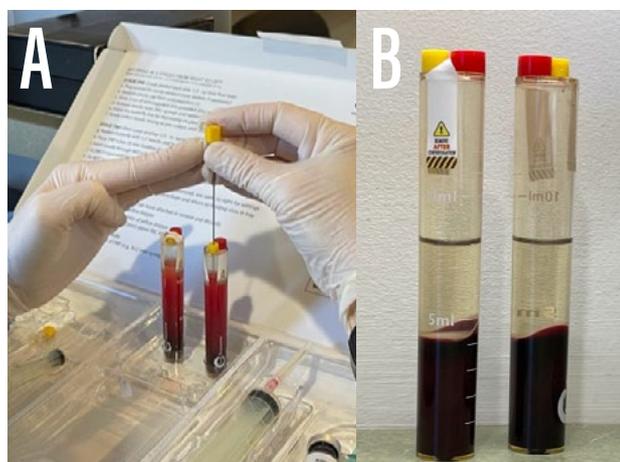


Figure 4 (A.) This photo is an example of what happens if the tubes are not handled with great care. Notice the mixing of RBCs with the plasma. (B) Appearance of tubes after collection of PRP fraction.



Figure 2 A & B. Kit contents



Figure 5. Hip joint injection



Figure 6. Stifle injection caudal to the distal edge of the patella



Figure 7. Tarsus injection

- 4) The needle is placed about 3mm above the red blood cell interface and the sample of about 1.5 to 3 mL per 10 mL of blood.
5. The needle on the syringe is then changed to one appropriate for injection into the selected joint spaces. In cats the most affected joints are elbow, carpus, hip and hock. Care must be taken to avoid damaging articular cartilage when placing the needle and during injection. The optimum amount to inject is not known at this time, however, I generally inject until I can see the joint capsule distend or feel resistance to injection increase. If the PRP is used judiciously, up to 8 joints can be injected from a single collection. (Figures 5,6,7) Joint injection aids are available on many websites.
6. Pre and post treatment pain control are important. Due to pain wind up and pain pathway establishment in arthritis patients, joint injections are quite painful and several days of high-level pain control are needed. In our practice we use long-acting buprenorphine or fentanyl patches placed in the axilla for pain control.

### What to Expect

After treatment, gradual improvement is seen over the next 3 to 4 weeks as the joint regenerates. Some studies have shown continued improvement in joints for as long as 6 months. In human medicine, multiple injections a few weeks apart are sometimes used and this may be a more effective approach for more severely affected joints. It appears that when joints are left to end-stage (time for a joint replacement), less can be expected from treatment and some of these patients will have no discernible improvement. I have had only one patient so far that has not had improvement noted by the client. This cat had severe bony changes and with the degree of bone remodeling present, gait abnormality and range of motion loss may make assessment by the client difficult.

One of the best outcomes of PRP treatment is the decrease in need for any other treatment. In cats that are difficult to give medications to or for clients that are unable to give medications, it offers a tremendous amount of relief from chronic arthritis pain.

I treated my own 15-year-old cat (Figure 8) about three months ago and the change was so profound that I feel very guilty for not having recognized the amount of pain he was in. The change after 2 weeks was so profound that I was simply amazed and I have been able to stop other treatments for degenerative joint disease. He went from climbing onto a 2-foot cloth covered piece of furniture with

great difficulty to jumping as much as 4 feet! He also began to play again and is no longer sleeping most of the day. His improvement plateaued after about 4 weeks and I am currently considering a second treatment as he is starting to sleep more. Considering that he is a foamy virus carrier and his age (stem cell activity reduces with age), the response is really quite shocking to me. I feel as though I have added another truly magical bullet to the treatment options I have available for addressing degenerative joint disease. I, personally, cannot recommend anything more highly.



Figure 8. Letrisa's cat Blondie, enjoying life after PRP treatment.

### Editor's comments:

Treatment of osteoarthritis (OA) in cats is an area that is rapidly changing. The same is true in human medicine. Platelet rich plasma has strong advocates, although the latest evidence in people (done at Royal Prince Alfred Hospital in the rheumatology department) was not supportive. Everyone is familiar with the use of pentosan (sometimes mixed with other things that are supposed to help cartilage) and NSAIDs like Onsiar and meloxicam. Galliprant is a new treatment from Elanco for dogs but is not approved in cats. Zoetis will soon be releasing a monoclonal antibody against Nerve Growth Factor to be given to cats every month, and this novel approach might prove very useful. Laser therapy is touted as a useful modality for dogs and cats with OA, and others advocate electromagnetic stimulation, while stem cell therapy can also be used to manage this disease. So, there is a lot happening in this space, which can make decision making complicated. One should not forget that weight reduction in obese cats and regular exercise can be helpful, as can providing aids to help cats avoid jumping up to or down from, their favorite places. And there is a lot of interest in rehabilitation and physiotherapy in companion animals at the moment. It will be interesting to see which of these new treatments gets traction over the next decade.



### Major Winner Bio

Joe is an English born veterinarian that moved to Sydney to complete his university studies. Joe graduated in 2017 and has since worked in both clinical practice and "human" medical research.

Joe currently works at the Small Animal Specialist Hospital, however, he will soon be moving back to the UK to complete a veterinary cardiology-training program.

Once Joe has completed his Cardiology training program he plans to come back to Australia, where he hopes to live out the rest of his career without ever having to sit another exam again!

The prize is a CVE\$400 voucher

Avian

# USE OF INTRALIPID TO PREVENT MYOCARDIAL NECROSIS POST PERSIN TOXICITY IN AN INDIAN RING NECK

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## Abstract

Avocado ingestion by birds is a severe and possibly life-threatening toxicity. When a toxic dose is ingested, it is often challenging to perform successful decontamination, and once the toxin is absorbed, there is no known antidote or cure for persin toxicity.

In the case presented here, intralipid therapy was used in the attempt to sequester the persin toxin and prevent myocardial necrosis in a 1-year-old female entire Indian Ringneck Parakeet (*Psittacula krameri*), which had been fed >10–15g of Hass Avocado (*Persea Americana*).

On initial physical examination, the patient had a reduced ability to perch, lethargy, and drooping of the neck. Crop lavage was of low yield, and charcoal was administered before gaining IV access and administering intralipid. Throughout the hospitalisation period, the ringneck developed an arrhythmia and dyspnoea. The dyspnoea resolved with diuretic therapy, and the arrhythmia resolved within 48 hours of intralipid administration, with discharge occurring on the 5th-day post avocado ingestion.

## Clinical case

A one-year-old female entire Indian Ringneck Parakeet presented within 30–60 minutes of ingesting >10–15g of Hass Avocado pulp. On initial visual examination, the patient was dull, mildly ataxic, was not perching and appeared to be bowing at the neck. On physical examination, the perching reflex was reduced, the patient was mentally dull and ataxic. On further examination,

the heart sounds were normal, regular with a rate >300bpm. Air sac auscultation was unremarkable, and the respiratory rate was 52bpm. The rest of the examination was unremarkable.

Due to the potentially significant dose of persin ingestion and the risk of myocardial necrosis, a crop lavage was performed within 90 minutes of ingestion. The crop lavage produced a small volume of white/yellow material mixed with the instilled water. Subsequently, 1g/kg of activated charcoal was instilled using a crop needle.

Subsequently, the patient was sedated using butorphanol 0.2mg/kg and midazolam 2mg/kg intramuscular (I.M.) injection. While sedated, the feathers were removed from the axillary region and the skin was aseptically prepared. A 26g intravenous catheter was placed within the brachial vein and sutured in place with 4-0 nylon suture.

Intralipid 20%, 2.5mL/kg bolus was initially given over one minute, followed by a C.R.I. running at 0.025mg/kg/min for 6.5h.<sup>1</sup> Concurrently, plasmalyte crystalloid IV fluid was started at a 25mL/kg/day rate, which was increased to 75mL/kg/day once the intralipid was discontinued. The patient was placed in a Brinsea TLC-50 incubator in I.C.U. and monitored actively throughout the treatment period.

The patient's mentation did not improve overnight, and the clinical condition remained static. Later the subsequent day, the patient remained dull and increased respiratory effort and rate were noted. The veterinarian on duty auscultated an arrhythmia and found one vomit/regurgitation in the bedding. Frusemide at 4mg/kg P.O. was given as a one-off dose, improving respiratory effort and rate. Intravenous fluids were discontinued with subcutaneous plasmalyte to be given q12h to maintain 50mL/kg/day fluid requirement.

The patient's demeanor improved throughout the second day, and a further dose of activated charcoal 1g/kg mixed with Emeraid® omnivore 2mL was given via crop needle.

The patient's mentation deteriorated on the second night, and on the morning of day 3, the parakeet was again depressed, with a small amount of vomitus dried onto the skin around the nares. Mild green staining around the vent was noted, and the urates were green-tinged. Tachypnoea with mild increased respiratory effort and harsh lung sounds were again recorded. Cardiac auscultation revealed muffled heart sounds with an H.R.>300bpm. TFAST was performed, which showed no pericardial effusion and no pleural

effusion. Frusemide 1 mg/kg q8h P.O. was started in addition to Silybin 50mg/kg q12h P.O.

Bloods to determine if there were hepatic abnormalities were not performed as there was a mild amount of bleeding during catheter removal, and blood draw for liver enzyme testing was deemed of high risk at this stage in time.

Mentation improved significantly on day 4, with demeanor characterized as bright, alert, and responsive. The patient started eating independently, and respiratory effort and sounds were normal. Cardiovascular examination was unremarkable. Frusemide was discontinued, and the patient was kept in for a further 24 hours of monitoring.

Discharge occurred on day 5 with no evidence of cardio-respiratory disease. The patient was discharged with Silybin 50mg/kg P.O. B.I.D. for seven days, and on a phone call recheck on day 10, the patient was described as bright and as her usual self by the owner.

## Discussion

Persin, a larvicidal and antifungal alkanol, is found in the stems, fruit, pip, leaves and skin of the avocado plant, with the Guatemalan strains (such as Hass avocados) being the most toxic.<sup>2, 3</sup> Despite all parts of the plant containing persin, the toxin concentration varies depending on which part of the fruit or plant is eaten (Table 1), with the pulp containing the highest toxin concentration.<sup>2, 4-7</sup> Prospective studies on rabbits fed 150g of avocado leaves showed that those who ate the Fuerte variety died within 12h. On the other hand, rabbits fed leaves from Nabal varieties survived past 12h but succumbed within 24h, and those fed Mexicola varieties showed no ill effects.<sup>8</sup>

Plant matter (freshly harvested Guatemalan variety)	Persin concentration mg/g
Peel	0.6-1.4mg/g
Flesh	1.5-5.8mg/g
Leaves	<0.01-4.5mg/g

Table 1. Persin concentration in mg/g in the different parts of the avocado plant<sup>7, 13</sup>

**Avocado toxicity has been shown to cause sterile mastitis secondary to coagulopathic necrosis, interstitial oedema, and desquamation of the acinar epithelium in goats, cattle and mice with acute exposure to 60-100mg/kg persin.<sup>14, 15</sup> Goats and horses have also been shown to develop neck and brisket oedema at 60-100mg/kg.<sup>2, 3, 12, 15</sup> However, sheep exposed to either an acute dose of 100mg/kg or chronic doses of 2.5mg/kg over 32 days develop cardiac insufficiency in controlled experimental models.<sup>3, 8, 16</sup>**

Clinical signs in birds are less well defined, with reports suggesting that avian species are more severely affected and often die after short periods of dyspnoea, neck oedema, thigh and abdomen anasarca and cardiac insufficiency.<sup>2, 9, 10, 17</sup>

**One of the few designed experiments investigating the effects of persin in birds found that both New Hampshire Hens and Ostriches often developed cardiac insufficiency when they had access to avocado fruit or leaves.** On histological examination, it was noted that the myocardium was infiltrated with heterotrophils, there were areas of macrophage proliferation, karyopyknosis, and the myofibres exhibited marked granularity of the sarcoplasm.<sup>9</sup> **Chickens** fed avocado also developed hepatocellular vacuolation and hepatocyte congestion in the liver parenchyma.<sup>9</sup>

A second branch of the same study looked at 2½-month-old **ostriches**, which were fed different parts of the avocado plant (see Table 2). All birds developed listlessness and drooping of the neck two hours before death.<sup>9</sup> Severe anasarca of the neck was evident in the ostriches fed Hass leaves, with mortality occurring within 48 hours.<sup>9</sup> Ostriches fed Fuerte fruit also developed severe hydropericardium, and pericardial oedema was noted in the birds fed the Fuerte foliage.<sup>9</sup> All birds

Product fed	Number of ostriches
Hass foliage 30g/kg	1
Hass fruit 100g/kg	1
Fuerte foliage 75g/kg	1
Fuerte fruit 100g/kg	1
Water (controls)	2

Table 2. Ostrich number and avocado matter fed in the Anna et al (1994) study.<sup>8</sup>

**Case reports on persin toxicity in animals are scant, with very few peer-review prospective studies having investigated avocado toxicity in veterinary medicine. Thus far, persin toxicity has been reported in budgerigars, cockatiels, turkeys, chickens, sheep, ostriches, fish, guinea pigs, canaries, rats, rabbits, horses, goats, and cattle, with unconfirmed incidences in dogs.<sup>9-12</sup>**



Figure 1. Catheter in place.

developed cardiomyopathies, and histopathology showed hydropic degeneration to fragmentation and rhabdomyolysis of myocardial fibres.<sup>9</sup> As with the chickens, the myocytes of ostriches fed avocado plant matter had sarcoplasm with increased granularity, myofibrilolysis and eosinophil infiltration.<sup>9</sup> Heart histopathology cross-sectional examination also showed eosinophilic cytoplasm and pyknotic nuclei of the myofibres, with heterotrophil infiltration.<sup>9,18</sup> A similar finding of hydropericardium has also been seen in caged birds.<sup>10</sup>

Our patient ingested >10–15g of pulp, placing the consumed dose of persin between 18.5mg/kg and 107mg/kg, depending on the toxin concentration within that specific fruit.<sup>2, 4-7</sup>

Standard decontamination procedures (crop lavage and charcoal therapy) were administered; however, the owner was highly invested in this parakeet and wanted to try everything possible. With decontamination, the prognosis was still determined to be poor due to the potentially large dose of avocado ingested, and due to the dull presentation, bowing head and ataxia, which in many studies have been described as end-stage clinical signs antecedent to death.<sup>1, 8, 9, 15</sup> As a result, based on the chemical properties of the persin toxin, we suggested trialling intralipid therapy (I.L.T.), which the owner approved of despite being warned of the possible risks and off-label nature of the treatment.<sup>19</sup>

Intralipid, a soybean-oil fat emulsion, has been used in human medicine since the 1970s to treat life-threatening toxicosis caused by fat-soluble

toxins.<sup>20</sup> Due to the unknown aetiology of many toxicities in veterinary medicine, and the lack of easily accessible extracorporeal therapies, I.L.T. is often initiated earlier or when conventional therapies are unsuccessful.<sup>20</sup> The objective of I.L.T. therapy is to increase energy production, thus altering the kinetics of persin and creating a lipid sink that can sequester lipophilic toxins within the intravascular space.<sup>20</sup>

The lipophilicity of a chemical is based on its LogP value, where P is the partition coefficient of the toxin.<sup>19</sup> The partition coefficient is a measure of how soluble a compound is between a lipophilic (octanol) and a hydrophilic (water) solution. The higher the LogP, the more lipophilic a compound is, although the lipophilicity depends on the acidity of the contained solution.<sup>19</sup> As a result, LogD is often used in medical chemistry, where the D represents the partition coefficient of a chemical at physiological pH of 7.4, again with partition coefficients varying in states of acidemia or alkalosis.<sup>20, 21</sup> Persin with a LogP and D of 5.98 indicates that the toxin is ~955,000 times more soluble in the lipid phase than the aqueous one.<sup>19</sup>

**To the author's knowledge, the use of I.L.T. has not been used in Ring Necks before with one reported use of intralipid in a goose with suspected oleander toxicity.<sup>22</sup> Parakeets can consume soybeans without known side effects, and only a low dose C.R.I. was used out of concerns of hepatic lipid congestion, anaphylaxis and increased plasma oncotic pressure.<sup>20</sup>**

The patient tolerated I.V. intralipid therapy without issues at the time of administration. While in hospital, the patient did develop signs of acute cardiorespiratory disease; however, this did resolve with diuretic therapy before discharge, and these symptoms were not apparent on recheck. No reports exist that suggest persin toxicity is reversible or self-limiting, with mortality seen in all birds that developed myocardial necrosis.<sup>3, 4, 6, 8-10</sup> At this time, without histopathology, we cannot determine whether the signs were secondary to persin myocardial toxicity or by volume overload caused by the intralipid itself.<sup>8, 21</sup> An immune reaction towards the intralipid could cause an increase in pulmonary microvascular permeability resulting in non-cardiogenic pulmonary oedema; however, this would not have been responsive to frusemide therapy.<sup>23</sup>

Our patient did develop green urates, a common sign associated with liver disease in birds, although this remains unconfirmed due to the lack of blood work and imaging.<sup>9, 10</sup>

Limitations include the case number and our inability to determine whether the arrhythmia and the dyspnoea seen during hospitalization were due to the acute side effects of the persin toxin or secondary to iatrogenic causes.<sup>20, 21, 23</sup> Furthermore, the response of intra-lipid by other species of birds may vary significantly compared to what was seen in our case. **However, despite the limitations of this report, we now have early-stage evidence to suggest that Parakeets can tolerate low dose IV intralipid therapy.**

We hypothesize that intralipid can reduce the cardiotoxic risk profile of avocado ingestion based on the chemical analysis of persin. As a result, this report can be used as a base on which to build further studies in the use of intralipid on lipophilic toxins in birds, and it can provide the basis for justifying a prospective study that investigates the use of I.L.T. in avocado toxicity.

## Conflicts of interest

The author and owners of the patient involved have no conflicts of interest.

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Avocado toxicosis is widely reported but predominantly anecdotally. The toxic effect is well known, but usually presented as a cause of death. In fact, I have had many bird owners declare adamantly that avocado is not toxic. It is pleasing to see the author not only successfully treated the patient, but expands on the toxic principles of avocado, the differences between different types of avocado and plant parts, the course and clinical signs of the toxicosis, and then presents a novel treatment protocol (for birds) that warrants further investigation.

Perspective No. 154

# DEVELOPING A WELFARE SCIENCE-FOCUSED APPROACH TO CLINICAL PRACTICE

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In the 21st century, our patients should have better welfare than ever thanks to advances in veterinary medicine: our knowledge of disease, new and improved diagnostic tests, advanced imaging modalities and targeted treatments.

However, sometimes considerations and priorities seem to compete—practicalities, client finances, compliance, time management, employer pressures—the list goes on! The reality is that clinicians can become easily overwhelmed and struggle with decision-making for both sick animals, and requirements for preventative care. This may result in suboptimal welfare outcomes for our patients, but also leave us feeling disillusioned and dissatisfied with our jobs.

As the profession battles to retain veterinarians in clinical practice, there has never been a better time to refocus on the primary role of veterinarians and why most of us chose this vocation in the first place—to improve animal welfare. Parallel to advancements in veterinary medicine, there have also been advances in animal welfare science; to date, these two fields have not been merged as much as they should be. Yet, to optimise animal welfare outcomes in our patients, we need to understand how animal welfare can be scientifically assessed, and how we can use that to maintain our focus on animal welfare outcomes as our primary goal. This approach can empower veterinarians to have confidence in their case management and in turn get the ultimate job satisfaction!

## A 22-year circle from clinical practice to wild horses: an animal welfare science journey and back again

To introduce this topic, I will start by providing some background and context about the evolution of the ideas that I outline in this article. As a clinician, internal medicine and feline Specialist, I spent the first 16 years of my veterinary career in primary and referral companion animal practice,

both in academia and private practice. I loved my first 2 years in general practice, but I felt that we could do better for cats. At that time, I couldn't really pinpoint or articulate what we could do better or how; it was just a feeling that I needed to explore and discover how, as a profession, we could do better for cats. So, I went back to the University of Bristol, being fortunate to undertake feline Specialist training at the world-renowned Feline Centre with inspiring leaders in this growing field, which instilled in me a very holistic approach to feline medicine (Figure 1).

There was something unique and special about the feline speciality training at Bristol because it was more than feline internal medicine training. It was learning everything about the domestic cat; how they behaved and why; recognising behavioural signs of illness, pain, anxiety; how we could provide optimal environments for them both at home and in the clinic; the links between behaviour and disease; and the importance of the owner-cat bond, and how that influenced decision making and management plans to achieve successful outcomes. We always spent a long-time observing patients in the relaxed environment of our beautiful cat-only ward, picking up on subtle body language, facial expressions and behaviours. It was common for us to be jokingly mocked (or perhaps not always jokingly!) by our peers in other departments wondering what we were doing wasting so much time 'just hanging out in the ward with cats'!



Figure 1. Andrea (far left) as a feline resident 20 years ago with inspiring mentors Dr Sarah Caney and Prof Tim Gruffydd-Jones.

My position as a resident and later as a Lecturer was also funded by the Feline Advisory Bureau (FAB, now International Cat Care, which incorporates the International Society of Feline Medicine) which provided a strong component of broader interactions with cat owners, and educational initiatives with owners and veterinary professionals alike. To be a good feline internist being 'cat-crazy' came with the territory; everyone

knows that the best cat vets embrace that concept! This holistic approach amongst FAB and the Bristol feline team, led to heightened recognition of the importance of anxiety in feline patients, and the need to recognise and reduce this in veterinary practices. I was subsequently instrumental in developing with colleagues the 'Cat Friendly Clinic' initiative in 2005, now an ISFM international accreditation scheme that is celebrating its 10<sup>th</sup> anniversary this year (Figure 2).



Figure 2. 17 years ago, together with Bristol feline nurse, Suzanne Rudd, we travelled around the UK visiting vet clinics and assessing for the very first time 'Cat Friendly Clinics'.

Fast forward another 11 years; many exams, residency completion, more time in academia than private referral practice, experiencing the many developments in veterinary practice over that time, delivering a lot of post-graduate education, a move to Australia and launching the 'Cat Friendly Clinic' scheme over here, I found myself again having a vague feeling that we could still do better as a profession. Something was still missing that we could do better, but what was it? This time the feeling was wider-reaching; it wasn't just about feline medicine, it was a broader feeling that as a profession we should be having more input into bigger decisions that impact animals, their daily lives and their fates.

I was now living on a farm in rural NSW, giving me a closer connection to the land, rural life, and daily interactions with a much wider range of species. Big issues such as live export were very topical and there was a growing public awareness of welfare issues in animal sport industries such as greyhound and horse racing. I started getting more interested in the broader field of animal welfare science and decided to sit memberships in animal welfare. Alongside this, with horses having been a long-standing hobby, I had adopted 3 young 'brumbies' and in doing so became aware of the controversies in wild horse management, where it was distinctly evident that there was very little interest or involvement from the veterinary

profession in this area. Looking for a new challenge and being driven by visions of where I might be able to make a difference to the lives of animals, I ended up enrolling for a PhD in wild horse ecology and welfare science (Figure 3).

Fast forward another 6 years, and I have now completed my PhD having immersed myself in animal welfare science and wild horses during that time. I was so fortunate to have as an inspirational mentor and friend, David Mellor, one of the 'Godfathers' of the field of animal welfare science who developed 'The Five Domains Model' for assessing welfare. If at this point you are thinking 'I've never heard of this 'Five Domains Model', don't worry, because prior to 2014 when I started studying for welfare memberships, I hadn't either. Now, having spent 6 years working on this in the context of wild horses, and developing a framework for how the Model can be applied to free-roaming wild animals (Harvey *et al.* 2020), I reflect and puzzle about how on earth as a profession we don't all know about the concepts of animal welfare science and the Five Domains Model more widely, and why we aren't all incorporating this into our daily lives as veterinarians as it would be so useful!



Figure 3. From UK cat clinics to the Australian Alps: 6 years ago, transferring cat vet skills into a PhD developing protocols for assessing welfare in free-roaming wild horses

With my newfound knowledge of animal welfare science, I reflect on my 22 years as a veterinarian so far with new insights and clarity. This is what I've been searching for in 'how we can do better'. I realise that the reason I managed to become a good feline clinician was that in my training at Bristol we actually were incorporating the science of animal welfare, and that is what gave us the holistic approach that I described. However, we didn't explicitly recognise or define this at the time; we were doing it unknowingly, subconsciously or even haphazardly, but it was that approach that made us good feline vets.

Sadly, probably because it wasn't explicit and recognised, this approach seems to have been  
 Authors' views are not necessarily those of the CVE

progressively lost in how specialities have become organised. For example, in the UK the speciality of feline medicine was dropped because of the ECVIM 'equivalent' internal medicine speciality. The number of feline focused speciality training programs substantially reduced; mostly dogs and cats are combined into the speciality 'companion animal internal medicine'. However, looking through the lens of animal welfare science, this has both narrowed the field into 'only' internal medicine by not incorporating other important species knowledge that is so important to being a good well-rounded internist and achieving good patient outcomes, but also broadened the field to multiple species, which makes it even harder to be a true expert in either species. Although cat-only qualifications have subsequently been introduced at a practitioner level, they very much do focus on the internal medicine, with few or no training programs that really capture the broad holistic approach to specialised cat care.

There have been so many developments in different areas of the profession over the last 22 years that being a good clinician seems so much more complicated than it was when I started my feline speciality training. To name but a few, there has been a huge rise in availability of diagnostic modalities; advanced imaging such as CT and MRI scanning is now commonplace in referral practices, there are lots more serological assays available like fPLI, SDMA, infectious disease PCRs, there has been a surge in corporate practices and an increased focus on veterinary business, separate emergency out-of-hours clinics have become commonplace, as have private referral hospitals, and there is an infinite availability of post-graduate education opportunities and qualifications. Despite the benefits of all this, the volume of information available and the choices can be overwhelming, and many clinicians often struggle with decision making giving rise to self-doubting about whether they are a good clinician.

What is even defined as 'a good' clinician? (Figure 4). One that has good patient outcomes, one whose clients don't complain, one who brings in the most money to the practice, one who works the longest hours, or one who has a good work-life balance, one who charges well, one who has the most patient admits, or one of has the least patient admits, one who does the most diagnostic tests, or one that does the least diagnostic tests, one who prescribes the most expensive medications, or one who prescribes the medications that the client finds easiest to give even if they aren't the most ideal, one who is always on time with their consults, or one who spends as long as is needed to explain something to a client, one who refers



Figure 4. What makes a good clinician? Surely it is one that first and foremost acts to achieve the best welfare outcomes for their patients in all aspects of their work.

a lot, one who doesn't refer much, one who always tries to get a diagnosis, one who often treats symptomatically, one who euthanases lots of patients, or one who doesn't euthanase many patients—it's all got complicated!

With the growing awareness and concerns about retention of vets in the profession and issues around mental health and burnout, I think this is a topic that we all regularly reflect on. Clearly, issues are complex and multifactorial with no single easy solution. However, the conversation is often focused along the lines of work-life balance, having a healthy lifestyle etc. Everyone is different, but for most vets we chose the profession because we wanted to make a positive difference to the lives of animals, and certainly for me, what is fulfilling about my career and keeps me motivated and enthused despite often long hours, tough and turbulent times, is, simply put, that 'feeling' of making animals and their carers 'feel' better and being confident in your ability to make them feel better. Surely that is the backbone to being a good clinician, and if our patients feel good, their carers feel good, and we feel good!

It sounds simple, but how do we see the wood for the trees in 21st century veterinary practice, and maintain this as a clear focus with all the other noise and pressures around us? This is where a structured approach to animal welfare science comes in and is the focus of this article.

### What is animal welfare?

Animal welfare is a complex concept and our understanding of it continues to be refined as knowledge evolves. Often in veterinary medicine, relatively dated concepts are used, such as a separation between physical and mental health. However, contemporary animal welfare science characterises animal welfare by an animal's 'feelings' (mental experiences or affective states)

and recognises that feelings result from physical states. In animal welfare science, we aim to interpret indicators of biological function and behaviour in terms of the mental experiences that those indicators are likely to reflect. Mental experiences, or affective states, are subjective and cannot be measured directly, but indirect indices can be used to cautiously infer affective experiences.

In veterinary medicine, we are often guilty of thinking that good welfare is present when an animal is not suffering unpleasant states. However, sentient animals have the capacity to experience both positive and negative feelings, which is backed up by decades of scientific research from the fields of neuroscience, behavioural sciences and cognitive ethology. Advances in neuroscience have shown that many animals can experience complex emotions, which have often previously been thought to be unique to humans. In particular, the ability to experience positive feelings and the importance of the opportunity to experience them, has also been demonstrated in animals through behavioural and neurobiological studies including advanced brain imaging. As animal welfare science has progressed to understanding that animals can experience positive emotions too, the aim with management of any animals is not only to minimize negative mental experiences but to enhance their welfare by ensuring opportunities for positive pleasurable experiences.

So simply put, contemporary animal welfare science, is essentially the science of animal feelings (affective states); understanding different feelings, how they arise, how they are assessed, the physical states linked to particular feelings, the scientific evidence linking particular physical states and feelings, what factors influence those feelings, and establishing how we can act to minimise negative feelings and maximise positive feelings.

## The science of animal welfare

The discipline of animal welfare science is relatively new; having been borne approximately 70 years ago out of concern for farmed animals in the growing intensive farming industries. Since that time, animal welfare science has been a rapidly growing discipline. However, the discipline has evolved largely parallel to, rather than integrated into veterinary medicine. Since the discipline arose out of addressing situations where the most negative welfare impacts appeared to occur, such as animals used in research and food production, it has historically been more closely linked to those areas. Academics involved in the animal welfare science field aren't always veterinarians, often they

have backgrounds in physiology or behaviour. As such, even within veterinary medicine, it seems to have evolved as a separate discipline, being taught as a separate subject to undergraduates, and at postgraduate level having separate member organisations such as the Animal Welfare Chapter of ANZCVS, and the Animal Welfare and Ethics Special Interest Group of the AVA and being recognised as its own speciality with Australian Fellowships, RCVS Diploma, and European Diplomas in welfare and ethics. Combined, these are likely reasons why the advancements in animal welfare science haven't really been integrated into clinical practice as much as they could be to date. It is only last year that for the first time a formal proposal was made for how animal welfare science could be better integrated into the veterinary undergraduate curriculum (Littlewood and Beausoleil 2021).

## Understanding affective states

### Negative affective states

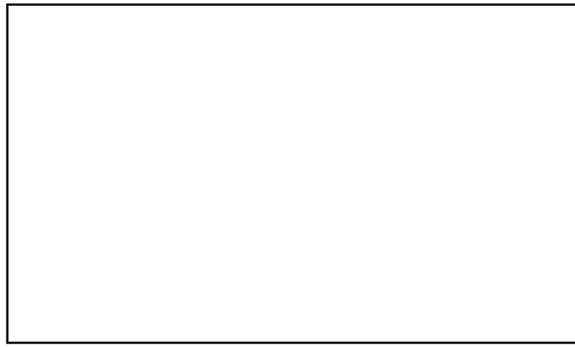
There is a growing body of neurophysiological and behavioural evidence in animals regarding the basis of negative affective states such as breathlessness, thirst, hunger, pain, fear, nausea/sickness, dizziness and weakness, and there are also validated links between measurable indicators of physical/functional states and some of these mental experiences.

Some affective experiences are generated by the animal's brain processing sensory inputs that register specific features of the internal physical/functional state. For example, water deprivation causes dehydration which leads to osmoreceptor-stimulated neural impulses passing to the brain generating the affective experience of thirst. Thirst elicits the behaviours of seeking water and drinking, to correct dehydration, after which the mental experience of thirst ceases. Other affective experiences may arise from externally stimulated sensory inputs that contribute to the animal's perception of its external circumstances. For example, threatening situations are registered via cognitive processing of sensory inputs from visual, auditory and/or olfactory receptors giving rise to anxiety and fear. Whilst some negative experiences such as thirst and hunger motivate the animal to be behaviorally active to achieve resolution of the experience, others motivate the animal to reduce its activity. For example, weakness, sickness and pain often induce inactivity and seeking to be isolated. These and other types of behaviour are referred to as 'sickness' behaviours and may facilitate recovery from disease and injury thereby enhancing survival. Experiencing negative emotions to some degree is therefore essential to motivate

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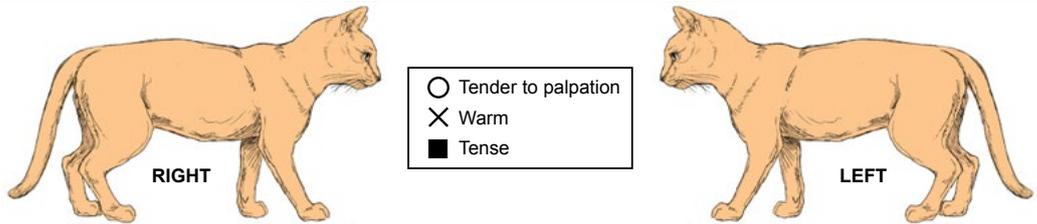
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**Feline Acute Pain Scale**

Rescore when awake  Animal is sleeping, but can be aroused - Not evaluated for pain  
 Animal can't be aroused, check vital signs, assess therapy

Pain Score	Example	Psychological & Behavioral	Response to Palpation	Body Tension
0		<input type="checkbox"/> Content and quiet when unattended <input type="checkbox"/> Comfortable when resting <input type="checkbox"/> Interested in or curious about surroundings	<input type="checkbox"/> Not bothered by palpation of wound or surgery site, or to palpation elsewhere	Minimal
1		<input type="checkbox"/> Signs are often subtle and not easily detected in the hospital setting; more likely to be detected by the owner(s) at home <input type="checkbox"/> Earliest signs at home may be <b>withdrawal from surroundings or change in normal routine</b> <input type="checkbox"/> In the hospital, may be content or slightly unsettled <input type="checkbox"/> Less interested in surroundings but will look around to see what is going on	<input type="checkbox"/> May or may not react to palpation of wound or surgery site	Mild
2		<input type="checkbox"/> Decreased responsiveness, <b>seeks solitude</b> <input type="checkbox"/> Quiet, loss of brightness in eyes <input type="checkbox"/> Lays curled up or sits tucked up (all four feet under body, shoulders hunched, head held slightly lower than shoulders, tail curled tightly around body) with eyes partially or mostly closed <input type="checkbox"/> Hair coat appears rough or fluffed up <input type="checkbox"/> May intensively groom an area that is painful or irritating <input type="checkbox"/> Decreased appetite, <b>not interested in food</b>	<input type="checkbox"/> Responds aggressively or tries to escape if painful area is palpated or approached <input type="checkbox"/> Tolerates attention, may even perk up when petted as long as painful area is avoided	Mild to Moderate <b>Reassess analgesic plan</b>
3		<input type="checkbox"/> Constantly <b>yowling, growling, or hissing</b> when unattended <input type="checkbox"/> May bite or chew at wound, but <b>unlikely to move</b> if left alone	<input type="checkbox"/> Growls or hisses at non-painful palpation (may be experiencing allodynia, wind-up, or fearful that pain could be made worse) <input type="checkbox"/> Reacts aggressively to palpation, <b>adamantly pulls away</b> to avoid any contact	Moderate <b>Reassess analgesic plan</b>
4		<input type="checkbox"/> Prostrate <input type="checkbox"/> Potentially <b>unresponsive</b> to or unaware of surroundings, difficult to distract from pain <input type="checkbox"/> Receptive to care (even aggressive or feral cats will be more tolerant of contact)	<input type="checkbox"/> May not respond to palpation <input type="checkbox"/> May be rigid to avoid painful movement	Moderate to Severe <b>May be rigid to avoid painful movement</b> <b>Reassess analgesic plan</b>



Comments \_\_\_\_\_

Figure 5A. The use of pain scoring scales and facial grimace scales has increased in clinical practice, but this is just focused on recognising and scoring one mental experience in isolation rather than the range of mental experiences that an animal may be having.

life-sustaining behaviours, but it is the incidence, intensity and duration of these experiences that are important in determining the overall impacts on an animal's welfare state. It is when negative experiences become extreme, prolonged, or unavoidable, that an animal experiences the most severe compromises to its welfare.

**Positive affective states**

Animals can also experience a range of positive affective states, and when experienced, these may enhance the animal's welfare state. Some positive mental experiences may occur because of behaviours that are directed at minimising negative effects. For example, the smell, taste, textural and masticatory pleasures of eating a range of foods and the comfort of post-prandial satiety may occur with eating that is directed at relieving hunger. Alternatively, other positive experiences may replace negative experiences when an animal is able to express more of its behavioural repertoire. For example, foraging/predatory behaviour, affiliative social interactions, adolescent play behaviour, maternal behaviour and sexual activity are behaviours that infer positive mental experiences.

**Current incorporation of animal welfare science in clinical practice**

Aspects of animal welfare science certainly are already incorporated into every day clinical practice. We increasingly recognise indices that are linked to different affective states. For example, we

recognise that azotaemia may give rise to nausea, which may in turn also contribute to inappetence. We recognise that inappetence is caused by nausea when it resolves with administration of anti-emetics. We also recognise that there are behavioural indicators of nausea such as salivation, lip smacking, and turning away when offered food. Pain is another affective state that has received increasing recognition, understanding of its pathophysiology, recognition of behavioural indicators and more subtle indicators comprising changes in posture and facial expression, which have given rise to tools such as grimace scales and pain scoring systems (Figure 5). There has also been growing recognition of fear and anxiety in animals, and how we can recognise and reduce this in the way that we interact with animals, giving rise to initiatives such as 'low stress stock handling', 'Fear Free pets' and 'Cat friendly clinic' (Figure 6). In veterinary practice we often use the term 'stress', however in animal welfare science more specific terminology is preferred, such as anxiety or frustration inferring more specific negative emotional states that the term 'stress' really refers to.

So, although we of course do incorporate this understanding of affective states into veterinary medicine, it does not tend to be done in an explicit, systematic, structured and complete way. The above examples focus on single negative affective states, rather than the combination of affective states that an animal may be experiencing at any point, or how our intervention to minimise one

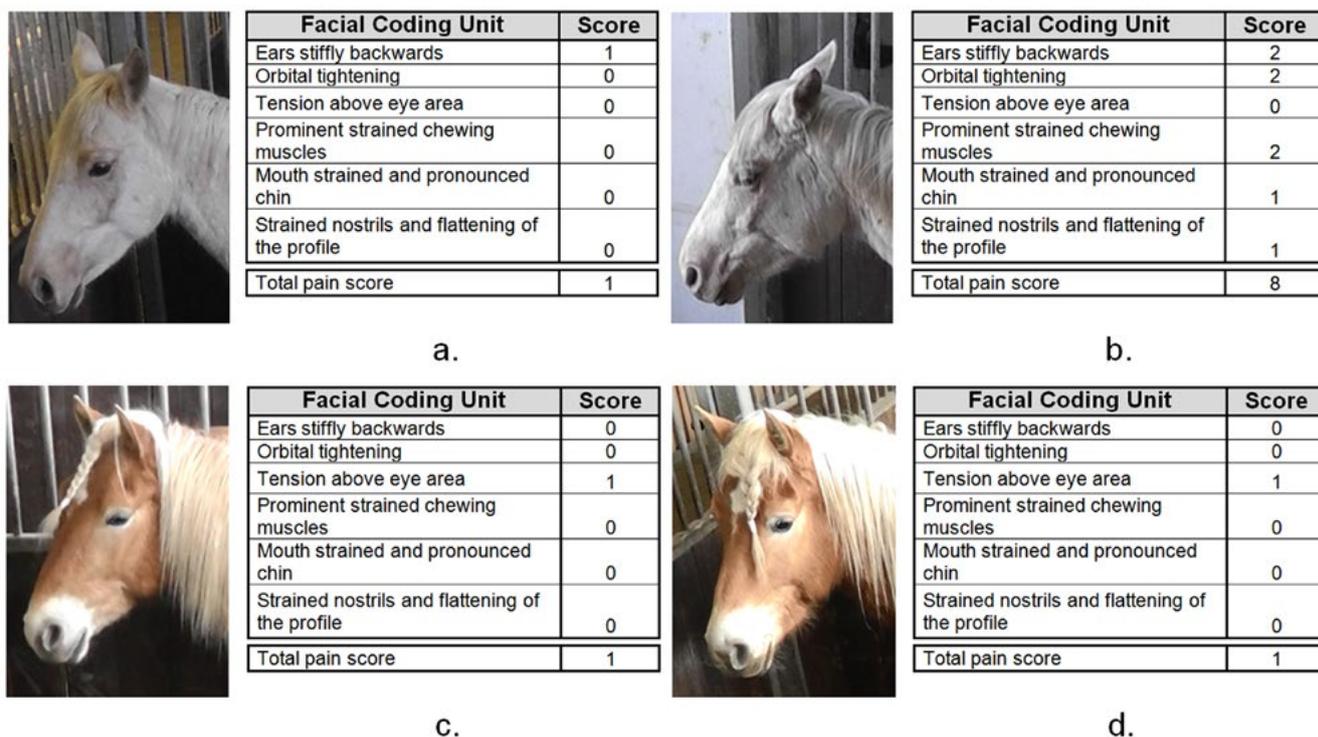


Figure 5B. The Horse Grimace Scale, developed by Dalla Costa et al. 2014, PLOS ONE [doi.org/10.1371/journal.pone.0092281](https://doi.org/10.1371/journal.pone.0092281)

negative affective state may cause or risk another negative state to arise. There is also probably more focus on negative mental experiences than positive mental experiences in both treatment and preventative care. To date preventative care is also more focused on reducing welfare risks associated with disease and not as orientated to welfare risks associated with other aspects of husbandry related to nutrition, the physical environment and behavioural interactions of the animal with its environment, other animals and humans.

**Moving to a more systematic, structured and complete way of incorporating animal welfare science into clinical practice: *The Five Domains Model for assessing welfare status***

The Five Domains Model, which has recently been updated (Mellor *et al.* 2020) is consistent with, and structurally represents, the understanding that physical and mental states are linked (Figure 7). It is a device that facilitates systematic and structured welfare assessment of individual sentient animals, based on current understanding of the functional basis of negative and positive subjective experiences that animals may have.

The Five Domains Model comprises four interacting physical/functional domains of welfare: 'nutrition', 'physical environment', 'health' and 'behavioural interactions' (including interactions with the environment, other animals and people), and a fifth domain of mental state 'affective/mental experience' (Figure 7). The physical/functional domains focus on internal physiological and pathophysiological states (Domains 1-3) and external physical, biotic and social conditions that may alter the animals' behavioural expressions (Domain 4) (Mellor *et al.* 2020). Following measurement of animal-based (and sometimes resource-based) indices within each physical domain, the anticipated negative or positive affective consequences are cautiously assigned to Domain 5. It is these experiences that contribute to descriptions of the animal's welfare state.

This also provides insight into how the Domains are linked to each other rather than being separate entities. For example, nutrition is considered not just in Domain 1, but also in Domain 4 in terms of behavioural interactions with the environment in how food is obtained whether through foraging or hunting. The way that indicators are scientifically linked to physical states and mental experiences also demonstrates how important it is for basic sciences such as physiology, pathophysiology and pathology, to be fully integrated into clinical practice, as well as separate disciplines such as internal medicine, nutrition and behaviour being



Figure 6. These initiatives have hugely increased recognition of, and management of anxiety and fear in certain situations, but again are only focused on one mental experience.

integrated together. As such, an animal welfare science approach is a very holistic and truly integrated approach to clinical practice. The way that this more complete and structured approach can be incorporated into veterinary practice and education has also been recently highlighted (Littlewood and Beausoleil 2021).

This is perhaps at odds with the trend for discipline-based specialisation in veterinary medicine, where different disciplines focus on a different domains, indicators and affective states. For example, nutritionists focus on Domain 1, internists focus on Domain 3, behaviourists focus on Domain 4. Anaesthetists tend to have the most expertise in pain management, which focuses on management and recognition of one affective state in Domain 5. This illustrates how with advancements in veterinary medicine we may actually have also increased some gaps, since a focus on animal welfare (the animals' feelings or affective state) requires all these areas to be integrated together.

## Applying the Five Domains Model to assess welfare status and risk

In my PhD I developed a step-by-step protocol, The Ten Stage Protocol (Harvey *et al.* 2020), for how the Five Domains Model could be applied to free-roaming wild animals in order to assess and grade both welfare status and risk. This is more complex than for domestic animals or animals in captivity, as free-roaming animals present even more challenges such as how relevant indices can even be observed or measured when these animals can be difficult to directly visualise, let alone physically examine. But some of the same stages still apply for domestic or captive species.

It should be noted that although there may be similarities between different species, particularly in the range of negative and positive mental experiences that they may have, there will be differences in the factors that give rise to these experiences, in addition to the measurable or observable indicators that may be linked to those experiences. So, although the structure of the Five Domains Model will be the same, it needs to be modified for each species and context that it is to be used in.

## 1. Acquiring species-specific knowledge across all Five Domains

To appropriately apply the Five Domains Model to assess animal welfare, a fundamental initial requirement is detailed species-specific knowledge within each Domain. Table 1 illustrates the type of species-specific information within each of the four physical/functional domains that is required. Without a thorough understanding of what is normal for a species under optimal conditions, it is not possible to identify or interpret abnormalities.

## 2. Developing a list of measurable/observable indicators in each physical/functional domain, distinguishing between welfare status and welfare alerting indices

Measurable or observable indicators can be animal-based, such as body condition, laboratory results or behaviour, or resource-based, such as the food and litter trays provided (Table 2, Figure 8). Some indices (specifically animal-based

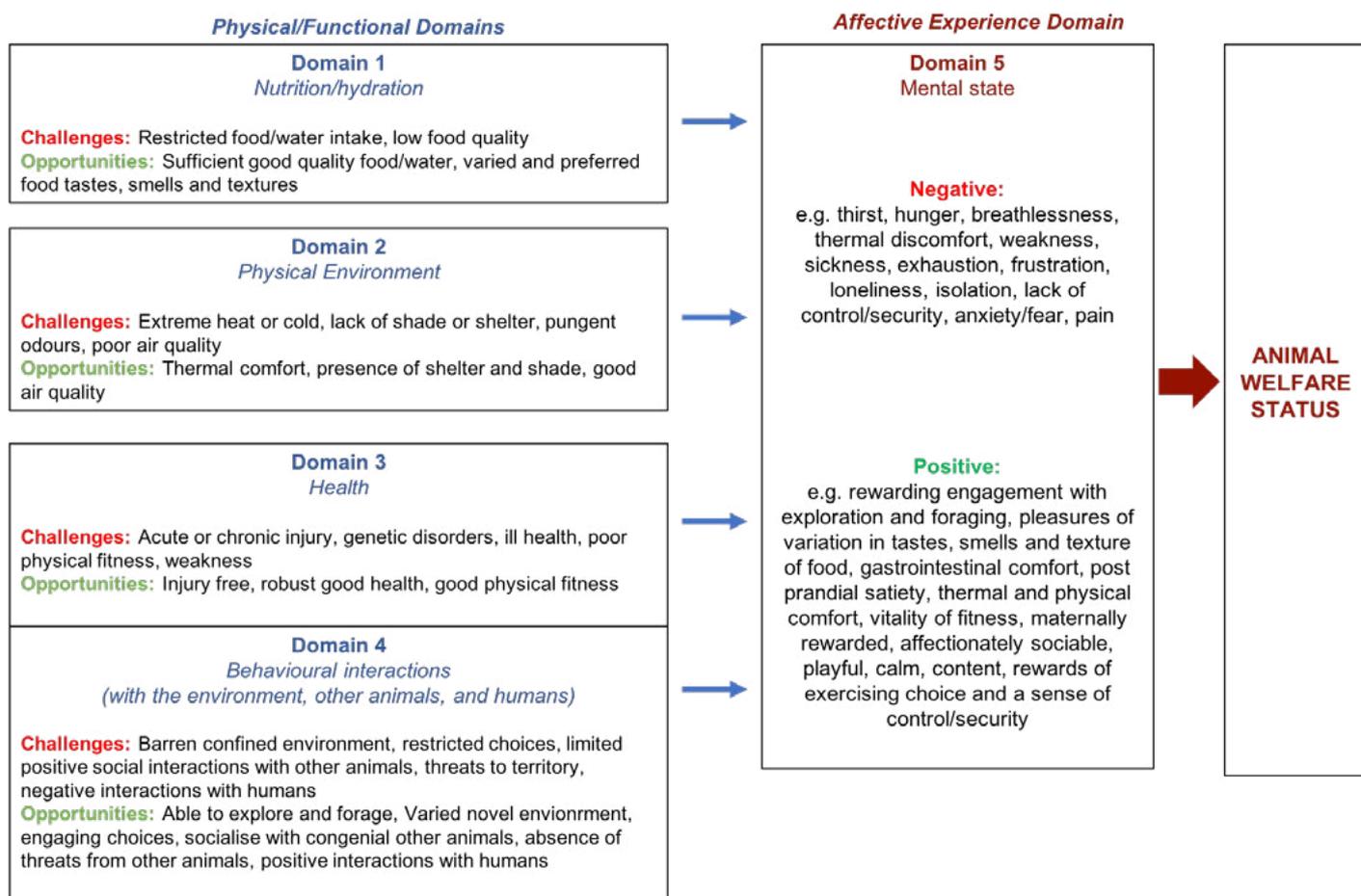


Figure 7. An abbreviated schema of the Five Domains Model (adapted from Littlewood & Mellor 2016), showing negative and positive physical/functional states or situations (Domains 1-4) and examples of their associated negative and positive mental experiences or affects (Domain 5). Taken together, these mental experiences represent the overall welfare state of the animal. More detailed schema are available elsewhere (Mellor & Beausoleil 2015, Mellor *et al.* 2020).

indices) will be direct indicators of physical states, and therefore reflect aspects of welfare status. Others will be indicators of the risk of particular states occurring, or welfare alerting indices (all resource-based indicators and some animal-based indicators). Welfare alerting indices do not directly reflect the animal's current welfare state, but they can direct attention in future assessment towards specific animal-based indices. Only animal-based indices can contribute information to the assessment of overall welfare status, since they provide the most direct evidence of what the animal may be experiencing. Animal-based indices may be externally observable, or internally measurable (Table 3).

### 3. Ensure welfare status indices are scientifically validated

Although mental experiences are subjective, those inferences derive credibility from validated knowledge of the underlying system's physiology, neurophysiology and affective neuroscience, and also from the caution exercised when inferring the presence of particular affects. Validation of welfare indices requires demonstration of the relationship between an observed indicator and the physical/functional impact (Domains 1-4), and of the relationship between the physical/functional impact (Domains 1-4) and the inferred mental experience (Domain 5) (Table 4).

### 4. Use the species-adjusted version of the Model to grade welfare compromise and enhancement, and separately grade risk

To standardize the assessment of welfare status across different individuals and/or different veterinarians, and to monitor animal welfare over time, a reliable, repeatable and practical method of grading is required. Grading the impact of mental experiences on welfare status involves a different approach depending on whether the experiences are negative (welfare compromise) or positive (welfare enhancement). Grading and the operational details of the Five Domains Model can be found elsewhere (Mellor & Beausoleil 2015; Littlewood & Mellor 2016; Mellor 2017; Mellor et al. 2020).

### Clinical applications of animal welfare science

Incorporating animal welfare science into clinical practice has a huge number of applications. Clinicians generally worry about adding time and complexity to their already busy days, however utilising this approach needn't be time consuming

or complex. One strength of the Five Domains model is its flexibility; it can be made very detailed if required, but it can also be used very simply. Similarly, if grading welfare compromises, a different number of tiers can be used (e.g. no compromise, mild/moderate compromise, severe compromise) and not every indicator needs to be individually graded; typically, indicators within each Domain are considered together and a single grade assigned for that Domain.

The following are examples of how an animal welfare science-based approach can be invaluable in clinical practice and ensure that decision making focuses on prioritisation of minimising negative affective states and maximising positive ones.

These will be the focus of the discussion in the upcoming webinar (see below).

1. Using assessment of welfare status to prioritise clinical problems by focusing on those that are directly impacting the animal's mental experiences above those that are only welfare risks
2. Using assessment of welfare status to guide case management and clinical decision making
3. Ensuring managing a welfare risk in one domain doesn't compromise welfare status in another
4. Improving decision making in ethically challenging situations to ensure optimal welfare outcomes
5. Using integrated basic science and clinical knowledge within all Domains to improve recognition of particular negative mental experiences
6. Resolving controversies in husbandry practices
7. Expanding preventative health care across all the Domains
8. Using repeated welfare assessments to assess quality of life and aid in end-of-life decision making
9. Using the Five Domains as a checklist for case management and preventative healthcare



Figure 8. Examples of resource-based and animal-based measures of nutrition (Domain 1) and behavioural interactions with the environment and other animals (Domain 4) in different species. Provision of appropriate resources (for example shown here are provision of a raised resting surface, climbing apparatus, varied food, tree for shade and opportunities for maternal nurturing and social interactions), enables the animal to interact with their environment and other animals, exhibiting behaviours that along with knowledge of behaviour and neuroscience, can be used to infer what mental experiences the animal may be having. The animal-based measures are how the animals are utilising those opportunities by resting, playing, eating, standing in the shade, and social interactions with other animals.

**Table 1. Illustration of examples of species-specific information required.**

Domain	Species-specific information required
1: Nutrition	Water requirements: volume, frequency, preferred water sources Nutritional requirements and preferences Common nutritional deficiencies, excesses, toxicities Body condition scoring
2: Physical environment	Environmental preferences, thermoneutral zone, optimal air quality and temperature, signs of thermal discomfort
3: Health	Common non-infectious diseases and their clinical signs, risk factors, aetiology, diagnosis and prognosis Common infectious diseases and their clinical signs, epidemiology, mode of infection, characteristics of infectious agent (e.g., life cycle, survival in environment, involvement of other species) Common injuries and their clinical signs, risk factors, aetiology, diagnosis and prognosis Sickness and pain behaviours
4: Behavioural interactions	Interactions with environment under optimal conditions e.g. foraging or predatory behaviour, burrowing, nesting, digging, scratching, climbing behaviours Normal range of behaviours and time budgets under optimal conditions Social behaviour (including 'rewarding behaviours' e.g., play, allogrooming and other positive affiliative behaviours) and communication

**Table 2. Examples of animal-based and resource-based indices that may be measured or observed, and which measures directly reflect mental experiences, i.e., welfare status, compared to welfare alerting indices that reflect welfare risk.**

Domain	Animal-based indices	Status/Alerting	Resource-based indices
	Index	Status/Alerting	All Alerting
1. Nutrition	Hydration status Body condition score	Welfare status Welfare status	Water availability/sources/location Food availability/sources/location Competition for resources
2. Physical environment	Use of the physical environment  Shivering, profuse sweating/panting/ open mouth breathing	Welfare alerting  Welfare status	Weather (e.g., temperature, humidity, direct sun exposure, wind, rainfall, extreme weather conditions such as snow, hail, fire)  Presence of and nature of protection from wind/sun/rain (i.e., shelter and shade), unpleasant odors, air quality, noise
3. Health	General demeanour, mobility, gait, posture, sickness behaviours, clinical signs and physical abnormalities such as excessive scratching, vomiting, tachypnoea, lab and imaging abnormalities  Some physical abnormalities (e.g. coat condition), some laboratory abnormalities (e.g. elevated liver enzymes), some incidentally found abnormalities on imaging	Welfare status Welfare alerting	Environmental conditions that may predispose to certain health conditions (e.g., heavy rain, poor air quality)  Hazards that may predispose to injury (e.g., poorly maintained fencing, roads, terrain)
4. Behavioural interactions (with the environment, other animals, humans)	Quantitative (e.g. frequency/duration of positive affiliative interactions) and qualitative (e.g. alert, relaxed, weak) assessment of behaviours	Welfare status	Opportunities to express complete range of normal behaviours; affected by environment, other animals and humans

**Table 3. Examples of animal-based indices that may provide information about welfare status.**

Externally observable indices	Internally measurable indices
Body weight and/or body condition score	Measurement of vital parameters e.g. heart rate, respiratory rate, rectal temperature
Altered gait or lameness	Measurement of laboratory parameters such as complete blood count and serum biochemistry
Clinical signs such as presence of vomiting or diarrhoea, nasal discharge, skin lesions	
Sickness or pain behaviours	

**Table 4. Description of the steps in scientifically validating animal-based indicators of welfare compromise (adapted from Beausoleil & Mellor 2017)**

Step 1: Validation of the links between observed indicators and physical/functional impacts (Domains 1–4)	Step 2: Validation of the links between physical/functional impacts (Domains 1–4) and particular mental experiences (Domain 5)
Scientific understanding of the pathophysiology and aetiology of disease	Scientific understanding of the neurophysiological mechanisms underlying the mental experience in species with similar neurological capacity, i.e., affective neuroscience evidence
Scientific understanding of the mechanisms related to deficiency, dysfunction, disruption or homeostatic imbalance	Comparison with mental experiences reported by humans in similar situations or with similar physical/functional impacts
Absence of elimination of the indicator using a method known to prevent or remove the underlying causative process (i.e. physical/functional impact)	Elimination or reduction of a mental experience reported by humans using a method known to prevent or alleviate the physical/functional impact
Coherence between multiple indicators in different modalities (e.g., behavioural, physiological) measured in the same situation	

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Kim Castro, VIC  
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Michael Clarke, QLD  
Kaiser Dawood, NSW  
Marina du Preez, SA  
Alex Elms, SA  
Andrew Flanigan, NSW  
Karmen Fong, NSW  
Kai Fung, WA  
Jo Hoad, NSW  
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Meera Kunathasan Chelliah, NSW  
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Cuixia Phan, NSW  
Anthony Phillis, QLD  
Lo Pin Hsun, Taiwan  
Suzanne Ravenscroft, NSW  
Malika Subodhini, VIC  
Theresa Suckling, VIC  
Jerrold Tan, Singapore  
Deeanna West, QLD

## Congratulations to DE participants who passed the ANZCVS membership exams in 2021

### Medicine of Cats

Anna Katria Lovell  
Celeste Lau  
Deborah Khoo  
Jess Rossi  
Maria Yanez  
Sarah Hill  
Stephanie Molloy  
Wan-Ju Jao

### Medicine of Cats UK

Brice Reynolds  
Florian Niethammer  
Lowri Elis-Williams  
Lucinda Alderton-Sell  
Martina Zakariasson  
Sarah Merrett  
Sherry Carlisle

### Medicine of Dairy Cattle

Sarah Rodwell

### Medicine of Sheep

Sophie Hemley

### Small Animal Medicine

Brody Pullens  
Hayley Hooper  
Kellie Farroway

Lauren Baume  
Megan Collins  
Tamara Dann

### Small Animal Surgery

Angela Pantangco  
Angus McMillan  
Benjamin McRae  
Casey Gordon  
Eliza McInnerney  
Emma Dunning  
Ho Yi Wong  
Jennifer Stewart  
Jesse Standage-Wardle  
Mya Helme  
Sacha Woodburn  
Sarah Leber  
Sarah Mo  
Steven Porep

### Veterinary Behaviour

Andrew Eaton  
Bridget Brown  
Denise Doyle  
Emily Lucas  
Emma Vermeeren  
Grace Thurtell  
Jake Lin  
Katrin Jahn  
Louise Flinker  
Lucy Asher  
Michelle Nicholson  
Sabine Wilkins

### Veterinary Emergency and Critical Care

Michelle Hahm  
Naomi Clarke

### Veterinary Radiology (Small Animal)

Emma Tragar  
Jennifer Judd  
Jordan Zec  
Kerri Renshaw  
Kevin Kang  
Mason White  
Scott Martin

# DIRTY WOUNDS? WE HAVE THE SOLUTION!

Wounds can vary widely in how they present, from straight forward through to complex, challenging us at every turn. Wounds may be superficial, gaping full thickness or punctures that go deeper than we can see, but no matter the depth of the wound, if it is not clean it cannot heal.

## What is Biofilm?

Biofilm forms when bacteria adhere to surfaces by excreting a thick, glue-like substance known as the Extracellular Polymeric Substance (EPS). This substance forms a protective layer, where the bacteria are no longer free to move (planktonic) but adhere to the wound bed. New bacteria are produced, and the colony grows under the protection of the EPS. Biofilms are often difficult to detect visually, but they delay wound healing due to the protection they provide to the bacteria in the wound bed.<sup>3</sup>

## The Solution

Traditional wound cleansing with saline and water is ineffective at removing coatings and debris in many wounds, especially complex biofilms.<sup>4</sup> Prontosan® Irrigation Solution and Prontosan® Wound Gel/Gel X are specifically indicated for the prevention and removal of biofilms. Prontosan® contains two key ingredients: Betaine and Polyhexanide.

Betaine is a gentle surfactant which is able to disturb, penetrate, clean and remove biofilm and wound debris.

Polyhexanide (PHMB) is a broad-spectrum antimicrobial with demonstrated good clinical safety, no evidence of resistance and minimal toxicity. It functions as a preservative which inhibits the growth of micro-organisms.<sup>5,6,7</sup>

The unique combination of Polyhexanide and Betaine have a double effect on the wound bed to create a wound environment optimal for healing.

**For more information and to see how it works visit:**

## How it works?



There is a plastic granulate on the surface.



## References

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