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Veterinary Referral News from Angell Animal Medical Center

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The Value of Orthogonal Views

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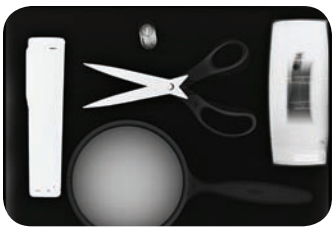
One of the most substantive challenges posed by radiograph interpretation for radiologists and general practitioners alike is extrapolating a three-dimensional structure from a two-dimensional image. In the current clinical environment, advanced tomographic imaging methods, such as CT and MRI, overcome key elements of this challenge by providing axial (bread slice) or multi-plane imaging through structures with complex anatomy. Advanced imaging is not generally considered part of the initial evaluation of most common veterinary patient presentations for many self-evident reasons. As clinicians we must therefore perform these complicated, three-dimensional reconstructions in our own heads, without the assistance of a computer.

Assuredly, everybody remembers learning about the importance of obtaining orthogonal radiographic views (projections oriented at right angles to one another) in veterinary school; orthogonal views are precisely the means by which it is possible to build a complete picture. Without an orthogonal view, a huge, essential chunk of clinical information is missing, leaving us to make two-dimensional interpretations. Common objects can become unrecognizable or, more commonly in our clinical practices, incompletely evaluated when visualized in a single, two-dimensional projection.

Would the stapler in the image on the left (Figure 1) be recognizable with only the one view? Would we be able to render a diagnosis of the tape dispenser with only the lateral view on the right (Figure 2)? (If my hand was forced, my guess would be an obstructive ileus, but is this enough information upon which to justify a surgical exploratory?)

A minimum of two views is required for assessment of possible fractures and luxations. Displaced, mid-diaphyseal fractures are obviously not the only types of fractures that occur; and even when they are, the degree of displacement or visualization of fissures can be easily obscured when assessed on only one view. More subtle fractures may require a minimum of two views; stress views are often necessary to determine the extent of ligamentous instability or derangement due to ruptures or avulsions. Areas of complex, superimposed, or multi-faceted anatomy (such as the carpus, tarsus, TMJs, and pelvis) definitely warrant multiple views in order to fully evaluate them.



↗ Figure 1

↘ Figure 2

One of the most commonly missed diagnoses with only a single view involves elbow luxations or intracondylar fractures. With a presentation of acute, non-weight-bearing lameness localized to the elbow, only a lateral view is often obtained due to the combination of severe patient discomfort and the inherent challenge of obtaining a caudocranial (CC) view of the elbow. The vast majority of the time, sedation is required to obtain a diagnostic CC view of the elbow (any elbow, let alone a markedly painful elbow). Thus, with only the lateral view, it may be possible to note that joint congruity appears slightly awry; however, if there is any obliquity on a lateral view of a normal elbow, the joint can also appear incongruent. When an intracondylar fracture is the cause of the elbow pain, the region of the medial or lateral epidcondyle has a peculiar appearance in a nonspecific, hard–to-articulate way on a lateral view. Without the orthogonal view, the diagnosis is just about impossible. Please see the

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Inside

Courtesy Consultations

We encourage our referring veterinary partners to call or e-mail our Angell specialists to consult on difficult cases.

Angell specialists are available for consultation Monday–Friday 9:00 a.m.–5:00 p.m.

Additionally, Angell emergency doctors are available for consultation on weekends and after hours (7:00 a.m.–11:00 p.m.).

Please see Page 7 and the back cover of this newsletter for full contact information.

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Determination of Immunophenotype in Hematopoietic Neoplasms

By Jennifer Mahoney, DVM
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Immunophenotype is a valuable tool in the diagnosis of hematopoietic neoplasms, and can provide important prognostic information, especially for canine lymphoma. Immunophenotype refers to the chemical and histological characteristics of a cell or group of cells, and usually relies on protein expression to differentiate cell types, such as B- and T-7 lymphocytes. The presence of a homogeneous population of cells of the same immunophenotype is supportive of a neoplastic process. Most cases of canine lymphoma (approximately 60%–80%) are of B-cell origin, while T-cell lymphomas account for 10%–38% of cases. There are well-documented differences in the prevalence of certain lymphoma immunophenotypes based on breed, most notably the prevalence of T-cell lymphoma in Boxers. T-cell lymphoma is usually associated with lower response rates to chemotherapy and shorter remission and survival times compared to B-cell lymphoma. In addition, dogs with T-cell lymphoma tend to present with more serious clinical signs compared to dogs with B-cell lymphoma. These clinical signs may include polyuria and polydipsia from hypercalcemia of malignancy, which is commonly associated with T-cell lymphoma.

Immunophenotype may be determined by immunocytochemistry, immunohistochemistry, flow cytometry, or PARR (PCR for Antigen Receptor Rearrangement). This article will focus on the use of flow cytometry and PARR for immunophenotyping in clinical practice.

There are many applications for flow cytometry in both research and clinical practice, particularly in the diagnosis of hematopoietic malignancies. Flow cytometry machines use lasers to analyze cells suspended in a stream of fluid and passed by an electronic detection apparatus. A beam of laser light of a single wavelength is directed at the stream of fluid. Multiple electronic detectors are aimed at the point where the stream of cells passes through the light beam. One of these detectors is in line with the light beam (Forward Scatter) and several are perpendicular to it (Side Scatter). Cells may be labeled with fluorescent markers to molecules such as cell surface proteins. Each cell suspended in the fluid scatters the light beam as it passes through. Fluorescent probes are excited to emit light, and cells can be sorted based on their fluorescence intensity. The combination of scattered and fluorescent light is analyzed by the electronic detectors, providing information about the physical and chemical structure of each individual cell. Forward Scatter correlates with cell volume, while Side Scatter correlates with granularity, determined by the inner composition of the cell (nuclear shape, membrane roughness, type and amount of cytoplasmic granules). Increasing the number of lasers and detectors in flow cytometry machines allows for the more precise identification of a target population of cells.

A scatter plot is generated to determine the size and granularity of a population of cells. Populations of specific cell types can be separated by creating a series of subset extractions, called "gating." Data from fluorescent probes is presented as a dot plot or histogram. The commonly used fluorescent probes to assay canine cell populations are monoclonal antibodies against epitopes on the surface molecules of leukocytes called cluster of differentiation (CD) markers. These include CD3 (T-lymphocytes), CD4 (T-helper cells), CD8 (cytotoxic T-cells), CD21 (B-lymphocytes), CD79a (immature B-cells), B5 (some B-cells, CD molecule unknown), CD45 (leukocytes), CD14 (monocytes and macrophages), and CD34 (hematopoietic stem cells). Antibodies against feline antigens are also available. Besides determining B-cell versus T-cell lymphoma, flow cytometry can also provide additional information. Dogs with B5+ lymphoma (the non-immunoglobulin B-cell marker) generally have longer progression-free intervals and overall survival times. A population of cells expressing CD34 indicates hematopoietic stem cells, helping to confirm a diagnosis of acute lymphoblastic leukemia and to distinguish this from Stage V lymphoma, which can provide valuable prognostic information for the clinician and owner.

Flow cytometry requires live cells suspended in some type of liquid media. If specific flow cytometry media are not available, saline or tissue culture media will also work. Blood, bone marrow, cerebrospinal fluid, or body-cavity effusion may also be submitted in EDTA. Flow cytometry can be performed by several veterinary diagnostic laboratories; samples must be refrigerated and sent overnight. PARR is an assay to detect clonality, which is the hallmark of malignancy; a malignant cell population is derived from expansion of single malignant clone with a unique DNA region. PARR can be used to determine if lymphoid neoplasia is present, as reactive lymphocytosis will not demonstrate clonality. It can also be used to determine immunophenotype and to detect the presence of minimal residual disease in patients undergoing chemotherapy treatment.

PARR is a type of polymerase chain reaction, which is a repetitive enzymatic reaction that can generate up to 10^9 copies of a particular DNA sequence. This test uses genomic DNA isolated from the cells of interest and PCR primers specific for the VDJ splice junctions of B- and T-cell receptor gene segments in lymphocytes. As lymphocytes develop, V (variable), D (diversity), and J (joining) segments are cut, spliced, and rearranged by DNA recombination for antigen-binding site diversity in the immune system. The presence of a single, clonal rearrangement can indicate lymphoid neoplasia. PARR uses primers specific for highly conserved V and J regions in B- or T-cell receptors. A crisp band on an electrophoresis gel is indicative of a clonal population of either B- or T-lymphocytes.

In dogs, PARR has a reported sensitivity and specificity of about 90%. In cats, sensitivity and specificity are slightly better in T-cell lymphoma (89% and 80%, respectively) than in B-cell lymphoma (60% and 70%, respectively). It is important to interpret PARR results with other clinical, cytologic, and immunologic findings. False positives have been reported with certain tickborne diseases, including Ehrlichia canis (clonal expansion of T-cells) and Lyme disease, Bartonellosis, and Rocky Mountain Spotted Fever (clonal expansion of B-cells).

An advantage of PARR over flow cytometry is that it can be performed on cytology slides; there is no need for live cells suspended in media. PARR can be performed on lymph-node and bone-marrow aspirates, cellular effusions, and blood. In addition to cytology slides, PARR can be performed on formalin fixed tissues and fresh frozen tissues. Currently PARR is commercially available through Colorado State University, Michigan State University, and North Carolina State University.

Immunophenotyping can provide important diagnostic and prognostic information in cases of suspected hematopoietic malignancies. In the future, targeted therapies may be developed for specific B- or T-cell lymphoid neoplasms. The Angell Oncology team is happy to help make recommendations in regard to immunophenotyping for specific cases, or to discuss test results.

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> The Value of Orthogonal Views

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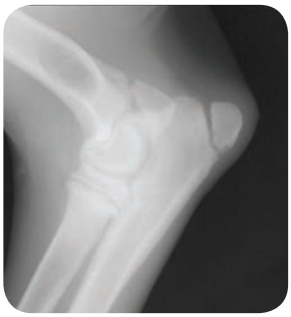
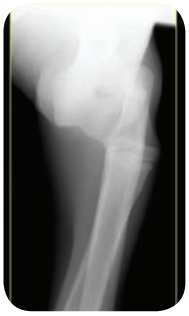
example of a complete elbow luxation below.

Cover the CC view (Figure 4) with your hand and try to force yourself to only evaluate the lateral view (Figure 3). If only the lateral view were available, what would your diagnosis be?

Obtaining all (or many) of the recommended views is sometimes cast in the light of being "merely academic." At first glance, the extra personnel time and/or additional materials (for instance, if a screen/film system is still in place at your practice) may seem to increase the expense required to perform a complete study, with the orthogonal view representing client money better spent on treatment (but, one queries, treatment for what? How would you treat the elbow if you only had the lateral view? NSAIDs and rest?). Radiographs are not performed in a vacuum. They are one diagnostic tool within a toolbox of many, all of which form the means by which a complete clinical evaluation can be performed.



↗ Figure 3

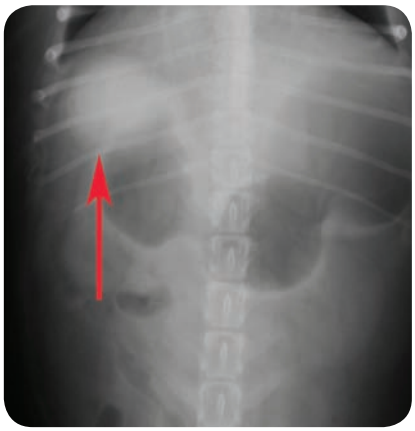


↗ Figure 4

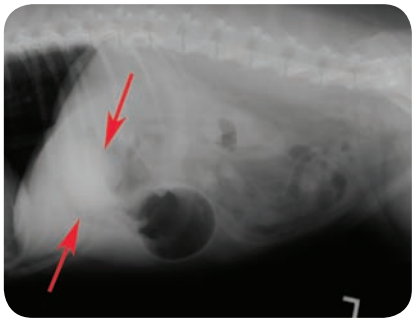
In the case of the elbow luxation, palpation would play a critical role in the diagnosis — but not all lesions are as easy to localize or palpate. A complete study provides more than a purely theoretical gain over the amount of information that can be derived from a single radiographic view. This extra expense is amply compensated for by an increased accuracy in interpretation. It is important to remember this: when you conclude that the result of a diagnostic test is normal, it effectively rules out a vast number of differential diagnoses, even though it may be frustrating that you cannot make a diagnosis quickly. In reality, there may be instances in which orthogonal views do not contribute enough additional information to warrant the expense, but a little ESP may be required to determine which ones are those cases. A lack of three-dimensional information can cost much more than originally imagined. In my experience, skimping on an orthogonal view can lead to unnecessary, extraneous diagnostics being performed; prolonged patient discomfort due to an unrecognized or undiagnosed disease process; unnecessary or additional surgery; prolonged time under general anesthesia; or even mortal injury.

A classic example of when additional views can greatly aid in reaching a diagnosis arises with juvenile animals, and determining whether something that has an unusual appearance may be normal versus a lesion. As veterinarians, we are required to evaluate a dauntingly broad range of variation in morphology. Making a diagnosis of "normal," especially when clinical signs guide one toward a lesion, can be a very tough call. Thus, the inherent redundancy present in many aspects of the body (from two kidneys, two cerebral hemispheres, to two tarsi) can function as a personalized textbook for comparison purposes. Imaging of the contralateral limb can efficiently differentiate between normal variation and a true lesion. The open physes of juvenile patients are quite confusing. Differentiating a fracture from an open growth plate is often merely a radiograph of the contralateral limb away.

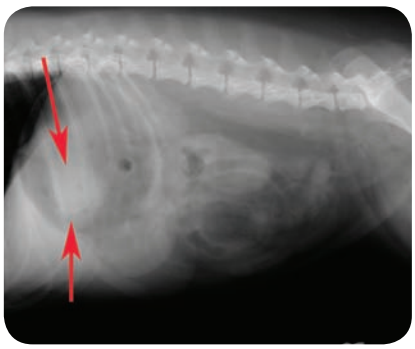
Multiple (generally three) radiographic views are helpful for thoroughly assessing the gastrointestinal (GI) tract, depending upon the suspected disease process. Ample additional knowledge is gained by the redistribution of gas and fluid within the GI tract due to gravity, when the patient is positioned in various recumbencies. Foreign material often silhouettes with the fluid that pools within the dependent portion of the stomach. For example, on a right lateral view, part of the pylorus of the stomach is "down" (i.e., dependent) and therefore fluid-filled, making a foreign body inconspicuous. Gas rises to the non-dependent gastric fundus, which is on the left side of the body. On the other hand, gas resides within the pylorus on a left lateral view, which can help outline and thus obviate foreign bodies that otherwise may have been obscured from view if only a right lateral projection had been obtained. Along a similar train of thought, it can be important to recognize the "mass-like" appearance of a fluid-filled pylorus in a right lateral view, and not be distracted from a true diagnosis. If you ever question whether there is a mass versus the normal pylorus, simply flip the patient over and take a left lateral view as well — plus, of course, a ventrodorsal (VD) view.



↗ Figure 5



↗ Figure 6



↗ Figure 7

In the case illustrated in Figures 5, 6, and 7, a rounded aggregate of radiopaque material is identified at the junction between the pyloric outflow tract and the proximal duodenum. The fundus, body, and pylorus of the stomach contain gas in the ventrodorsal view (Figure 5). The fluid distributes in the body and the pylorus, obscuring visualization of the foreign body on the right lateral view (Figure 7).

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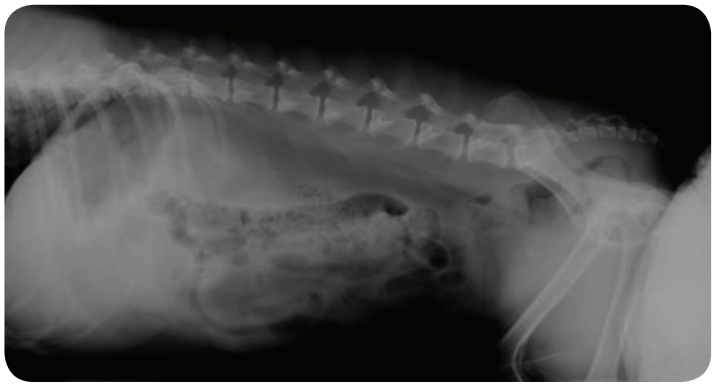
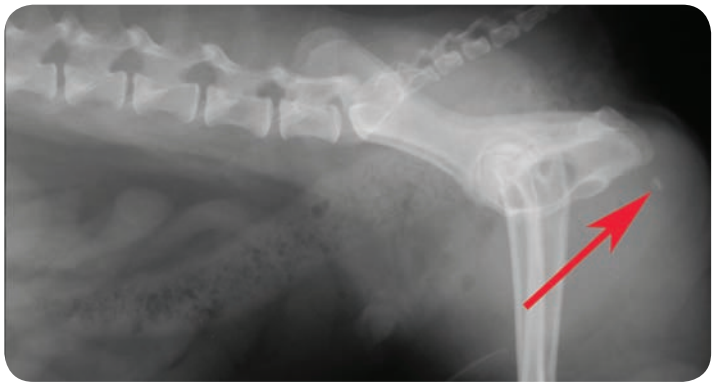
(Continued from Page 3)

Gas fills the body and pylorus of the stomach on the left lateral view (Figure 6), enabling visibility of the rounded, caudal margin of the foreign body. If only a right lateral view had been obtained, identification of the foreign body (which turned out to be a large wad of Play-Doh) would have been severely hampered. Commonly, a left lateral radiograph, in combination with a VD and a right lateral radiograph, is extremely helpful in making diagnoses of gastrointestinal obstructive disorders.

Whenever radiopaque cystoliths are noted on abdominal radiographs, it is critical to obtain a radiograph of the entire urethra. This is most commonly an issue with male dogs, but occasionally females may have an obstructive (i.e., very large) urethrolith as well. A lateral radiograph of the urethra, colloquially known as "the butt shot," requires positioning of the femurs such



↗ Figure 8



↗ Figure 9

that there is no superimposition over the os penis (they must be pulled far enough cranially so as to not impair visualization of the entire "butt," from the os penis to the ischium). In the following example, the original radiograph (Figure 8) was obtained with a sandbag obscuring visibility of the urethra. In order to save the owners' money, the patient was taken to surgery without the performance of further diagnostic imaging. On the post-cystotomy radiograph, you can clearly see a radiopaque cystolith within the urethra. The surgeons then were required to retropulse the stone and go back to surgery to remove it. This exemplifies the ways in which incomplete examinations withhold essential information.

Thoracic evaluation is an excellent example of a region that warrants more than one view. Three views really are necessary to determine whether pulmonary metastases are present. The down lung becomes "relatively" atalectatic and the up lung inflates amply. If the down lung contains a lesion, the soft-tissue opacity of the poorly inflated lung will silhouette with the pulmonary lesion — making it invisible or poorly visible. Thus, on a lateral view it is the up lung that is effectively evaluated.

By obtaining both right and left lateral views, as well as a VD or DV projection, all the portions of the lung will be acceptably aerated on at least one of the views, without obscuring lesions or nodules.

On a related note, skin nodules/ticks/nipples can artifactually appear as pulmonary nodules. Differentiating these superficial structures from a true pulmonary lesion can be the deciding factor in a case, and thus it is a priority to determine the true location of the structure. The first thing I do if I cannot clearly identify the location of the nodule or mass on my multiple views is palpate over the patient's thorax, trying to find any bumps or lumps that may be fronting as a pulmonary lesion. The subcutaneous lumps may be mobile, depending on how loose the patient's skin is, so repeating a film after tugging on the skin to reposition it would be an easy next step. Often, I will place a dot of barium paste on the most elevated portion of a subcutaneous nodule, and repeat the radiograph to determine whether the superficial structure is the source of the lesion. Hot-lighting the overexposed areas of the films, especially at the peripheries, can help to visualize protrusions that otherwise are lost information.

A single lateral view may be satisfactory in order to determine successful placement of a nasoesophageal tube within the esophagus rather than the airway. However, it is of the utmost importance to visualize the cervical portion of the tube, where it extends from the nasopharynx and crosses through the upper esophageal sphincter, passing dorsal to the larynx. Obliquity on a radiograph in the layrngopharynx area, most commonly secondary to axial rotation of the alanto-occipital joint, makes it challenging to fully visualize the course of the tube. If there is any question as to the location, more radiographs would be required, since the ramifications of administering per os materials into the airway are devastating. Options are to obtain a VD view in which the esophageal tube is clearly on midline, extending to the caudal esophagus, near the cardia of the stomach (if it were in the airway, it would diverge laterally, following the course of a primary bronchus toward the periphery of the lung), or to inject into the tube a small volume (less than 1 ml) of a non-ionic, iodinated contrast medium (such as that used specifically for intra-thecal administration in myelography), and repeat the radiograph. Remember, standard ionic contrast medium and barium would be unacceptable for this usage. Because most practices do not stock a specifically non-ionic iodinated contrast medium, use of contrast media may not be possible.

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A Newer Immunosuppressive Drug and Its Increased Use in Our Critical Care Unit: Mycophenolate Mofetil (MMF)

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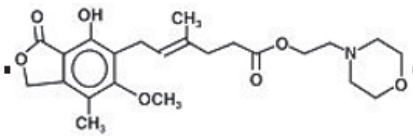

↗ Mycophenolate Mofetil (MMF).

Mycophenolate mofetil (MMF) is a pro-drug whose metabolite inhibits guanine (a purine) nucleotide synthesis. Both B- and T-cells rely on this pathway for proliferation. The drug has been used to treat rheumatoid arthritis, lupus, vasculitis, IBD, myasthenia gravis, immune-mediated hemolytic anemia (IMHA), and immune-mediated thrombocytopenia, and to prevent renal allograft transplant rejection in human patients. Its use has also been reported in veterinary literature. A recent journal article, by Dr. Bacek et al.[1], describes the use of MMF in two cats with primary IMHA. This was the first report in the literature that described the use of oral MMF as an adjunctive treatment in cats with primary IMHA.[2] Both cats survived and no adverse effects from the drug were reported. In addition, this drug's use has been described in an abstract of eight dogs with IMHA, in a dog with immune-mediated glomerular disease, a dog with pemphigus vulgaris, and dogs with canine myasthenics.[3,4]

↗ "Spauling" was treated with MMF and remains in remission.

Mycophenolate mofetil comes in the following formulations: pills, capsules, liquid, and injectable. In dogs the recommended dose ranges from 7 to 20 mg/kg PO BID, with the usual starting dose around 10 mg/kg. It can be given intravenously and has been given at 15–20 mg/kg diluted in 500 mL of 0.45% saline and 2.5% dextrose over four hours or 16 mg/kg IV over two hours.[4] It is thought that MMF may achieve immunosuppression before azathioprine, since a positive clinical effect may take several weeks[3] with the latter medication. In fact, some papers report rapid inhibition to occur within two to four hours after dosing of MMF.[5] Potential adverse side effects in people include bone-marrow suppression, leukopenia, sepsis, infection, gastrointestinal upset (nausea, vomiting, diarrhea), and hypertension. In dogs the most commonly seen adverse side effect is gastrointestinal upset, though in my experience it is not too severe except perhaps at the highest doses. Mild suspected allergic reactions have been reported with the parenteral preparation.[5] This medication has not been extensively reviewed in the veterinary literature and so its use and therefore efficacy remain controversial. Routinely, it is not a first-line immunosuppressive agent, and it is a fairly expensive drug. However, unlike some other immunosuppressive agents, blood levels need not be monitored to ensure efficacy.

Last year, MMF was used in our hospital to treat "Spaulding," who was managed by one of our emergency critical care residents, Dr. Roxanna Khorzad. "Spaulding" is a one-year-old CM Dachshund who was presented to Angell Animal Medical Center's Emergency service for labored breathing, not eating for two days, and vomiting. His physical exam and bloodwork were classic for IMHA. He had pale gums, icteric sclera, lethargy, and a II/VI heart murmur. Full bloodwork showed +2 spherocytes, autoagglutination, and polychromasia. His tick panel was negative. Whole-body radiographs and abdominal ultrasound did not reveal any abnormalities; therefore his diagnosis was primary IMHA. He was started on prednisone, cyclosporine, gastrointestinal protectants, and an anticoagulant. He needed four packed red blood transfusions prior to starting mycophenolate. After a few days on mychophenolate his red-blood-cell count stabilized and he was discharged from the hospital. His medications were tapered over a period of eight months, with mycophenolate as the sole agent keeping him in remission. All medications were stopped seven months ago and he remains in remission. Though it cannot be proven that the mycophenolate was the sole cause of his stabilization, clinically it seems like we have seen success with this medication.

The MMF used to treat "Spaulding" was ordered from outside pharmacies. However, recently our pharmacy has begun to stock MMF. We have Cellcept,® which can be given intravenously, and oral formulations (500 mg tablets, and a suspension that comes in 200 mg/ml). With these forms of medication, all of our patients can be dosed appropriately. A double-blind, placebo-controlled, prospective clinical study needs to be conducted to see if this drug decreases the length of hospital stay, and time to remission, in our patients with primary IMHA and other immune-mediated, small-animal diseases.

For more information about Angell's Emergency service, please visit angell.org/emergency. Angell's Emergency service doctors are available for consultation via phone or e-mail **(emergency@angell.org)** on weekends and after hours 7:00 a.m.–11:00 p.m. To reach an Angell criticalist by phone, please call **617 522-5011**. Dr. Megan Whelan of Angell's Emergency service can also be reached via e-mail at **mwhelan@angell.org**.

References:

1 Bacek et al. Treatment of Primary Immune-Mediated Hemolytic Anemia with Mycophenolate mofetil in Two Cats. *J Vet Emerg Crit Care* 21(1): 45–49, 2011.

2 Nielsen L, Niessen S, Ramsay M, Ramsay IK. The Use of Mycophenolate Mofetil in Eight Dogs with Idiopathic Immune-Mediated Haemolytic Anaemia. ECVIM Congress 2005 Proceedings.

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5 Whitley N, Day M. Immunomodulatory drugs and their application to the management of canine immune-mediated disease. *J Small Anim Pract* 52: 70–85, 2011. ■

Thoracoscopy at Angell

By Nancy Laste,
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It is hard to believe that it has been 13 years since I did my first thoracoscopic pericardectomy. Having completed over 100 cases, I thought it was time to summarize the Thoracoscopy program at Angell Animal Medical Center.

Thoracoscopy is the term for entry and exploration of the thorax using endoscopy which, when coupled with the use a video camera and monitor, facilitates VAT (video-assisted thoracoscopy). There are many indications for thoracoscopy but my main focus and experience have been in performing partial pericardectomy ("pericardial window") on dogs with recurrent pericardial effusion. The procedure eliminates future episodes of cardiac tamponade, which allows for less intensive recheck schedules. In addition, thoracoscopy provides some clues as to the etiology of pericardial effusion, particularly in those dogs that are "tumor-negative" on echocardiography. In these cases, the main differential diagnoses are occult right atrial (usually auricular) hemangiosarcoma, idiopathic fibrosing pericarditis (there are many other names for this non-neoplastic condition), and malignant mesothelioma. Malignant mesothelioma is a diffuse, malignant transformation of the lining cells of the pericardium, pleural space, or peritoneal cavity (and occasionally other mesothelial-lined spaces), resulting in persistent neoplastic effusion.

I prefer to hold off on thoracoscopy in tumor-negative dogs who present with a first-time effusion. The rationale for this is compound: first, the timing and pattern of recurrence is a helpful clue to the etiology (for example, most dogs with occult HSA will have a recurrent bleed, acutely within three weeks, whereas patients with a benign condition or mesothelioma are more likely to recur slowly and gradually). Second, although thoracoscopic pericardial biopsy is helpful in making a diagnosis of mesothelioma, the procedure will speed the spread of the disease from the pericardial space to the pleural cavity (if it is not present already). Many patients who are eventually diagnosed with malignant mesothelioma initially have long periods (months to years) between pericardial effusions. If the patients are tumor-positive on echocardiography, going ahead with a procedure is an individual decision. Most patients with a "heart base tumor" or a dense tumor adjacent to the aortic arch that is presumed to be a chemodectoma will have a favorable short- and long-term prognosis. These patients do tend to have recurrent pericardial effusion, and therefore often do quite well with a palliative thoracoscopic pericardial window. It is important to note that tumor location alone has been shown to be misleading when making a tentative diagnosis of a cardiac-associated tumor. If the tumor appears irregular, cavitary, or associated with the right heart, the clinical suspicion for hemangiosarcoma rises significantly. If there is recurrent pericardial hemorrhage within days, our clinical suspicion climbs. Hemangiosarcoma carries a poor long-term prognosis and is considered metastatic at the time of diagnosis. Palliative thoracoscopic pericardial window can be done to eliminate episodes of cardiac tamponade, but the tumor bleeding will in all likelihood persist and can lead to significant hemothorax. I have had mixed results with these cases, with some patients doing well for months and others for only days to weeks.

To summarize the overall results of the Angell thoracoscopy program: looking at well over 100 cases, the results have been excellent. The procedure is generally quick (average of 30 minutes operative time). The recovery is very quick (generally discharged one day post-operatively) and the pets and clients generally are happy with the results. To date, no patient has had recurrent pericardial effusion or tamponade after a pericardial window. The main potential complication is hemorrhage. Four cases to date have experienced clinically significant bleeding: one patient did not require therapy, two patients received a single transfusion of packed red blood cells, and one patient required multiple transfusions as well as a thoracotomy to identify and address the source of the bleeding (a severed aberrant branch of the internal thoracic artery). One patient (a diabetic) developed steatitis at one of the port sites. The remaining cases have not had any complications.

Our other main focus for exploratory thoracoscopy is for diagnosis of idiopathic pleural effusion. These cases are quick, low-risk, and high-yield. No complications have been noted. Potential additional indications include canine idiopathic chylothorax, vascular ring anomalies, and lung biopsy.

For more information or to discuss referral of a patient for thoracoscopic surgery, please contact me (Dr. Nancy Laste) at **nlaste@angell.org** or **617 541-5038**. For more information about Angell's Cardiology service, please visit angell.org/cardiology. ■

> Determination of Immunophenotype in Hematopoietic Neoplasms (Continued from Page 3)

For more information about Angell's Oncology service, please visit **angell.org/oncology**, e-mail **oncology@angell.org**, or call **617 541-5136**. You may also e-mail Dr. Mahoney at **jmahoney@angell.org**.

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Tips to Help Clients Brush Their Pets' Teeth

By Curtis Stiles,
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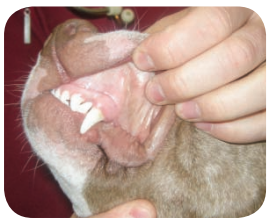
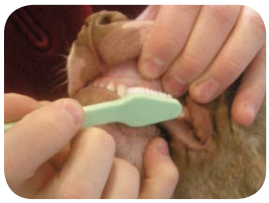
It has been said that "prevention is the best medicine." This is certainly true when discussing periodontal disease in cats and dogs. The "gold standard" for prevention is brushing, but it has been estimated that less than 10% (Linick S., *Veterinary Economics*, February 1, 2010) of our clients brush their pet's teeth daily. Following are some tips to help your clients develop an effective, successful, less stressful brushing routine with their pets.

- Introduce brushing when the pet is young and more malleable. Include a discussion of why it is important to brush and how to brush during one of the puppy and kitten visits.
- Inform clients that the bacteria in the plaque film that forms on their pets' teeth cause gingivitis that can lead to gum and bone recession, eventually resulting in the loss of teeth. Brushing will remove the film before it turns into tartar, and may prevent tooth loss in the future.
- Focus the client's attention on the outside surfaces of the teeth. The tongue usually does a good job of keeping the inside surfaces clean, and most pets dislike having their mouth opened.



- Recommend lifting the pet's lips and brushing his/her mouth when it is closed. A lot of pets do not appreciate having their mouth forced open and the mandibular teeth that are obscured by the maxillary teeth when the mouth is closed do not tend to develop significant plaque deposition.
- Encourage clients to brush the pet's teeth at least once daily about the same time every day and follow the brushing with a reward.
- Show clients how to brush the pet's teeth. Show the client how to lift up the lip and what is involved with brushing. Once shown how to brush the teeth, people often are surprised at how easy it can be.



Additional tips for more resistant pets — frequently the small breed dogs that are very prone to developing significant periodontal disease:

- The client should move the brush in small circles or back and forth on the visible teeth (buccal surfaces) with the bristles angled towards the gum line and the mouth closed.
- Suggest smearing the toothpaste on the teeth after brushing, if they want. For some animals this can be their treat after getting their teeth brushed.
- Be sure to remind owners to only use a pet toothpaste because human toothpaste can be harmful when swallowed.

For more information about Angell Animal Medical Center's Dentistry service, please visit **angell.org/dentistry**, e-mail **dentistry@angell.org**, or call **617 524-5643**. Additionally, Dr. Stiles can be reached at **cstiles@angell.org**. ■

> The Value of Orthogonal Views

(Continued from Page 4)

Finally, I would like to emphasize the importance of radiograph quality control. Rotated, poorly centered radiographs are hard to interpret, do not contribute to a diagnosis, and can be a waste of money. Repeating a poorly executed radiograph with an appropriate technique is invaluable, enabling visualization of a lesion made inconspicuous by under- or overexposure, or poor positioning. If you cannot interpret the radiographs due to poor technique, a radiologist will likely have just as much difficulty as you. If you or your technicians find yourself struggling with a patient, only to obtain mediocre radiographs, do not give up in frustration. Repeating the exam after sedating the patient will help you to help your patient. Sedating a patient is invariably money well spent.

I cannot reiterate enough that it is worth the extra time and effort to obtain a good-quality, complete set of radiographs. Orthogonal views will help you determine an accurate, three-dimensional assessment of your patient. Your own diagnostic ability will improve dramatically. And, if you are still stumped, we are always happy to consult with you and put in our two cents' worth.

For more information about Angell's Diagnostic Imaging service, please visit **angell.org/diagnosticimaging**, e-mail **diagnosticimaging@angell.org**, or call 617 541-5139. You may also e-mail Dr. Basseches at **jbasseches@angell.org**. ■

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Are your clients new to Angell? Send them to angell.org/directions for detailed directions to our location. Ample free parking on site.

We encourage you to e-mail Angell's specialists with questions. We hope you will use Angell as a resource, and we look forward to working with you as we continue our legacy of providing compassion and care for animals.

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