Interventional Cardiology

by Nancy J. Laste, DVM, DACVIM (Cardiology)

WHAT IS INTERVENTIONAL CARDIOLOGY?

As the name would imply, interventional cardiology refers to that subset of cardiology patients who are having some type of surgical procedure. Although this would include all patients having any type of open thoracic surgery, thorascopic surgery or catheter-based surgery, it is most typically the term used to describe interventions performed in the cardiac catheterization laboratory.

WHAT EXACTLY IS A CARDIAC CATHETERIZATION?

Cardiac catheterizations were commonly performed on veterinary patients with either congenital or acquired cardiac disease prior to the development of cardiac ultrasound. While echocardiography has abolished the need for routine catheterization, cardiac catheterization remains an important diagnostic test in patients with complex congenital disease. Although it can bring important information to any patient with cardiac disease, cardiac catheterization is now generally reserved for those patients who will have a therapeutic intervention of some sort (balloon catheterization, PDA closure, etc.).

The advances in pediatric equipment and the continued development of minimally invasive, catheter-based techniques in the past 10 years have led to greater success in a wider scope of patients with congenital heart disease than ever before.

Cardiac catheterization is performed under general anesthesia. In patients 10 kg or larger, catheter introducers are placed in the femoral artery/vein or both vessels. (In smaller animals, the jugular vein and/or carotid artery may need to be used.) Catheter introducers allow easy exchange of different catheter types through the vessels and

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Clinical Trial: Head Trauma in Dogs

Dear Doctors,
The Angell Animal Medical Center Emergency and Critical Care service is participating in a multi-institutional (seven participating centers), IACUC-approved, clinical trial funded by Cornell University (ACVIM and Emergency Critical Care Society grants) to further understand factors affecting outcome in dogs with head trauma. Head trauma is a common emergency in dogs and there are limited veterinary studies on this topic. We are evaluating blood glucose (sugar) concentrations and other values in dogs presenting to the hospital after experiencing head trauma. Prognosis in these cases can be very difficult to predict, and the results of this study may allow us to better inform clients whose pets sustain head trauma about their pets' likelihood of recovery. After identification and determining the significance of the biomarkers, the hope would be to identify new therapeutic targets for these patients.

This is a prospective, observational study. Specifically, the purpose of the study is to determine the prognostic significance of the following biomarkers (blood glucose, cardiac troponin I, blood pH, sodium and hemoglobin) in patients with moderate/severe traumatic brain injury (TBI). The hypothesis is that in canine patients with moderate to severe TBI, deviations and degree of changes to the biomarkers are associated with the MGCS (Modified Glasgow Coma Score), mortality, cost and length of hospitalization. The inclusion criteria for a case consist of a history of head trauma in the prior eight hours, physical evidence of head trauma (hemorrhage/abrasions/fractures) and an MGCS of <15. Owners would need to be willing to treat his/her pet as an inpatient and sign the client consent form to further understand factors affecting outcome in dogs with head trauma.

The inclusion criteria for a case consist of a history of head trauma in the prior eight hours, physical evidence of head trauma (hemorrhage/abrasions/fractures) and an MGCS of <15. Owners would need to be willing to treat his/her pet as an inpatient and sign the client consent form.

The goal is to enroll 60 dogs. If you would like to refer a case for possible enrollment, you can send the patient through our Emergency and Critical Care service: call Eleanor Cousino, our Referral Coordinator, at 617 522-5011. If you have any questions or would like to discuss a case, please feel free to call 617 522-5011 and have me paged, or e-mail mwwhelan@mspca.org.

Sincerely,

Megan Whelan, DVM, DACVECC
Angel Emergency and Critical Care service
Common liver diseases for which a dog may present early in the pathology that we can treat, and more importantly, treat early. It can be very difficult to I would argue that we should pursue dogs with non-clinical liver ill. By the time this dog is icteric, it may be too late to help. What do we do with the middle-aged or geriatric canine patient who is feeling well, you will find that the ALT was mildly to moderately elevated for a year or more before the dog became ill. By the time this dog is icteric, it may be too late to help. I would argue that we should pursue dogs with non-clinical liver enzymes elevations more aggressively. It can be very difficult to convince clients to pursue US and liver biopsy for a dog who is completely healthy as far as we can see, but I think it is our job as veterinarians to convince them that it is better to be proactive with these cases and find out if there is significant liver pathology that we can treat, and more importantly, treat early.

Common liver diseases for which a dog may present early in the course of the disease with minimal to no signs of illness include reactive hepatopathies, vascular hepatopathies, nodular hyperplasia, chronic hepatitis and even certain hepatic neoplasias. A US exam will help determine if there is a mass, but cannot definitively evaluate nodules to determine if they are benign or malignant. Dogs with reactive hepatopathies develop these as a sequel to an underlying disease, and often present with clinical signs referable to another organ system. For example, dogs with inflammatory bowel disease can have mild inflammation from uptake of GI toxins, and typically present with vomiting and/or diarrhea. Dogs with vascular hepatopathies and nodular hyperplasia are often asymptomatic, unless the vascular change is associated with hyperadrenocorticism, in which case they commonly present with the typical clinical signs of polyuria, polydipsia, polyphagia. Dogs in the early stages of chronic hepatitis are often clinically well, which is why modest liver enzyme elevation is often ignored or just monitored, with no further investigation.

The first stage of the work-up includes repeating the liver enzymes to see if the abnormalities persist. In a clinically well dog, I recommend repeating values in one month. If the values are still abnormal, the next step is abdominal US. Assuming a thorough history and PE as well as the remainder of the CBC, general profile and UA do not turn up any underlying disease or atrogenic reasons for the elevations (e.g., steroid therapy), liver biopsy is recommended. Even if the US reveals a normal-appearing liver, or only subtle changes such as a coarse echotexture or hyperechogenicity, this tells us very little about the true pathology. A diagnosis of vascular hepatopathy is markedly better than a diagnosis of chronic hepatitis, and should be treated very differently. If ALT is the only liver enzyme which is elevated, then I am less likely to pursue a liver biopsy rapidly in these cases, as this is a very common finding in middle-aged and older dogs. However, once there is elevation of ALT and/or AST, we need to know what is going on at a histopathologic level.

Once we have decided that a biopsy is necessary, the next question is how do we obtain it? We recommend obtaining all liver biopsies via laparoscopy, assuming the dog does not need a laparotomy for other reasons. Angel has both standard-sized and pediatric equipment, so no dog is too small for the procedure. It has been well documented that laparoscopic samples are far superior to US-guided needle biopsies. Surgical samples are also acceptable, however, the morbidity associated with laparoscopy is much less than that of surgery, and most of our patients go home the evening of the procedure. We can easily obtain enough liver tissue for copper analysis in addition to obtaining samples, and we rarely use this for culture. It has been demonstrated that bile yields more bacterial growth than liver tissue, so whenever possible we aspirate the gall bladder to obtain samples for aerobic and anaerobic cultures.

In summary, liver biopsy is a very useful tool for further defining liver disease in our canine patients, as well as guiding appropriate therapy. Dogs with advanced disease and cirrhosis have a very poor prognosis, many of them having one month to live or less. The earlier we can intervene in the cases of hepatitis, the better outcome we are likely to achieve. However, we cannot make the diagnosis without a liver biopsy, and with the use of laparoscopy we are able to obtain excellent-quality samples with low morbidity. Also, the cost of laparoscopy is only a few hundred dollars more than a US-guided biopsy, making it a cost-effective option for most clients.

For more information about Angel’s Internal Medicine service, please visit angel.org/internalmedicine. Angel’s Internal Medicine doctors are available for consultation via phone or e-mail (internalmedicine@angell.org) Monday–Friday 9:00 am–5:00 pm. To reach an Angel internist by phone or to refer a patient to the Angel Internal Medicine service, please call Referral Coordinator Eleanor Cusson at 617 522-5011. 

Treatment of Autoimmune Diseases of the Central Nervous System of Dogs

by Allen Sisson, DVM, MS, DACVIM (Neurology)

Several inflammatory, primary central nervous system (CNS) diseases of dogs have been described:

1. Granulomatous Meningecephalopathies (GME)
2. Neutrophilic Encephalitis of Pug, Maltese, and Yorkshire terrier dogs
3. Corticosteroid-Responsive or Neutrophilic Meningitis
4. Eosinophilic Meningecephalopathies
5. Idiopathic Tremor Syndrome or Cerebellitis

It is now suspected that these idiopathic diseases are due to abnormal immune system function (an autoimmune disorder).

Depending on where in the CNS these diseases start, they can cause a wide variety of signs such as:

1. Progressively worsening central vestibular signs
2. Progressively worsening seizures and behavior
3. Progressively worsening neck and/or back pain
4. Progressively worsening para- or tetraparesis often mimicking a disc herniation
5. Progressively worsening generalized severe-intention tremor
6. Acute onset of blindness

These signs can progress at various rates, but they are often acute (1–2 days) to peracute (8–12 hours) in duration. In the peracute form these CNS diseases are emergencies. If rapid neurologic deterioration is noted, immediate referral to a 24-hour emergency center or aggressive immunosuppressive therapy should be started until a spinal fluid analysis and advanced CNS imaging can be done to confirm the diagnosis. Since abnormal spinal fluid can be normalized within 24 hours of starting prednisone therapy, referral for diagnostic testing as soon as possible after initiating therapy is best.

High-dose, long-term immunosuppression is the key to successful therapy for all autoimmune diseases of the CNS. For this reason it is important that infectious causes of CNS inflammation be ruled out by diagnostic testing, since immunosuppressive therapy would worsen these conditions.

Corticosteroids, primarily prednisone, are the drugs of choice and are sometimes used as the sole therapy for neutrophilic meningitis. It is important that immunosuppressive doses be used initially, and therapy be sustained at high doses, very gradually tapered over many months, or relapses are likely to occur.

Prednisone causes many adverse effects. When these adverse effects are severe, they may require the prednisone dose be reduced or even stopped and another immunosuppressive drug to be used in its place or combined with a reduced prednisone dose. In addition, when immune-mediated encephalitis or myelitis is present, it is unlikely that prednisone therapy alone can lead to permanent remission. For this reason the neurology service at Angel Animal Medical Center now treats all immune-mediated CNS diseases with combination immunosuppressive therapy.

Dogs with immune-mediated meningitis are treated with prednisone and with the immunomodulatory drug leflunomide, which is a once-daily oral medication given for one year or in some cases longer. This drug inhibits T and B lymphocyte proliferation and function and is very effective. It is a bone-marrow suppressor and requires monthly CBC monitoring and initial dose adjustment based on leflunomide blood levels. For this reason it is preferred for immune-mediated meningitis cases to relapse, with most cases achieving permanent remission and coming off of all therapy within one year.

Most dogs with GME are treated with a combination of prednisone, leflunomide and monthly cytarabine injectable therapy given over a 48-hour period. This three-drug combination leads to long-term remission in over 90% of dogs after one to 1.5 years of therapy.

Pug dogs, Maltese and Yorkshire terriers that have necrotizing encephalitis are given a combination of prednisone, leflunomide, cytarabine, lomustine and cyclosporine modified. The cytarabine and lomustine are given monthly. 14 days apart, since both drugs cause leukoencephalopathy. It is important that immunosuppressive doses be used to achieve complete remission.

For more information, please visit angel.org/neurology. Angel’s Neurology doctors are available for consultation via phone or e-mail (neurology@angell.org) Monday–Friday 9:00 am–5:00 pm. To reach an Angel surgeon by phone or to refer a patient to the Angel Neurology service, please call Lisa Canale at 617 541-5140.
> Shockwave Therapy (Continued from Page 3)

weeks apart. Ap-
lications at Angell have been primarily for shoulder tendonopathies (biceps, supraspinatus), but they have also been recommended for patellar tendonitis post-TPLO; osteoarthritis; chronic back pain due to spondylosis, disc disease or lumbosacral instability; non-union or delayed union fractures; and chronic non-healing wounds such as lick granulomas. It has been used in humans for diabetic foot ulcers, and in equine medicine for suspensory ligament injuries, stress fractures, osteoarthritis and tendinosis. Cost treatment (not including sedation or hospitalization) is $250 for new cases, or $150 for patellar tendonitis cases that have had the TPLO done at Angell.

If you have any questions or cases that you think might benefit from shockwave therapy, feel free to e-mail me at creese@msmpca.org.

For more information, please visit angell.org/Surgery.

Angell’s surgeons are available for consultation via phone or e-mail (surgery@angell.org) Monday–Friday 9:00 am–5:00 pm. To reach an Angell surgeon by phone or to refer a patient to the Angell Surgery service, please call Referral Coordinator Eleanor Cousino at 617 522-5011.

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into the cardiac chambers. In a full cardiac catheterization, both the right and left heart are catheterized. Due to the differences in anatomy, the catheter paths are made into the left and right ventricles (subsequently) and the anatomy defined on cinematographic playback. Pressure oximetry samples are taken from the cranial and caudal right atria, the right ventricle, the pulmonary artery and the left atrium. This will identify any area of suspected shunting (ASD, VSD). Pressure tracings may be obtained on the right side (pullback tracing from the pulmonary artery-right ventricle-right atrium) to detect any evidence of pulmonary hypertension, pulmonic stenosis or tricuspid stenosis. Pressure pullback across the aortic valve on the left side will identify any degree of sub-aortic or aortic stenosis. These defects would have already been identified on Doppler and two-dimensional echocardiography, so pressure tracing is mainly for teaching purposes and to help identify the degree of improvement after balloon dilation. We do a full cardiac catheterization (catheterization of both sides of the heart, bilateral contrast angiography and a full oximetry “run”) to define all anomalies in patients with complex congenital disease. Most commonly, we do limited cardiac catheteriza-

tion to perform a catheter-based intervention (Amplatz ductal occlusion, balloon dilation of pulmonic stenosis, aortic stenosis).

WHAT ARE SOME COMMON INTERVENTIONAL PROCEDURES?

Patient ductus arteriosus: For over 10 years, the closure of a patent ductus arteriosus (PDA) could be accomplished in some patients using catheter-based delivery of polypropylene microcoils. However, many patients still required thoracotomy for ductal ligation, as only smaller PDAs with an appropriate tapering morphology were good candidates for coil embolization. In addition, the placement of coils could be tricky and sometimes resulted in embolization of a coil into the pulmonary arterial circulation. Patients who had unsuccessful procedures required a thoracotomy. Various occlusion devices are available for use in human patients for PDA closure. Although these devices sometimes used successfully in canine patients, their shape and design were not ideal for the canine ductus and the pricing of the devices remains high. In 2007 Infract Medical commercially released the Amplatz canine ductal occluder (ACDO). This device was specifically designed for the canine species. The device comes in a variety of sizes ranging from 3 mm to 14 mm. The ACDO has facilitated closure of most canine PDA sizes and shapes in the cardiac catheterization lab. Although the device is not expensive ($600 USD), the pricing was made as veterinary-friendly as possible. Procedural simplicity has reduced anesthesia time, off-loading the equipment expense. Obviously, avoiding thoracotomy significantly reduces recovery time and intensity of post-operative management and expense. When presented with a patient with a PDA, the ductal size and shape are determined echocardiographically, paying close attention to measurements of the pulmonic ostium (where the ductus con-
nects with the main pulmonary artery). This allows approximate determination of occluder size and associated delivery catheters. A full range of device sizes is stocked, so the angiographic measurements do not always correlate perfectly with those taken from the echocardiogram. Once the patient is under general anesthesia, vascular entry is achieved from the femoral artery. A calibration catheter is positioned into the ascending aorta and a contrast injection is made to evaluate the size and shape of the ductus. Precise measurement and selection of the proper device size, the most critical part of the procedure. The ACDO is delivered through a catheter directed through the ductus into the main pulmonary artery. The ACDO is advanced until the proximal phalange is deployed. The catheter is then pulled back into the ductus until the phalange engages at the pulmonic ostium. The second phalange is then deployed into the ductal ampulla where, if sized and positioned appropriately, it will be in a stable, secure position. Complete closure of the ductus is noted within 15 minutes of placement. Procedural morbidity is very low, and we have not had any unfavorable outcomes to this procedure thus far. The main limitation for the use of the ACDO has been the size of the patient as the delivery devices range in size from 6 to 8 French outer diameter (quite large compared to the small vessels). Patients ranging in size from 3 kg to 32 kg have been successfully treated using the conventional ACDO, making this the preferred therapeutic option for most patients with patent ductus arteriosus. While size limitation prevents changes in devices below 3 kg, a prototype device is now being tested which will have a very low collapsed profile, enabling delivery via a 4 French catheter, which will allow use of the same technique in even the smallest patients. Precise sizing of the device is critical, as errors in anatomical definition can be the biggest factors in procedural success. We are fortunate to have state-of-the-art C-arm digital cinematography allowing multi-plane imaging which, when coupled with high-pressure auto-injection, provides precise anatomical delineation.

Balloon dilation of pulmonic stenosis: The develop-
ment of small-profile, high-pressure balloon catheters ensures that these patients still die at the same rates as non-operated dogs. Here success is predicated on appropriate patient selection so they may require referral to a specialized center (Texas A&M).

WHAT DO I REFER A PATIENT TO? For more information, please visit angell.org/cardiology. Angell’s cardiologists are available for consultation via phone or e-mail (cardiology@angell.org) Monday–Friday 9:00 am–5:00 pm, Saturdays 9:00 am–3:00 pm. To reach an Angell cardiologist by phone or to refer a patient to the Angell Cardiology service, please call Sandra Russo at 617 541-5038 or feel free to use our Emergency and Critical Care service as needed.
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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Are your clients new to Angell? Send them to angell.org/directions for detailed directions to our location. Ample free parking on site.