Key Points:

- Percutaneous transjugular coil embolization (PTCE) is a minimally invasive image-guided technique used for the attenuation of intrahepatic portosystemic shunts.
- Cross sectional imaging is important for gaining a detailed anatomic understanding of the vascular anomaly.
- Fluoroscopic guidance is utilized during the coil embolization procedure which creates a favorable pressure gradient between the portal venous system and the central venous circulation (caudal vena cava) allowing for the development of portal perfusion of the liver.
- Further evaluation of the PTCE procedure is needed to optimize the utilization of this technique in the future.

Intrahepatic portosystemic (IHPSS) shunts most often affect large to giant breed dogs. Breed predispositions include the Labrador Retriever, Bernese Mountain Dog, and Irish Wolfhound. Small breed dogs are rarely affected by IHPSS. Traditional management of IHPSS is through surgical intervention. The literature clearly demonstrates that dogs with intrahepatic portosystemic shunt (IHPSS) have a very high incidence of surgical morbidity and mortality.

Multiple techniques for endovascular attenuation of IHPSS have been described. The most commonly utilized technique is the Percutaneous Transjugular Coil Embolization (PTCE) technique (stent supported coil embolization) and it is associated with low peri-procedural morbidity and mortality.

Signalment and clinical signs coupled with clinicopathologic abnormalities often raise a high index of suspicion for the presence of portosystemic shunting. Diagnostic imaging techniques are able to confirm the presence of an intrahepatic shunt in most instances. Ultrasonography is often able to confirm the presence or absence of IHPSS, but is often unable to provide very specific anatomical detail about the shunt. To prepare for PTCE, the exact anatomy of the shunt is identified using Helical CT Portography (CT Angiography (CTA)). Briefly, a timing bolus of sterile non-ionic iodinated contrast agent is administered via a peripheral vein while continuously scanning the same region (slice) of the abdomen. This is usually at the level of T12-13. Time to maximum opacification of the portal system is noted. A second large bolus of sterile iodinated contrast agent is administered and the entire abdomen is scanned. Dual phase CTA is a similar technique that provides images of both the arterial and portal venous systems and can be useful for further identification of the anatomy of the hepatic arterial, central venous, and portal venous systems.

Once the anatomy of the shunt is identified, the endovascular repair is performed under fluoroscopic guidance. Some clinicians separate the CTA from the PTCE procedures to spread the total dose of iodinated contrast agent over two days. The author has been able to modify the CTA study to minimize total dose of iodinated contrast agent utilized such that both the CTA and PTCE procedures can be safely performed during a single anesthesia event.

The patient is positioned based on the location of the shunt. Dogs with left and right divisional IHPSS are most often placed in VD recumbency while those with central divisional IHPSS are most often placed in lateral recumbency. A radiopaque stent guide is placed on the
table, under the patient, in a location parallel to the vena cava, opposite the side where the shunt enters the cava. A vascular sheath introducer (10-12F) is placed in the jugular vein for the introduction of catheters, wires and the stent while providing hemostasis. Angiograms are performed of both the portal system and the caudal vena cava to help localize the anatomic relationship of the junction of these two structures. Angiography of the vena cava during a positive pressure breath hold maximally distends the abdominal vena cava such that an appropriate caval stent size can be chosen (approximately 20% larger than the caval diameter). An appropriately sized caval stent is deployed in the caudal vena cava across the mouth (junction of the shunt and the caudal vena cava) of the shunt (Figure 1). Through the stent, embolic coils are placed to partially attenuate the shunt while concurrently monitoring portal pressures (through the same catheter) (Figure 2). Physical attenuation of the shunt occurs initially due to the presence of the fibered embolization coils. These coils also trigger clot formation at the site. This clot formation and subsequent fibrosis further attenuate the shunt. Creation of an initial 5-10mmHg pressure gradient between the vena cava and portal system is traditionally achieved. The resulting increase in portal pressure results in increased hepatic portal flow, subsequent liver growth and development, and thus patient growth and development (Figures 3 and 4).

The author has been involved with approximately 43 PTCE procedures (23 at MSU) with <5% perioperative mortality (seizures). Causes of morbidity (procedural or post-procedure) have included mild neurologic signs (<5%), minor bleeding from the access site (<5%), and development of portal hypertension (<10%). One dog with acute portal hypertension (four days post-procedure) required a second intervention. Dogs are most often discharged <24 hours after their procedure. The PTCE procedure is a technique that minimizes morbidity and mortality when contrasted with open surgical intervention. It is this short term outcome that guides the procedure. Approximately 35% of dogs the author has treated at MSU require a secondary procedure for the addition of more embolization coils to further attenuate the IHPSS. Long term outcome is similar to dogs undergoing surgical intervention.

As with many “new” procedures, there is a paucity of clinical studies describing the technique and its outcomes. Questions that remain unanswered include:

- What is the optimal pressure gradient to initially create between the portal and systemic (vena cava) circulations?
- What is the optimum age for treatment?
- Are there predictors (based on shunt anatomy) that will help predict outcome?
- What is the long-term outcome of dogs treated with PTCE? Do they live a full lifespan?
- Multiple acquired IHPSS are a sequela in some patients treated by PTCE. What is the incidence of this outcome and how is it optimally managed?
- Should complete attenuation of the shunt (eventually) be the goal or is some shunting still acceptable?

We hope that in the future, some of the answers to these questions will help the PTCE technique evolve to optimally manage our canine patients.

References and Suggested Reading


Figure 1: An appropriately sized caval stent is deployed in the caudal vena cava across the mouth (junction of the shunt and the caudal vena cava). The catheter is placed across the mouth of the stent into a left divisional IHPSS.
Figure 2: Through the stent, embolic coils are placed to partially attenuate the shunt.

Figure 3: Coronal image from a dog with IHPSS before treatment. Note the size of the right liver lobe and the lack of portal venous branching.
Figure 4: Coronal image from the dog in Figure 3 after treatment. Note the development of the right liver and the development of portal venous branching.