

FLUROSCOPY: INTRAVASCULAR TREATMENT OF PORTOSYSTEMIC SHUNTS IN TOY BREEDS AND CATS

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CLINICAL PATHOLOPHYSIOLOGY INTRAHEPATIC PORTOSYSTEMIC SHUNTS

Congenital intrahepatic portosystemic shunts (CIHPSS) are vascular anomalies which divert portal blood away from the liver. Vascular deprivation leads to hepatic underdevelopment, insufficiency and in many cases, liver failure. Hepatic failure can be associated with many morbid clinical consequences including: seizures, ataxia, obtundation, anorexia, vomiting, diarrhea, pollakiuria, stranguria and death.¹⁻³ Consequently, surgical intervention aimed at perfusion of the starved liver is recommended.⁴⁻¹⁰ To date, a number of surgical techniques have been recommended to correct perfusion of the liver in dogs with CIHPSS. Surgical techniques can be divided into *extravascular* and *intravascular* and can result in either *partial* or *complete* attenuation of the aberrant portal blood flow. Gradual occlusion has been performed most frequently because complete occlusion of CIHPSS is rarely feasible.⁴⁻¹⁵ Partial suture ligation has been reported most commonly in veterinary medicine.^{4,5,11,12,16} Partial suture ligation causes sudden, nonprogressive attenuation, and persistent vascular shunting which may lead to persistence of clinical signs and a poor outcome in some dogs. Perioperative complications range from 40-77%, perioperative mortality ranges from 13-27% and median survivals were between three and four years.^{4,5,11,12,16} To overcome the limitation of static attenuation, gradual occlusion devices have been utilized to eliminate persistent shunting in dogs with CIHPSS. Ameroid constrictors, cellophane bands and hydraulic occluders have been used clinically and they cause progressive gradual attenuation.⁶⁻⁸ Clinical results were improved when compared to previous reports with perioperative complications ranging from 9-55%, perioperative mortality ranging from 0-27% and 2-year survival between 60-80%.⁶⁻⁸ More recently, the results of intravascular, percutaneous, transvenous, coil embolization (PTCE) for CIHPSS attenuation in dogs have been reported with improved clinical outcomes.¹⁷⁻²⁰ In these series, perioperative complications ranged from 8-16%, perioperative mortality was 5-8% and median survivals were > 6 years.^{17,19,20} In one recent study comparing outcomes between PTCE and cellophane banding, postoperative complications were significantly more frequent and hospitalization time was 3 times longer in the cellophane banding dogs.¹⁹

Given that most dogs with CIHPSS are large breed, there has been question about the efficacy and technical differences in treatment of small breed dogs. While small- and toy-breed dogs rarely present with CIHPSS, these cases may be more difficult to manage surgically due to their small size and may therefore experience different outcomes than previous reports which include predominantly large breeds. A recent retrospective study from two academic institutions evaluated the technical differences and clinical outcomes in a series of twenty small- and toy-breed dogs with CIHPSS.²¹ In this study, 60% of dogs had right-, 30% left- and 10% central-division CIHPSS. The initial mean gradient between the portal and central venous pressures was 1 mmHg, and post PTCE mean gradient was 6 mmHg. The most commonly used stent size was 18x80 mm, followed by 14x60 mm, 16x80 mm, 20x80 mm, 22x80 mm, and 10x20 mm. Coil diameter ranged from 3-8 mm, and a mean of 6 coils were placed. Complications occurred in 4/20 dogs (20%). All complications were grade 1 (55%) or grade 2 (45%), and included hypotension, hypothermia, bradycardia, ventricular premature contractions, and hypercapnia. A grade 1 post-operative complication occurred in 1 dog, who regurgitated at the time of extubation. All dogs survived to discharge at an average of 3 days postoperatively. Follow-up time ranged from 36 to 1,705 days (median 413.5 days). Clinical signs resolved in 95% of dogs, and median time to resolution of clinical signs was 21 days.

PATIENT POSITIONING AND TECHNICAL DESCRIPTION

A summary of the PTCE procedure is described here. However, the reader is referred to a complete textbook on the procedure and instrumentation required before attempting in client-owned dogs.¹⁸ Dogs are positioned in dorsal recumbency (left and right division IHPSS) or left lateral recumbency (central division IHPSS) for PTCE. The cervical region is clipped and prepared using aseptic technique. The Seldinger method is used to place a 9 Fr or 12 Fr introducer in the right external jugular vein (EJV) depending on the type and size of caval stent to be placed. In small- and toy-breed dogs, smaller diameter caval stents are often used which can be placed using a 9 Fr introducer sheath. Fluoroscopy is used to guide placement and position of the introducer. A 4 French, 65 cm, 0.035 Angiographic (Berenstein/Kern) catheter is then used to select the shunt and a 5 French, 65 cm, 0.035 Angiographic (Marker) catheter is placed along side the 4 Fr. catheter into the caudal vena cava for calibration. Resting caudal vena cava and portal pressures are measured using a transducer. A manual breath-hold maneuver is performed by the anesthetist and a combined digital subtraction porto-cavogram is performed using 6-8 mls of iodinated contrast diluted 1:1 in sterile saline and measurements made/confirmed for stent and coil selection. An 0.035, 260 cm, straight tip exchange length Guide wire is advanced into the caudal vena cava via the marker catheter and the marker catheter is removed. Next, a self-expanding, laser-cut Nitinol stent (Vet-stent Cava) is advanced over the guide wire and deployed with the dog temporarily paralyzed. The stent is placed to maximize coverage of the portosystemic shunt ostium (minimum of 2 cm on either side) and to maintain adequate distance from the right atrium of the heart and right renal vein. Commercial caval stents generally range in size from 14 Fr to 28 Fr. In some toy-breed dogs smaller stents are needed. In these instances, both laser cut urethral stents or open-cell vascular stents designed for coronary arteries can be used. Stent diameters for these stents range from 6 Fr to 14 Fr. Following stent placement, a 4 French, 100 cm, 0.038 Angiographic Kerns catheter is advanced over the guide wire and the guide wire removed. The Kerns catheter is used to select the portosystemic shunt across the stent and beyond the level of the caval ostium. A 0.035, 150 cm, hydrophilic glide wire is used to guide the catheter progressively into the shunt. The pressure transducer is attached to the Kerns catheter for continuous portal pressure monitoring. A Cobra-style or second Kerns angiographic catheter is advanced along side the Kerns catheter and used to select the shunt across the stent just inside the caval ostium. Careful attention to the size and length of the shunt ostium is critical to select and place coils safely, especially in small- and toy-breed dogs and cats. Digital subtraction angiography is performed to confirm appropriate position within the shunt. Next, 0.035 platinum coils are deployed into the shunt via the Cobra catheter immediately adjacent to the vena caval stent. The size and shape (cylindrical versus tornado) of the coils depends on the size and morphology of the portosystemic shunt which in small- and toy-breed dogs tends to be smaller with a narrower landing zone. For medium- and large-breed dogs typical coil diameter is 7-to-8 mm whereas in small- and toy-breeds 3-to-4 mm is more appropriate. **Figure 2** Combined portocavogram (C) and post-PTCE angiogram (D) in a dog with a right IHPSS.²¹ The current recommendations are to increase the portal-caval pressure gradient by 5-6mmHg. Once the target portal pressure increase is reached, a final digital subtraction angiogram is performed and a plain radiograph obtained to document implant position. The introducer sheath is removed and digital pressure (with or without an interrupted stitch in the vessel wall) is applied for 25 minutes to the venipuncture site for hemostasis.

FIGURE 1. Survival curve for 20 small or toy-breed dogs with CIHPSS treated by PTCE.

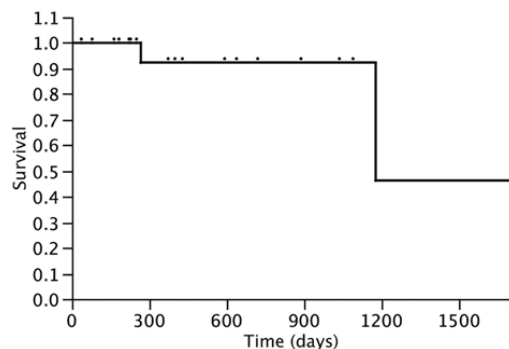
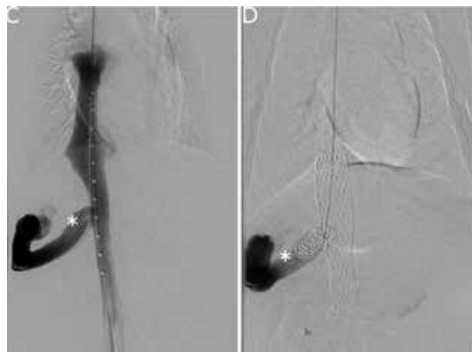


FIGURE 2. Fluroscopic angiographic image of a small-breed dog before (C) and after (D) PTCE.



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