Interventional Radiology and the referral patient - stents, biopsies, advanced imaging

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Interventional radiology (IR) refers to the use of advanced imaging techniques including ultrasound, fluoroscopy, CT, endoscopy, and MRI to obtain biopsies for diagnostic information or to deliver various agents or devices for treatment of disease. In some cases, interventional radiology techniques offer the only realistic approach to treating an animal when they minimize costs and/or potential stricture.

Advantages and Disadvantages

The use of IR techniques in veterinary patients offers a number of advantages to more traditional therapies. These procedures are minimally invasive and can therefore lead to reduced peri-operative morbidity and mortality, shorter anesthesia times, decreased pain, shorter hospital stays, and often a more rapid return towards good health. Some less equipment-intensive procedures can result in reduced costs as well. In addition, some techniques such as chemoembolization of tumors or palliative stenting for malignant obstructions offer treatment options for patients with various conditions that may not be amenable to standard therapies or when the standard-of-care treatments are associated with excessive morbidity, cost, or poor outcome.

The primary disadvantages of IR include the required technical expertise that is not part of traditional veterinary training, the specialized equipment necessary (fluoroscopy with or without digital subtraction capabilities), and the initial capital investment necessary to provide a suitable inventory of catheters, guide wires, balloons, stents and coils. Radiation exposure to personnel can be substantial when using fluoroscopic guidance and full lead gowns, thyroid shields, and leaded glasses are recommended.

Some of the more common disorders treated with interventional radiology procedures include:

1. **Tracheal collapse correction with intraluminal stents:**

   Older toy and small breed dogs that present with “goose honking” coughs often suffer from some degree of tracheal collapse. If caught early, medical management such as cough-suppressants, bronchodilators, anti-inflammatories, weight loss, exercise restriction and/or removal of allergens such as smoke is initiated for these patients to help control clinical signs. When these therapies fail, or if an animal presents in such severe respiratory distress that it does not have time to respond to even the most aggressive medical management, immediate recovery of a normal tracheal luminal diameter is the only option. While extra-tracheal ring prostheses are very successful with an efficacy of 75-85% for extrathoracic tracheal collapse, the significant surgical complications such as laryngeal paralysis, the need of a permanent tracheotomy, or perioperative death can be seen. Even higher surgical morbidity can be seen when intrathoracic tracheal collapse is present. Using fluoroscopy, IR assisted intraluminal self-expanding metallic nitinol stents can be placed in the cervical and/or intrathoracic trachea. This is a minimally invasive procedure, the stents have excellent flexibility, and they can be overlapped when the length of collapsing trachea exceeds the length of available stents with a
given diameter. At the University of Missouri, we have admitted some patients that received intraluminal stents using IR as an emergency procedure necessary to save them and a few others whose tracheas collapsed after surgery for something unrelated and could not be weaned off the ventilator until a stent was placed. Any other underlying or contributing disease such as small airway disease, heart disease, obesity, and treatable components of brachycephalic airway syndrome should be addressed concurrently or optimally prior to tracheal stent placement whenever possible. Complications associated with intraluminal tracheal stent placement include stent shortening or fracture, excessive granulation tissue, progressive tracheal collapse. Medications usually remain necessary and many dogs retain a mild cough.

2. **Diagnostic and therapeutic angiography:**
   
   a. Balloon valvuloplasty for pulmonic stenosis
   
   b. Canine ductal occlusion for patent ductus arteriosus (PDA)
      
      Embolization coils can be placed through an intravenous catheter into the PDA or an Amplatz canine ductal occluder can be inserted.
   
   c. Temporary and Permanent Pacemakers for Bradyarrhythmias
   
   d. Stenting and Coil Embolization for Hepatic Shunts (Intravascular)
      
      Portosystemic shunts (PSS) are abnormal vascular communications between the portal venous system and the systemic circulation and can be diagnosed non-invasively using ultrasound and portal scintigraphy (transcolonic or splenic). Ultrasound is 81% sensitive but only 67% specific. Nuclear scintigraphy has greater sensitivity and specificity in detecting portosystemic shunts, but does not allow differentiation between intrahepatic and extrahepatic shunts. Definitive identification and anatomic characterization of the PSS can be achieved minimally invasively with interventional diagnostic angiographic procedures, such as transvenous retrograde portography. This type of portography is a minimally invasive interventional diagnostic procedure that can provide definitive anatomic localization of the PSS and does not require a celiotomy like mesenteric portography does. Most congenital portosystemic shunts are extrahepatic in origin and the surgical occlusion success rate is high. Intrahepatic portosystemic shunts are less common, are surgically challenging for veterinary surgeons to treat, and have a high morbidity and mortality rate. A balloon jugular catheter is passed into the caudal vena cava and pressure measurements can be performed. Next, the cava is occluded and non-ionic iodinated contrast is administered resulting in retrograde filling of the abdominal vena cava and any PSS. After localizing the shunt, thrombogenic coils can be used for staged embolization with or without stent placement. Complications can include coil migration into the heart and lungs.
   
   e. Embolization of arterio-venous malformations
   
   f. Transarterial embolization of hepatic or renal tumors
   
   g. Directed treatment material deposition of various tumors (radioactive isotopes, chemoembolization)
Percutaneous arterial embolization with and without chemoembolization techniques can be performed. Arterial embolization allows particulate material to be delivered directly to a location by use of a selective catheter in order to occlude vascular malformations (most commonly shunts), control hemorrhage, or reduce malformations. With chemoembolization, chemotherapy is delivered directly to the tumor which can result in a 10-50 times higher intra-tumoral drug concentration than systemic chemotherapy with less systemic toxicity. This may be of special benefit in non-resectable hepatocellular carcinomas.

3. **Urinary tract stenting**

   a. Urethral stenting (retrograde or antegrade)
      
      i. Bypass bladder, intra-urethral, and/or prostate tumors
      
      ii. Canine incontinence

   Transitional cell carcinoma (TCC) is a common neoplasia of the urinary bladder and urethra of dogs. Urinary tract obstruction occurs in approximately 10% of TCC cases due to the location and severity of local tumor progression. This local disease leads to death in up to 60% of cases. Hydronephrosis is a common sequelae to the obstruction.

   Prostatic neoplasia (most commonly adenocarcinoma) is another common tumor that affects the urinary tract in male dogs. Clinical signs in this disease are associated with the local effects of the tumor in up to 40% of these dogs and include stranguria as well as tenesmus. Hydronephrosis can also occur when these tumors grow cranially up the prostatic urethra into the bladder trigone. Minimally invasive techniques to palliate the clinical signs associated with local disease include ultrasound guided laser ablation, as well as balloon expandable and self expanding metallic urethral stents placed with fluoroscopic guidance. In addition, interventional radiology can be used for treatment of prostatic tumors like those enrolled in a current MU CVM study using radioactive gold nanoparticles placed into prostatic tumors using CT guidance.

   b. Ureteral stenting

   Ureteral stents can also be placed for both benign obstructions such as those caused by a ureteral stricture or calculus, as well as malignant obstructions e.g., TCC occluding the ureterovesicular junction.

4. **Nasopharyngeal Stenosis:**

   Animals that suffer from nasopharyngeal stenosis have narrowing of the nasopharynx caudal to the choanae. This narrowing results in stertorous breathing with an exaggerated inspiratory effort. Patients often present with a complaint of severe mucoid to mucopurulent nasal
discharge that has lasted for long periods of time (sometimes years). Nasopharyngeal stenosis is more common in cats than dogs, and can be congenital or acquired in etiology. Balloon dilation has been used successfully as have numerous surgical procedures but recurrent stenosis can occur with balloon dilation and surgery is invasive and can require a long anesthetic procedure. An alternative treatment is the placement of a balloon expandable metallic nasopharyngeal stent. It can be performed rapidly and was reported to be effective in relieving clinical signs for 12-28 months.

5. **Parathyroid tumors** – Ultrasound guidance is used to guide a needle into the parathyroid gland/tumor to inject ethanol into the tumor for chemical ablation.

References


**Some of the Veterinary facilities currently offering Interventional Radiology:**

Cornell University Veterinary Specialists

UC Davis, CA - William R. Pritchard Veterinary Medical Teaching Hospital

University of Georgia College of Veterinary Medicine

Michigan State University Veterinary Teaching Hospital

Mississippi State University’s College of Veterinary Medicine

*University of Missouri Veterinary Teaching Hospital

North Carolina State University Randall B. Terry, Jr Companion Animal Veterinary Medical Center

The Ohio State University Veterinary Medical Center

Oregon State University – Lois Bates Acheson Veterinary Hospital

University of Pennsylvania’s Ryan Veterinary Hospital

*Purdue University College of Veterinary Medicine (cardiology procedures)

Texas A&M University’s Veterinary Hospital

Tufts University – Cummings School of Veterinary Medicine

University of Wisconsin-Madison Veterinary Medical Teaching Hospital

Washington State University Veterinary Medical Hospital

The Animal Medical Center in New York *Chick Weisse VMD, DACVS

VetMed referral hospital in Arizona

Veterinary Specialty Center(s) – (Buffalo Grove, Chicago, and Crystal Lake IL; Mount Pleasant WI)

VCA Northwest Veterinary Specialists

NorthStar VETS Robbinsville, NJ