Interventional radiology is a subspecialty of diagnostic radiology that uses minimally invasive techniques performed under imaging guidance. Interventional radiology has its roots in angiography, which is the radiologic examination of blood vessels after the introduction of a contrast medium that allows them to be imaged. Going forward, the collaboration between human and veterinary interventional radiologists will persist as a two-way street and will continue to innovate together and learn from each other and from the patients.

Interventional radiology in veterinary medicine was adapted from techniques developed in human medicine and has a variety of applications to treat disease in multiple body systems. Fluoroscopy is required for almost all interventional procedures, requiring knowledge of proper safety techniques for working with ionizing radiation. There are a wide variety of catheters, wires, sheaths, stents, and embolics used in veterinary medicine. Familiarity with their indications and sizing compatibility is essential for procedural success.

Chondromalacia of the tracheal and bronchial cartilages and redundancy of the dorsal tracheal membrane result in collapse of the large airways, leading to coughing and airway obstruction. It most commonly affects small-breed dogs, although larger-breed dogs, cats, and miniature horses are also sporadically reported. Dynamic airway imaging is used to confirm the diagnosis. The primary goal of medical management is to control clinical signs attributable to coughing and airway inflammation. When this is no longer effective, tracheal stents provide a minimally invasive, rapid way to restore airway patency. Bronchial stenting is in its infancy in veterinary medicine.

Vascular malformations are abnormal connections between blood vessels that can have various endothelial characteristics. Although uncommon, these malformations can present challenging diagnostic and therapeutic

Interventional Radiology Management of Vascular Malformations: Portosystemic Shunts and Vascular Fistulae/Malformations

William T.N. Culp and Maureen A. Griffin
scenarios. The use of interventional radiology techniques in the management of various vascular malformations is an attractive option because of the ability to treat these malformations at the most appropriate anatomic location and in the most effective manner. Techniques such as coil embolization of intrahepatic portosystemic shunts and liquid embolization of arteriovenous fistulae/malformations have shown tremendous potential as treatments for these challenging diseases.

Cardiac Interventions in Small Animals: Areas of Uncertainty 797
Brian A. Scansen

There remain areas of uncertainty in optimal technique, preferred candidates, and expected outcome for small animal patients undergoing cardiac intervention. This article highlights issues within interventional cardiology that are in need of study and offers the author’s opinion and experience on topics such as variants of pulmonary valve anatomy and alternatives to conventional balloon dilation for pulmonary valve stenosis, patient selection for cutting or high-pressure balloon dilation of aortic valvar or subaortic stenosis, occlusion of patent ductus arteriosus in very small dogs, ductal stenting in conditions with reduced pulmonary blood flow, and alternative considerations for vascular access and closure.

Interventional Radiology Management of Vascular Obstruction 819
Marilyn Dunn and Brian A. Scansen

Vascular obstructions in small animals have numerous causes and variable signs depending on location and chronicity. The decision to treat and by which method (medical, interventional, surgical) can be challenging. A combined approach of catheter-directed thrombolysis, angioplasty, or vascular stenting may be most appropriate for acute thrombosis, although optimal therapeutic strategies are undefined in this population. The role of embolic trapping devices in animals is uncertain. Chronic cases of vascular obstruction, with collateral flow and neither ischemia nor venous congestion manifest, may be conservatively managed. Prospective clinical studies are needed to better guide management of vascular obstructions in veterinary medicine.

Interventional Radiology and Interventional Endoscopy in Treatment of Nephroureteral Disease in the Dog and Cat 843
Alexander Gallagher

Interventional endoscopy and interventional radiology have led to the development of minimally invasive techniques for management of kidney and ureteral diseases in the dog and cat, including idiopathic renal hematuria, ureteral obstruction, and ectopic ureters. Sclerotherapy is a renal-sparing chemical cauterization technique used in cases of idiopathic renal hematuria. Diagnosis of ureteral obstruction is challenging in some cases based on ultrasound imaging alone, and antegrade pyelography should be considered. Treatment options for obstructions include nephrostomy tubes, ureteral stents, and subcutaneous ureteral bypass devices. Treatment with cystoscopic-guided laser ablation provides similar outcomes to surgery in dogs with intramural ectopic ureters.
Interventional Management of Urethral Obstructions  
Matthew W. Beal

Lower urinary tract (LUT) emergencies are common reasons for small animal patients to be presented to their veterinarians. Patient stabilization and management of life-threatening problems is a priority in this population. Urethral obstruction is a common LUT emergency. Urethral stent placement has gained popularity over the past decade, allowing for a minimally invasive, image-guided method for relief of urethral obstruction in some patient populations. This article focuses on candidate selection, diagnostic workup, stent placement technique, and the expected outcome and complications for patients undergoing urethral stent placement and addresses some additional strategies for interventional management of LUT emergencies.

Minimally Invasive Management of Uroliths in Cats and Dogs  
Andréanne Cléroux

Urolithiasis commonly affects cats and dogs. The American College of Veterinary Internal Medicine established guidelines for the treatment of uroliths that reflect modern techniques prioritizing minimally invasive procedures, with an emphasis on prevention strategies to limit morbidity and mortality. Extracorporeal shockwave lithotripsy and endoscopic nephrolithotomy constitute some of the minimally invasive treatment modalities available for upper urinary tract uroliths. Cystoscopic-guided basket retrieval, cystoscopic-guided laser lithotripsy, and percutaneous cystolithotomy are minimally invasive options for the management of lower urinary tract uroliths. Following stone removal, prevention strategies are essential to help reduce morbidity and mortality associated with stone recurrence.

Interventional Radiology Management of Nonresectable Neoplasia  
William T.N. Culp

Whenever possible, surgical removal of tumors should be pursued because this likely allows for the best possible outcome for a particular patient; however, this may not be pursued for various reasons. In those situations, interventional radiology (IR) options can be considered as definitive therapy or palliation. Locoregional therapies such as intraarterial chemotherapy and embolization/chemoembolization, although rarely reported in veterinary medicine, offer an alternative minimally invasive treatment option. In addition, drainage of body fluids or neoplastic effusions can be established via IR means, and when tumors are not removed but luminal patency needs to be reestablished, palliative stenting can also be performed.