The purpose of this talk is to define Interventional Radiology, present some of the equipment involved, and describe the minimally invasive and long-term treatment options for ureteral and urethral obstructions.

Interventional radiology (IR) is a rapidly growing medical subspecialty which utilizes minimally invasive image-guided procedures to diagnose and treat nearly every organ system. The first human interventional radiology procedure was an angioplasty in 1964. The human IR field has made tremendous technological advances over the past 30 years; so much so that some IR procedures are considered the gold standard of treatment. Interventional radiology has not been widely adopted in veterinary medicine, but has been in trials for about eight years. Advantages of IR procedures include minimized physical trauma to the patient, reduced infection rates and recovery time, shortened anesthesia and hospital stays, less equipment, less cost, and novel procedures for previously untreatable diseases. Disadvantages of IR procedures include lack of technical expertise, initial capital investment to maintain suitable inventory, and the need for specialized equipment.

Existing procedures such as fluoroscopy, computed tomography (CT), ultrasonography and endoscopy obtain images which are then used to direct interventional instruments throughout the body. The procedures are usually performed using specialized needles, various catheters, hydrophilic guide wires, coils and self-expanding metallic stents. Stents are specially designed Nitinol metal mesh tubes that are deployed into the body in a collapsed state on a catheter and then expand to the preset diameter inside the lumen or vessel to open the walls. A hydrophilic guide wire is a thin wire with a hydrophilic polymer coating. The hydrophilic guide wires, catheters, introducers and dilators are flushed with sterile saline and then submerged in the saline until ready for use. The interventional equipment allows the participants to deliver medications directly to the organ site, dilating or stenting narrowed ducts or vessels, drain an obstructed kidney or bladder, obtain biopsies and perform many other procedures.

Prior to performing the minimally invasive IR procedures, the participants should not only be familiar with IR equipment, but have a complete understanding of radiation safety protocols to minimize exposure time, proper collimation and source-to-image distance. Radiation safety equipment consists of lead gowns (wrap around preferred), lead thyroid shields, lead eye wear, sterile radiation attenuation surgical gloves, radiation dosimeter badges, caps, sterile gowns and masks. The specific IR procedure to be performed will determine the type of equipment that is needed.

Ureteral stenting is indicated for bypassing a ureteral obstruction due to various causes (ureteral stone, tumor, stricture, blood clot, ureteritis, etc.). Specifically, ureteral obstructions in feline patients present with vomiting, lethargy, a decreased appetite and acute or chronic weight loss. Dogs typically show clinical signs of incontinence, stranguria, hematuria, vomiting, inappetance, depression or lethargy. Most dogs with a ureteral obstruction will have concurrent urinary tract infections and associated pyelonephritis and cystitis resulting in signs of systemic illness. Dogs often have neutrophilia with pyelonephritis and dogs with ureterolith obstructions may have some degree of thrombocytopenia. Azotemia in cats and dogs is also common at the
time of diagnosis. During a physical exam, it is common in cats to palpate one enlarged kidney and one small kidney. Renal pain is common in dogs upon palpation which is associated with pyelonephritis and capsular inflammation. The ureteral stent has also been shown to encourage passive ureteral dilation after a few days to a few weeks, and may potentially allow for small stone passage, and provides increased urine drainage both around and through the stent. The Vet Stent-Ureter® is a sterile double-pigtail, multiple fenestrated, polyurethane stent designed for use in both cats and dogs. To minimize the possibility of stent migration, both ends have a “pigtail” loop to keep one end inside the renal pelvis, the shaft down the ureteral lumen, and the other end inside the urinary bladder. One end of the stent is tapered for smooth transition to the appropriately sized guide wire, and the other end of the stent has a radiopaque black band. Different ureteral stent placement techniques include percutaneous antegrade (male dog), endoscopically assisted percutaneous retrograde (female dog), or surgically assisted antegrade (cats). There must be ultrasonic evidence that the renal pelvis is dilated \( \geq 5 \) mm in diameter in order to place a ureteral stent antegrade safely. A hydrophilic guide wire is passed antegrade from the kidney through the ureter to the urinary bladder. A dilator is passed over the guide wire, to maintain a through and through access, for a few minutes to allow ureteral distention. The Vet Stent-Ureter® is then placed. Regardless of the stent placement technique, ureteral stenting is performed under fluoroscopic guidance. Ureteral stenting is considered a long-term, safe treatment option in veterinary medicine because they can remain in place for months to years, unlike human placement of 3-6 months. Complications reported in dogs include stent migration (<5%), stent occlusion (<5%), and urinary tract infections (<10%). The current reported success rate for ureteral stent placement is 94% in cats and 98% in dogs.

Urethral stenting is considered a palliative procedure for malignant obstructions. Urethral stents can also be placed for benign diseases such as proliferative urethritis, urethral strictures and pelvic lymphadenopathy. Malignant urethral obstructions can cause pain, dysuria and life threatening azotemia. The two most common malignant urethral obstructions are derived from transitional cell carcinomas (TCC) and primary prostatic carcinomas (PPC). About 85% of patients with TCC will have dysuria and about 10% of those patients will develop a complete urinary tract obstruction. PPC has a worse prognosis compared to TCC. Survival time after urethral stenting with chemotherapy is reported to be greater than 250 days. With stent placement alone, survival time is 80 days. To determine the severity of the obstruction, a cystogram is performed using a 50/50 saline solution to contrast solution. The urinary bladder needs to be distended with the solution in order to see the ureterovesicular junction (UVJ). An urethrogram is then performed to allow for maximum urethral distention. The cystogram and urethrogram are performed under the guidance of fluoroscopy. Once the obstruction is located and measured, the appropriate size urethral stent is deployed through a transurethral approach, which is safe and reliable in male and female dogs. Vet Stent-Urethra™ comes in various sizes from 6mm – 12mm in diameter, and 40mm – 80mm in length. There are 5mm diameter stents available for cats. After the stent is deployed a cystourethrogram is repeated to ensure that the urethra is no longer obstructed. When the patient has recovered from anesthesia, often times the dysuria is significantly improved; however, maximum benefit may not be seen until two weeks post stent placement. Approximately 25% of canines diagnosed with a malignant urethral obstruction will have mild to moderate incontinence post stent placement. Urethral stents are not replaced; it is rare to have tumor growth through the stent, but there may be tumor obstruction that develops in front of or behind the stent. If those obstructions occur, additional urethral
stents may be placed. There are no reported complications with indwelling urethral stents; urethral stents do not tend to migrate or cause a foreign body reaction.

Ureteral and urethral stenting improves the quality of life in animals, while relieving life-threatening obstructions. Interventional Radiology provides a minimally invasive alternative with a high rate of success in animals that would otherwise be humanely euthanized.

References
1. Infinity Medical, LLC