This lecture will mainly focus on urinary tract disease. Mostly stone disease but also some upper urinary tract conditions. At friendship, we are also offering treatment for incontinence (bulking agents with collagen) and endoscopic laser ablation for ectopic ureters or vestibulovaginal remnants (dual vaginas, etc). We have also removed both colonic and gastric polyps with endoscopic snare as well.

**Lower urinary tract stones**

Standard of care for lower urinary tract stone disease is slowly moving away from traditional surgery. Effective treatment is removal of all stones and prevent recurrence and need for invasive procedures in the future, so this does require some commitment from the owner for follow ups. There are some stone forms (i.e ca oxalate) that prevention of recurrence is just not possible in some cases, therefore detection as early as possible is the goal so non-invasive methods such as voiding urohydropropulsion can be employed for stone removal. When possible medical dissolution is recommended (surgery involving infected tissue is not ideal). Some stone type such as calcium oxalates are not amenable to medical dissolution, some such as cystine can be challenging (even if medically dissolvable). Certainly there are exceptions, even with dissolvable stones, intervention may be needed if causing obstruction or there’s poor patient compliance. There can be certain predictive factors such as urine pH, presence of urinary tract infection, radiographic density, shape, signalment and crystals that can be used. However, certainly not completely reliable for predicting stone composition, therefore stone analysis is still recommended (especially for stone prevention plan).

Struvite stones should be medically dissolved, these are typically moderately radiopaque with alkaline urine and UTI caused by urease producing bacteria. Examples include staph, proteus, corneybacteria mycoplasma/ureaplasma, klebesiella. Although e coli infections are common in the urinary tract, it is not associated with urease production. Cats can develop struvite stones as well, but are typically sterile ston. Dissolution diets such as hills c/d multicare or Royal Canin Urinary SO are typical diets. Although hills s/d can be used to dissolve struvite stones, it is only for short term use, as long term use can predispose to calcium oxalate stones. A recent study in cats showed hills s/d resulted in faster dissolution of stones, however hills c/d multicare also dissolved struvite stones (just at a slower rate). The 50% reduction of stone size was 0.7 weeks for hills s/d compared to 1.75 weeks for c/d multicare. Benefits of medical dissolution include avoiding the need for anesthesia, sutured-induced ureoliths recurrence (which is responsible for up to 9% of recurrence). Treatment for struvite stones are with antibiotics (based on urine culture), and dissolution diets. Duration of dissolution diet can be variable based on stone burden; antibiotics are administered until attaining a negative urine culture. Serially monitoring with urine culture, urinalysis and abdominal radiographs are recommended.

For animals that develop urate stones, hyperuricosuia, concentrated urine and acidic urine are the main factors driving urolith formation. For most dogs and cats, uric acid (product of purine metabolism) is transported to the liver where it is further metabolized by intracellular hepatic uricase to allatonin, an innocuous nitrogenous compound with high water solubility. A defective uric acid transporter and portosystemic shunts are identified as common causes for hyperuricosuria and subsequent urate formation. For some (especially cats), urate stones can
be idiopathic. Dissolution of urate uroliths in dogs usually is accomplished within 4 weeks by feeding a purine restricted, alkalinizing, diuretic diet. Administration of xanthine oxidase inhibitor (allopurinol) can be helpful as well. In one study, medical dissolution was effective in ~40% of Dalmatians, partial in 30% and no dissolution in 30%. Dissolution has not been possible in dogs and cats with uncorrected liver disease. No data in dissolution for cats.

Cystine stones occurs due to decreased proximal tubular reabsorption of cystine. Dissolution is achieved by increasing cysteine solubility. In one study, consumption of decreased protein, urine alkalizing canned food resulted in 20-25% decrease in 24hr urine cystine excretion compared to a maintenance diet. The same diet with addition of 2-mercaptopropionylglycine (2MPG) was successfully in dissolution of cystine stones. Cystine solubility increases with increasing urine pH. In some forms of cystinuria, neutering has been associated with decrease in cystine concentration as the result of potential androgen-dependent effect (but this is not universal). Currently, although 2MPH is commercially available in the US, it can be cost prohibitive.

In select cases, stone removal may not be always necessary. Can be considered for dogs without clinical signs but diagnosed with non-dissolvable uroliths too large to pass into the urethra or too irregular to cause urethral obstruction. This can be specifically considered for calcium oxalate stones, as up to 40-50% recur within 3 years.

Traditional surgery with cystotomy is probably the quickest procedure compared to most minimally invasive procedure, but may not be the best treatment modality for the patient due to poor visibility, not able to address embedded stones (more trauma with scraping bladder mucosa), inability to visualize the urethra, and use of excess suture. Incomplete removal is reported to occur in 14-20% of dogs, and 20% of cats that underwent cystotomy from a large retrospective study (128 dogs that underwent a cystotomy over a 12yr period). Recurrence rate from this study was reported to be 25-60%. Dogs with urethrolith and bladder stones are more likely to have a failed cystotomy (compared to bladder stones alone). Laparoscopic assisted cystotomy has the disadvantages of pneumoperitoneum, urethroscopy is not performed and still has the issue of poor visibility as the bladder is not distended.

With minimally invasive intervention, each procedure has its own set of limitations and appropriate patient selection is important. The options for lower urinary bladder intervention include PCCL (percutaneous cystolithotomy), voiding urohydropropulsion, laser lithotripsy and cystoscopy/stone basket.

PCCL can be performed successfully for variable number of stones in the urinary bladder and urethral in male or female dogs and cats. In animals weighing less than 5.5 kg, the penile urethral cannot be fully visualized. The procedure is performed with a mini-laparotomy incision in the caudal abdomen. A small incision (1.5-2cm) is all that is needed for the procedure (to accommodate the 6mm laparoscopy cannula for access, to minimize trauma to the bladder with repeated entry into the urinary bladder). A red rubber catheter is used concurrently, placed via penile urethra in male dogs or via antegrade approach with use of a
guidewire access for female dogs or cats. Using this method, the majority of the stones are flushed (i.e. saline applied through red rubber catheter and suction applied to the laparoscopy cannula). Any stones that are not retrieved can be retrieved via stone basket. Once bladder stones are removed, the urethra is examined. Using this method, there is minimal trauma to the bladder mucosa and optimal visualization of both the bladder and urethra is achieved.

Laser lithotripsy can be used instead of PCCL, but generally is longer procedure (especially with bladder stones). More fragments were left behind compared to PCCL (8% with lithotripsy vs 3% with PCCL). There is also risk of edema and obstruction that required recovery with urethral catheterization (13% in males, 18% in females) for 24-48 hours with lithotripsy. Finally, for lithotripsy there is need for specialized equipment (holmium YAG laser for stone fragmentation).

**Upper urinary tract stones**

Dogs and cats with nephroliths rarely need intervention. Presence of nephroliths in dogs and cats with chronic kidney disease did not significantly affect the progression of renal disease. Nephroliths and ureteroliths consistent with composition of struvite should be medically dissolved. When the ureters are obstructed, they should be stented (even in presence of infection). Long courses of antibiotics based on urine culture results (6-8 weeks) is typically needed.

Complete obstruction causes an increase in ureteral pressure, the net hydrostatic pressure gradient across the glomerular capillaries decrease, which results in a decline in filtration. There’s a 35% permanent decrease in GFR after 7d, 54% after 14d and 100% after 40d. Relief after 14 days of obstruction, took > 4mo for renal recovery to occur. We think over 80-90% of ureteral obstruction in cats are considered partial. Data currently is not available to determine the amount of renal function that may return after the repair of complete or partial ureteral obstruction. In cats, no imaging prognostic factors (renal pelvis size, amount of renal parenchyma on ultrasound, renal tissue doppler) have been found to predict the extent of renal recovery after decompression. Therefore, interventions to repair obstruction despite severe imaging abnormalities is still recommended as there’s a chance to preserve some renal function.

The major diagnostic imaging data for dogs and cats with ureteral obstruction is compiled from two major retrospective studies. Radiographs have a sensitivity 81% in cats (88% in dogs) for ureteral stones. Small calculi, calculi overlying colonic contents and radiolucent calculi may be missed on survey radiographs. Abdominal ultrasound has a sensitivity of 77% in cats and 100% in dogs for ureteral stones. Abdominal ultrasound is needed to document hydroureret/nephrosis and exact location of the obstructive lesion. Dilation of the ureter and/or renal pelvis usually is apparent on ultrasound within 3-4 days of obstruction, thus their absence should not rule out obstruction. Combination of abdominal ultrasound and radiographs are reported to be 90% sensitive in cats. GFR can be difficult to assess when an obstruction is present. Excretory urography studies in obstructed individual may not have sufficient diagnostic value due to decreased renal blood flow, reduced/absent glomerular
filtration. Frequency of adverse effects is unknown in veterinary medicine, but there is ample human data to document a high risk of intravenous contrast induced AKI with underlying chronic nephropathy. GFR via nuclear scintigraphy can provide GFR of individual kidneys. However, GFR of the obstructed kidney is most often reduced and the predictability of return of function based on scintigraphy is often unclear (& underestimating post-obstruction renal function). Antegrade pyelography in a study of 11 cats with percutaneous antegrade method showed excellent sensitivity and specificity for ureteral obstruction, when the procedure was successful. There was evidence of leakage in 44% of studies, and 30% were non-diagnostic studies.

Unfortunately, there is not consistent data on success of medical management for cats with ureteral obstructions. Medical treatment with diuretics, glucagon, amitriptyline, alpha blockers and calcium channel blockers have been described previously. The length of time that the feline kidney can tolerate complete obstruction is not known. But given that there’s a chance that medical management could work, it seems reasonable to attempt medical management in the stable patient (for 24-48 hours). Extrapolating from people, medical management seems to be more effective for stones in the distal 1/3 and if stones are < 2-3mm. Movement of stones has been reported in up to 17% of cats, but complete stone passage occurs in less than 10%.

**Idiopathic renal hematuria**

Idiopathic renal hematuria is thought to be a rare condition of chronic severe upper urinary tract bleeding. Typically seen in otherwise healthy large breed dogs, but also in cats (associated with dried solidified blood). Affected dogs are typically young, less than 2yrs (though range from 2mo to 11yrs). Renal hematuria can be unilateral or bilateral (at the time of original diagnosis or within months to years after the initial diagnosis). In people, renal vascular abnormalities that rupture (hemangiomas, papillary angiomas found inside the renal pelvis are typically the cause of this condition). This has not been clearly documented in veterinary medicine. But the long term course does appear benign; but anemia, iron deficiency, ureteral and urethral obstruction can occur.

A minimally invasive method using sclerotherapy has been recently described. Sclerotherapy material using silver nitrate is considered to be coagulating and serves as a chemical cauterizing agent, and use has been reported for a small number of people with successfully treatment of renal hematuria. Treatment is often repeated 2-3 times, typically done by leaving the indwelling ureteral catheter inside the renal pelvis (which is not done in dogs due to risk of ureteral perforation). Instead, serial dwells with the patient under anesthesia is performed. The combination of iodine and silver nitrate is thought to work synergistically. Iodine is considered a corrosive agent because of its oxidizing potential and is a thickening and granulating agent. Together silver nitrate and povidone iodine may have chemo-cauterization effects, resulting in cessation of bleeding and antisepsis. Because there’s only one chance of renal pelvis access, the combination of the two products are used. Placement of ureteral stent after sclerotherapy is recommended (due to associated ureteral swelling from the procedure) but the stent can be removed 2-4 weeks after the procedure. If sclerotherapy fails and ureteral stent is in place, the ureter will passively dilate over a few days to weeks. This will allow the
passage of a ureteroscope up the canine ureter for retrograde ureteropyeloscopy, and electrocautery to be performed. Electrocautery is the treatment of choice in people, which is effective in > 90% of people when a lesion is identified. A recent retrospective study using sclerotherapy for renal hematuria describes 6 dogs, four with unilateral and two with bilateral hematuria. Cessation of macroscopic hematuria occurred in 4/6 dogs (median follow up was 8 months), the other 2 had improvement but not complete resolution. 

Other options include partial occlusion of the renal artery, Yunnan baiyao or aminocaproic acid. Yunnan baiyao is thought to augment hemostasis by shortening bleeding times and increasing permeability of platelet membranes. Aminocaproic acid is a derivative of lysine (inhibitor of proteolytic enzymes such as plasmin) which is responsible for fibrinolysis, potentially making this effective in the treatment of bleeding disorders.

Benazepril was used in 4 dogs with idiopathic renal hematuria. Macroscopic hematuria resolved in all dogs (persistence microscopic in 2 dogs), with clinical signs recurring when benazepril was discontinued. Benazepril is thought to decrease intraglomerular blood pressure and GFR by causing vasodilation of the efferent arteriole and it deceases the porosity of the glomerular membrane. These effects and in particular the reduction of intraglomerular blood pressure may have contributed to the good clinical response in our patients.

References:


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