ADVANCED DIAGNOSTICS FOR CANINE AND FELINE LOWER URINARY TRACT DISORDERS

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Urodynamics
Urodynamic testing provides a quantitative assessment of the function of the lower urinary tract. Most commonly these techniques are utilized to assess urethral closure pressure via the urethral pressure profile (UPP) and bladder detrusor muscle function with a cystometrogram (CMG). These diagnostics are becoming more readily available, and the techniques have been standardized for small animal patients. Many large referral centers and Universities in the United States use the Urovision Janus V system by Life Tech (uorlab System V. Life Tech, Inc., Stafford, TX, Website: http://www.life-tech.com). This computerized system is fairly easy to use, but does require some training. A UPP can be performed on a male or female dog1,2, and newer studies have documented normal values in the female cat.3 Unfortunately, commercial catheters are not available for male cats at this time.

The urethral pressure profile
Indications for a UPP
A UPP is used to evaluate the pressure along the length of the urethra. This test is indicated for dogs with refractory urethral sphincter mechanism incompetence (USMI) or for those dogs with USMI where medications may cause significant side effects. A UPP can also be used as screening tool for dogs with ectopic ureters prior to surgical or laser correction. Finally, it should be considered for dogs with disorders such as reflex dyssynergia.

Performing the procedure
All anesthetics will decrease urethral closure pressure to some extent; therefore, if possible, the UPP should be performed without sedation. If chemical restraint is necessary, propofol and sevoflurane have been reported to be acceptable at doses less than 0.8 mg/kg/min and 2.0% MAC respectively. Preliminary data in cats suggest that propofol (0.2 mg/kg/min) is also acceptable for use in the cat. A bolus of propofol (2-3 mg/kg) can be given IV for catheter placement. Once the animal is sedated, a double or triple lumen catheter (http://www.life-tech.com) of appropriate size is inserted through the urethra to the level of the trigone. The catheter is slowly withdrawn at a standard rate (0.5-1mm/s) while warm sterile water is infused at 2ml/min.3,4 This generates a pressure curve that is visualized on the computer screen.

From this curve the following are recorded:
1. Maximal Urethral Pressure (MUP): the maximal pressure generated in the urethra
2. Maximal Urethral Closure Pressure (MUCP); the difference between the MUP and the perfused intravesical pressure
3. Functional Profile Length (FPL): the portion of the UPP tracing during which urethral pressure exceeds intravesical pressure.
4. Functional Area (FA): the area under the FPL curve

The cystometrogram (CMG)
Indications for a CMG
Detrusor hyperreflexia (overactive bladder) can occur from a variety of causes including bacterial cystitis, urolithiasis, neoplasia, polypody cystitis, or can even be idiopathic. Before performing a CMG, the animal should first be evaluated using imaging, urine cultures, and possibly cystoscopy for the causes of detrusor hyperreflexia mentioned above. If such a cause for the clinical signs is discovered and clinical signs improve with appropriate therapy, then no further testing is likely warranted. However, if no underlying cause is found, or if clinical signs persist despite therapy, a CMG may be indicated. A CMG can also be used to evaluate animals suspected of having detrusor atony. The procedure can be performed in both the dog and the cat.

Performing the procedure
Just like with the UPP, all drugs affect the detrusor reflex to some extent. Many drugs can abolish the reflex (e.g. gas inhalants), and ideally a CMG should be done while the patient is awake. Often, this is not practical for animals however because they will not cooperate and excess artifact will prevent reliable readings. However, experimentally, we have performed CMGs on unanesthetized cats and dogs. We were able to obtain interpretable readings in these cats and dogs, although studies were only performed on a small number of patients. Various sedatives have been evaluated in dogs for a CMG and the alpha 2 agonist, xylazine is still commonly used.5 Others (including the author) have used propofol.6 In the author’s experience, higher doses of either drug can abolish the detrusor reflex. Once the animal is sedated, a double lumen urinary catheter is aseptically placed into the urinary bladder of the dog or cat. One of the ports is connected to the pressure transducer on the machine and the other port is utilized for fluid administration. Sterile water is then infused at a constant rate. The rate of infusion is very important,
and studies in animals suggest that slower infusions are more representative of true bladder filling and are likely to cause significantly less side effects. \textsuperscript{5,6} Pressures are measured as the bladder is being filled with water indicating the degree of compliance of the bladder. The following values are generally reported for a CMG:

1. Resting bladder pressure
2. Threshold pressure: the pressure at which the detrusor reflex occurs
3. Threshold volume: the volume at which the detrusor reflex occurs
4. Bladder compliance: calculated as the fluid infused (mL)/(bladder pressure (cm H\textsubscript{2}O) - resting bladder pressure (cm H\textsubscript{2}O))

**Cystoscopy**

**Indications for cystoscopy**

Cystoscopy can be a very useful diagnostic tool for a variety of canine and feline lower, and even upper urinary tract disorders. Some of these disorders are described below:

**Ectopic ureters**

Cystoscopy is one of the diagnostic tests of choice for suspected ectopic ureters in dogs. \textsuperscript{4} The test is usually easy to perform and allows one to visualize the mucosa and evaluate the vestibule as well. If further diagnostics are needed, we have also performed retrograde ureterogram studies under fluoroscopy. The ureters are catheterized with small flexible guidewires that are passed through the cystoscope; a 4 Fr ureteral catheter can then be safely passed over the guidewire and contrast injected under fluoroscopy.

**Collagen injections**

Submucosal urethral collagen injection can be performed for urinary incontinence that is refractory to standard medications or in patients where these medications are contraindicated. The scope is introduced into the urethra and the anatomy is carefully evaluated for any abnormalities. If no significant abnormalities are detected, the scope is positioned approximately 1.5-2cm distal to the trigone and 3-4 collagen deposits are injected into the submucosa until the urethral lumen diameter is significantly smaller.

**Biopsy of the lower urinary tract**

Cystoscopy can be very helpful to obtain diagnostic tissue samples from the vestibule, urethra and bladder. We often use cystoscopy in animals suspected of having lower urinary tract neoplasia (usually transitional cell carcinoma) to obtain samples and also to evaluate the extent of disease. Biopsies can also be helpful to obtain culture of the bladder mucosa particularly in dogs with recurrent urinary tract infections. Infections, such as *E. Coli*, can be deep seated within the mucosa. Baskets inserted through the cystoscope can also be used to biopsy bladder masses; this tool can oftentimes provide a larger biopsy specimen for histopathology and culture.

**Holmium YAG laser Lithotripsy**

Removal of cystic calculi can be performed by various methods. For urethral calculi in male dogs or cystic calculi in female dogs and cats, holmium YAG laser lithotripsy is available at some referral institutions, including UC Davis. The reader is referred to the section entitled ‘Holmium:YAG laser lithotripsy’ for further information on this technique.

**Basket retrieval of cystic calculi**

If cystic or urethral calculi are small enough, a basket can be inserted through the cystoscope and the largest fragment can be grasped with the basket. With cystoscopic guidance and proper fluid instillation, the stone is slowly removed through the urethra.

**Cystoscopes**

Suggested scopes used for various urologic procedures in small animal patients:

1. **Rigid cystoscope for female cats and small female dogs**: 1.9mm, 8.5 Fr sheath
2. **Rigid cystoscope for medium size female dog**: 2.5mm, 10.5 Fr sheath
3. **Rigid cystoscope for large dogs**: 4mm, 19.5 Fr sheath
4. **Flexible scope for male dog**: 2.5mm (7.5Fr) outer diameter; 1.2mm channel
5. **Flexible scope for male cat**: 1.2mm diameter

**References**


More references available upon request.