ARTIFICIAL URETHRAL SPHINCTERS
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Background:
Urethral sphincter mechanism incompetence (USMI) occurs in 13.6% \(^1\) to 20.1% \(^2\) of dogs following ovariohysterectomy. Urethral sphincter dysfunction is also a common cause of failure after surgical repair of ureteral ectopia, with approximately 50% of dogs suffering from continued urine leakage after ureteral reconstruction. Dogs that fail to respond to pharmacologic therapy require surgical intervention. Numerous options exist for the treatment of refractory incontinence in female dogs, though none has achieved uniform success. Pharmacologic therapy is the initial treatment of choice, but alpha agonists and estrogens are associated with a number of potential side effects and must be administered for the remainder of the animal’s life. \(^3\)-\(^7\) In addition, approximately 27% of dogs are refractory to medical therapy. \(^2\) Surgical techniques described for dogs with refractory USMI include sling urethroplasty, \(^8\) cystourethropexy, \(^9\) urethral intussusception, \(^10\) periurethral injection of collagen or Teflon \(^11,12\) and colposuspension. \(^13,14\)

Unfortunately, surgery alone has produced poor long-term results. Colposuspension is one of the more common surgical techniques practiced by veterinary specialists, but was reported to maintain continence in only 14% of dogs after one year in a recent prospective study \(^13\) and has not exceeded 53% efficacy in other large case series. \(^14\) With the increased availability of video endoscopic equipment in referral practice, submucosal collagen injections are also being applied as a minimally invasive technique for dogs with urinary incontinence. Although initial efficacy is high, \(^11\) effects are short lived and dogs will typically require repeated injections every 1-2 years for the remainder of their lives. In our practice, we have switched to the use of a hydraulic urethral sphincter, expanding applications to include male and female USMI, failed ectopic ureter repair, failed collagen injection, and pelvic bladder.

Artificial Urethral Sphincters in Dogs:
An adjustable artificial urethral sphincter (AUS, Figure 1) was created by combining an inflatable silicone vascular occluder (DOCXS, Ukiah California) with a titanium subcutaneous injection port (Le Grande Vascular Access Port, Access Technologies). The device was then modified by widening the cuff to minimize urethral trauma during compression. We also changed the entry point of the actuating (inflation) tubing, making a side entry that would be parallel to the urethra and would allow easier implantation. Inflation of the occluder is performed by injecting fluid into a titanium vascular access port, which is placed in the subcutaneous tissues along the ventral abdomen. The occluders are composed of medical grade silicone and have been used in physiology research for many years. An in vitro experiment in our lab demonstrated reliable maintenance of occlusion during a 5 month period of immersion in simulated body fluid when occluders were infused with either isotonic saline or sodium hyaluronate. \(^15\) Following the in vitro work, maximal urethral closure pressure (MUCP) and cystourethral leak point pressure (CLPP) were measured before and after application of the HUS to 6 female dog cadavers. \(^16\) MUCP and CLPP were directly proportional to the volume injected into the hydraulic occluder and equaled or exceeded values reported in live, continent dogs after 50% occlusion of the HUS. \(^16\) The data obtained in this cadaver model suggested that urinary continence may be achieved after application of the HUS to spayed female dogs with USMI. Although adjustable, this system is not intended to be patient-controlled. Rather, the HUS would provide a low level, static increase in urethral...
resistance, similar to that achieved through submucosal collagen injection, but of a more durable nature. The amounts of saline that were injected in the cadaver study were later modified to small volumes based on observations in live animals with USMI. A pilot study was funded by the American Kennel Club to test application in dogs with refractory USMI and long term results (2 years) in 4 dogs were reported. Subsequent experience in >20 dogs will be presented in abstract form at this meeting.

**Screening prior to surgery:**

Complete physical examination, serum chemistry panel, complete blood count, urinalysis/bacterial culture and abdominal ultrasound, should be performed to rule out concurrent disease. Urodynamic studies may be performed to confirm diagnosis of USMI and to obtain baseline information. Additional uroendoscopy or computed tomography is indicated to rule out ureteral ectopia if clinical history in animals with congenital incontinence, but are not routinely performed in animals that develop acquired incontinence after sterilization surgery.

**Surgery:**

*Females*- After induction of general anesthesia, a caudal midline approach to the urinary bladder is performed, continuing the abdominal wall incision to the pubic symphysis to allow maximal exposure of the urethra. The bladder is retracted cranially and a 2cm section of the pelvic urethra is isolated from the peri-urethral adipose tissue by blunt dissection, approximately 3-4 cm caudal to the trigone. The urethral circumference is approximated by measuring with a strand of suture, then a silicone AUS of equal or larger circumference to the pelvic urethra is selected, erring on the larger side to avoid excessive compression (Figure 1). A size chart has been included to aid in selection of the device in female dogs (Table 1), but should only be used as a guide. Prior to

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*Figure 1 (A and B)*: *A*. An artificial urethral sphincter with side entry tubing is sized by comparing to a piece of suture that was cut to approximate urethral circumference. The sphincter is closed around the urethra by placing a strand of non-absorbable suture material through the suture eyelets in both ends of the cuff. The cuff may then be inflated by injecting fluid into the subcutaneous port, causing mild, static occlusion of the urethra. *B*. The actuating tubing is attached to a titanium subcutaneous injection port using a “boot” (white arrow) supplied by the manufacturer of the port.
placement of the AUS, all air is flushed from the lumen of the balloon and actuating tubing by retrograde filling of the system with isotonic saline, using a 21 gauge catheter. The AUS is then completely filled, tested for leakage, and filling volume is recorded before placing the device around the pelvic urethra, 2 cm caudal to the trigone. The cuff is closed around the urethra by placing 0 to 2-0 polypropylene suture through the eyelets and tying a secure knot. The infusion line is exited through a stab incision in the abdominal wall and is connected to an injection port that is anchored in the subcutaneous tissues of the inguinal area. The abdomen is closed routinely. Dogs are administered analgesics and monitored in the hospital for 24 hours following surgery to monitor for urethral obstruction. Urethral catheterization has not been necessary in our experience, making postoperative management relatively simple and inexpensive.

**Males-** Surgery is performed through a similar caudal midline approach after a para-prepuccial skin incision. It is important to continue the abdominal wall incision to the level of the pubis in order to maximize exposure of the urethra. The bladder is retracted cranially and the prostate is located. A 2cm wide area is dissected around the post-prostatic urethra (caudal to the prostate) and the urethral circumference is measured using a penrose drain or length of suture. A device that is slightly larger in circumference is selected, primed with saline and placed around the urethra as described above for the female dog. In my limited experience, male dogs have required larger devices (12-14 mm luminal diameter), although I have only operated on large breed dogs at this time.

<table>
<thead>
<tr>
<th>Device size</th>
<th>6 x 11 mm</th>
<th>8 x 14 mm</th>
<th>10 x 14mm</th>
<th>12 x 14mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median BW</td>
<td>3-6 kg</td>
<td>10-20 kg</td>
<td>20-30 kg</td>
<td>25-40 kg</td>
</tr>
</tbody>
</table>

**Table 1:** Guidelines for selection of artificial urethral sphincter cuffs based on body weight of female dogs

**Follow up:**

Dogs are allowed to recover for 4- 6 weeks prior to inflation of the cuff. Delay in inflation of the HUS cuff is recommended by physicians to allow revascularization of the dissected portion of urethra and decrease the incidence of urethral atrophy. Thus far, 70-80% of dogs have become continent without cuff inflation and inflation of the cuff has primarily been used to improve continence in dogs that have regressed after 1 or more years of follow up.

In dogs with persistent incontinence, the skin above the port is shaved and aseptically prepared before making an injection. 0.9% sodium chloride is injected into the subcutaneous infusion port using a 22 gauge, non-coring needle (Huber needle). Originally, I advised administering 25% of the original filling volume, but found that this volume is excessive in some dogs and will cause incomplete bladder emptying. As a result, I have empirically altered the volume to increments of either 0.1mL or 0.2mL, depending upon the severity of clinical signs that are manifested by the dog at the time of presentation. When the clients are scheduled to recheck, I advise them not to allow the dog to urinate as they are coming in to the hospital. After the injection, the dog is immediately walked outside and urination is observed to characterize the quality of the urine stream and
Complications and outcome:

Data for complications and outcome in over 20 dogs will be presented in abstract form at this conference.

References: