Urinary Tract Surgery - Recent Developments

Philipp Mayhew BVM&S, MRCVS, DACVS
Assistant Professor, Small animal surgery
University of California-Davis, USA
Lecture Format

+ Introduction
+ Urinary Tract Trauma and obstruction
  - uroperitoneum
  - catheter-associated trauma
+ Urolithiasis
  - minimally invasive urolith removal
  - feline ureterolithiasis
+ Urinary incontinence
  - new therapies for ureteral ectopia & urethral sphincter mechanism incompetence
Introduction

+ Many new urinary tract therapies have been introduced in the last few years
  - New options for previously untreatable conditions
  - Improvements of current standard of care
+ Minimally invasive approaches to many urinary problems now possible
  - Ureteral ectopia, trauma, urolithiasis, neoplasia
+ In our practice majority of urinary procedures now involve less invasive techniques compared to 10 years ago
Urinary Tract Trauma

**Important considerations:**
- Medical v. Surgical Emergency
- Site of urine leakage
- Underlying cause

**Important consequences:**
- Uroperitoneum/Uroretroperitoneum/Urinary leakage into tissues
- Urinary obstruction secondary to stricture formation
UROPERITONEUM - Etiology?

- Dogs and Cats – 84.6% trauma
  - In dogs → blunt trauma
  - In cats → 59% blunt trauma
    - 32% urethral catheterization
    - 9% bladder expression

- Other causes
  - Iatrogenic - post-cystotomy, nephrotomy
  - Rupture secondary to obstruction, neoplasia

- Location: ~70% bladder
  ~30% urethra
**Diagnosis: uroperitoneum**

- **Retrieve abdominal fluid by abdominocentesis**
- **Measure effusion and peripheral blood K and creatinine**
- **If slightly to markedly higher values in effusion → suggests uroperitoneum**

<table>
<thead>
<tr>
<th></th>
<th>Dog</th>
<th>Cat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Creatinine</strong></td>
<td>5:1</td>
<td>2:1</td>
</tr>
<tr>
<td><strong>Potassium</strong></td>
<td>2.5:1</td>
<td>1.9:1</td>
</tr>
</tbody>
</table>


Imaging: Uroperitoneum

+ Positive contrast cytourethrogram – use FLUORO
  - Contrast study of choice for LT
  - Detected 100% bladder ruptures (only 72% with double contrast)
+ Intravenous urogram
  - If suspect renal/ureteral trauma
+ Antegrade pyelogram
+ Ultrasound ± contrast cystography (microbubble)
+ Computed tomography
**Treatment: Bladder trauma**

- Revision cystotomy
- Radical cystectomy

- Complications: pollakiuria, dysuria

- Gastro-intestinal conduit diversion

- Complications: pyelonephritis, renal failure

- Colonic augmentation cystoplasty
Colonic augmentation cystoplasty

**Bladder neck necrosis**

- **Technique for circumferential resection of bladder neck**
- **Involves sparing the dorsal vascular and neurological pedicles**
- **Requires bilateral ureteral reimplantation**
- **Mainly described for tumor resection**

Urethral trauma

- Most likely to be secondary to catheterization or pelvic trauma
- Can be full transection but more often tear
- In cats - tend to be mid-pelvic urethra
- Ideal repair of transection:
- Primary repair + catheter better than primary repair or catheter only in dogs (Layton CE et al. Vet Surg 1987;16:175-182)
- Anastomoses results in some degree of strictures
Algorithm to deal with Feline urethral tears

Urethral Tear

Distal
- Perineal urethrostomy
- Transpelvic urethrostomy

Intrapelvic

Proximal
- Retrograde or antegrade catheterisation
- Pelvic symphysiostomy/pubic-ischial osteotomy flap with primary repair

Prepubic urethrostomy

Intrabdominal repair

Cystostomy
Urethral Tear Options

+ Prepubic urethrostomy
  - many complications: incontinence (37%), peristomal dermatitis (44%).

+ Perineal urethrostomy
  - 0-18% stricture rate, predisposed to infection

+ Intrabdominal repair
  - For rare cases where tear is intrabdominal

+ Transpelvic urethrostomy
  - Same complications as PU
Transpelvic urethrostomy

- Gets you a little “higher”
- Allows access to 1-2cm cranial to the bulbourethral glands
- Few complications
- Assymptomatic stricture

Treatment by catheterization alone

+ In many cases urethral tears will heal if a catheter can be passed across the lesion
+ In ~50% of cases catheter will pass retrograde
+ If catheter doesn’t pass retrograde in many cases will pass antegrade
+ This can be done using guidewire from cystotomy incision
+ Leave catheter in place for 5-15 days
+ Post-operative stricture occurred in 2/10 cats in one study

Meige et al. Management of traumatic urethral rupture in 11 cats using primary alignment with a urethral catheter. VCOT 21: 76-84; 2008
Minimally invasive Retrograde/Antegrade catheterization

- IV catheter passed percutaneously into bladder
- Small soft hydrophilic wire (glide/weasel) passed through catheter into bladder
- Under fluoroscopic guidance wire passed into urethra and across lesion
- Then once out of penis can thread a locking loop or pigtail catheter over wire
Antegrade catheterization

Images and videos courtesy C. Weisse and A. Berent
Antegrade catheterization
UROLITHIASIS: NEW OPTIONS

- In human medicine limited role for traditional “open” surgery for urolithiasis

- Canine/feline cystic/urethral calculi
  - Laparoscopic-assisted cystotomy
  - Lithotripsy

- Ureterolithiasis (mainly feline)
  - Surgery
  - Ureteral stent placement
Laparoscopic-assisted Cystotomy

**Advantages:**
- Less post-operative pain
- Less wound-related complications
- Ability to thoroughly evaluate for residual stones

**Disadvantages**
- Greater equipment and cost
- More time-consuming
**INSTRUMENTATION**

- 5mm 0° or 30° laparoscope
- 2 trocar-cannula assemblies
- 5 or 10mm Grasping forceps
- 2.7mm cystoscope with cystoscopic sheath
- IV fluids with pressure bag
- Stone retrieval devices
**Instrumentation: Stone retrieval devices**

Many different devices can be used for stone retrieval once have bladder access:

- Placed alongside cystoscope:
  - Lap babcock
  - Carmalt forceps

- Placed down working channel of cystoscope:
  - Biopsy forceps
  - Basket catheter (different sizes)
Patient positioning and port placement

- **Dorsal recumbency**

- **Trendelenburg (head down)**

- **Camera portal is subumbilical**

- **Instrument portal will be located on ventral midline at level of bladder apex**

- **In males may be parapreputial**
Lap-assisted cystotomy: Surgical technique

- Laparoscope is inserted to view bladder
- Can fill bladder with sterile saline through catheter
- Second port established at level of bladder apex on midline
- 5 or 10mm Babcock forceps used to elevate bladder
- Stay sutures placed followed by cystotomy
- Cystoscope (1.9-2.7mm 30° degree cystoscope in sheath) placed into bladder

Rawlings CA et al. Use of laparoscopic-assisted cystoscopy for removal of urinary calculi in dogs. JAVMA 2003;222;759-762
Securing Bladder Access

+ Placing the stay sutures or suturing the edge of a cystotomy to the skin margin allows secure access for repeated entry into bladder
  - Very helpful when many stones
+ Cannula technique:
  - Provides closed bladder and best visualization
  - Tedious when many or large stones need to be removed
Recovering Urinary Calculi

- Can use Babcock forceps placed alongside telescope to recover individual stones
  - Works well for medium to large stones

- Can use basket catheter placed through working channel of cystoscope sheath
  - Works well for medium-sized stones
  - Depends on size of the basket
Retrograde flushing of stones through cystotomy
Post-operatively

- **Cystotomy incision is closed routinely**
- **Bladder is replaced into abdomen and inspected once more**
- **Purge pneumoperitoneum**
- **Close camera portal**
- **3 days of analgesia and dogs can usually return home the day after surgery**
Feline ureterolithiasis – A very common problem?

- Increasing numbers of upper tract stones
  - 10x↑ in upper tract stones in 20 years
  - 50x↑ in calcium oxalate in UT stones (Lekcharoensuk C et al. JAAHA 41;39-46,2005)

- Increasing prevalence of calcium oxalate over past 20 years (Ling GV et al. JVIM 1998;12:11-21)

- Historical findings non-specific:
  - Inappetence, vomiting, lethargy, weight loss
  - 83% of cats are azotemic
  - 25% of cats have bilateral ureterolithiasis
  - 62% of cats have concurrent nephroliths
**Feline Ureterolithiasis - Diagnostic Imaging**

- **Sensitivity of plain radiographs** 81%
- **Sensitivity of ultrasound** 77%
- **Sensitivity of both** 90%
- **Allows assessment of degree of hydronephrosis**
Feline ureterolithiasis - Other imaging modalities

Antegrade pyelography

Computed tomography
Ureterolithiasis - Medical Management

Medical treatment in cats:

- Serial monitoring
- IV fluids and diuretics (mannitol)
- Glucagon - side effects - no longer recommended
- Amitryptyline - no reports
- Ca channel blockers (nifedipine)
- Alpha-adrenergic antagonist (tamsulosin)
- Extracorporeal shockwave therapy - concerning results in cats but early stage of development
**Does medical management work?**

- **Humans:** 98% of ureteroliths <5mm will pass
- **Dogs:** little information on medical management
- **Cats:**
  - 64% serially assessed ureteroliths passed into bladder
  - 33% euthanased/died within a month

<table>
<thead>
<tr>
<th></th>
<th>6mo Survival</th>
<th>12mo Survival</th>
<th>24mo Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medical</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Surgical</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Ureterolithiasis - Indications for Surgery

Consider surgery if:
- obstruction present
- chronic infection present
- no important co-morbidities

Timing of surgery:
- dogs - acute obstruction
  renal blood flow 40% of control 12-24 hrs post
- dogs - chronic obstruction
  1 wk → GFR returns to 65% normal
  2 wk → GFR returnes to 46% normal
Ureterolithiasis - Surgical Management

- Consider location, severity of renal impairment
- If proximal
  → pyelotomy/ureterotomy
- If mid to distal
  → ureterotomy or ureterectomy with ureteroneocystostomy
- If end-stage hydronephrosis
  → ureteronephrectomy
- Renal transplantation if severe CRF and available
Ureterotomy - Single Large Stone

- Use magnification
- Gentle use of tourniquet proximal and distal to calculus
- Incise over single stone
- Suture with fine monofilament suture
**Multiple ureteral calculi**

- Commonly encountered - multiple calculi in one ureter or bilateral ureterolithiasis
- We now prefer ureteral stents to bypass obstruction
- Can be challenging to place but well tolerated
Nephrostomy Tube

+ Provides urine drainage temporarily
+ Can be used in conjunction with ureterotomy to try and decrease leakage
+ However not without complications
  - Post-op uroabdomen 25%
  - Post-op blockage/dislodgement 21%
+ Generally a move away from nephrostomy tubes in these cases
Ureteral Stenting

- Has been used for palliation of ureterolithiasis, strictures or malignancies
- Can be placed cystoscopically in dogs but in cats requires surgical placement
- Introduced through the kidney, dilator is used to dilate the ureter and then stent is placed over the guidewire into the bladder
- Double pigtail design is used
**Ureteral Stenting**

- **Intraoperative fluoroscopy (C-arm) is used to confirm placement of the pigtail in the renal pelvis**
- **Post-operative radiographs confirm placement and should be done sequentially to monitor for migration**
- **Can be placed bilaterally**
- **Left in long-term and well tolerated**
# Urinary Incontinence


<table>
<thead>
<tr>
<th></th>
<th>Juvenile female</th>
<th>Adult female</th>
<th>Juvenile male</th>
<th>Adult male</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ureteral Ectopia</strong></td>
<td>47%</td>
<td>4%</td>
<td>34%</td>
<td>8%</td>
</tr>
<tr>
<td><strong>USMI</strong></td>
<td>33%</td>
<td>81%</td>
<td>41%</td>
<td>17%</td>
</tr>
<tr>
<td><strong>UE and USMI</strong></td>
<td>8%</td>
<td>&lt;1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>12%</td>
<td>14%</td>
<td>25%</td>
<td>75%</td>
</tr>
</tbody>
</table>

**N=481 female dogs**

**N=82 male dogs**
Ureteral ectopia

+ Relatively common in many breeds
+ Traditionally treated by neoureterostomy for most intramural cases
+ True extramural cases are extremely rare but can be treated by ureteral implantation
+ Surgery has been main treatment to resolve incontinence and prevent progression of hydroureter and hydronephrosis
Literature - Diagnostic Imaging

- **IVU:** No association exists between the shape of the ureterovesicular junction and the surgical diagnosis of EU (Canizzo 2003).
  - Only 32% had double contrast used.

- **Retrograde vaginourethrogram:** EU were diagnosed in only 47% of dogs with the disease in one study using this modality (Samii 2004).

- **Abdominal ultrasonography:** User dependent and difficult to tell which side affected (Mantis 2008).

- **Contrast-enhanced CT:** Correct diagnosis of EU in 16 of 17 dogs (Samii et al. 2004).

- **Cystoscopy:** Diagnosed EU in 24 of 25 affected dogs (Cannizzo et al. 2003).
Neoureterocystostomy with distal ureteral tunnel ligation or excision (trigonal reconstruction)
Cystoscopic evaluation

+ 100% sensitivity and 75% specificity in a population of 24 dogs suspected of having EU. (Samii et al. 2004).
+ Combine with other modality that evaluates upper tract.
Cystoscopic laser ablation of ectopic ureters.

Images and videos courtesy A. Berent
CLA technique video
12 weeks post CLA of ectopic ureter
**What is the post-operative incontinence rate for surgery versus CLA for EU**

+ **Neoureterostomy with distal ureteral ligation**

+ **Neoureterostomy with distal tunnel excision (trigonal reconstruction)**
  - 71% remained incontinent (Mayhew 2006)

+ **CLA-EU technique**
  - 53-68% (Smith et al. 2009, A. Berent – personal communication).
Cystoscopic-guided collagen implantation
Hydraulic occluder placement
Any Questions?

Olympic National Park