Feline Urethral Obstruction:

To Pee, or Not Pee...

Edward Cooper, VMD, MS, DACVECC
Professor – Emergency and Critical Care
Department of Veterinary Clinical Sciences

Underlying causes

- Idiopathic cystitis
- Urethral plug (20-60%)
  - Inflammatory debris
  - Crystalline matrix
  - Proteinaceous material
- Urethral spasm/edema? (20-50%)
- Urethral calculi (10-30%)
- Stricture (2-3%)
- Neoplasia (1-2%)


Pathophysiology of Obstruction

- Bladder/urethra
  - Pressure necrosis, mucosal injury
  - Muscle/neurologic injury
  - Neurogenic inflammation, increased spasm
- Renal tubule
  - Pressure transmitted through tubule to Bowman’s capsule
  - Diminished GFR as pressure exceeds RPP
  - Pressure necrosis to tubular epithelium, loss of concentrating ability
  - Severe metabolic and cardiovascular derangement in 24-48hrs, death in 3-5 days without intervention

Pathophysiology of Obstruction

- Uremia
- Nausea/Vomiting
- Anorexia
- Dehydration
- Metabolic acidosis
  - Denaturing of proteins, enzymatic dysfunction
  - Catecholamine hyposensitivity
- Hyperkalemia
  - Raises resting membrane potential
  - Slowed depolarization
  - Bradycardia

Prevalence of Metabolic Disturbances*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Median</th>
<th>Range</th>
<th>% of cats below reference range</th>
<th>% of cats above reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venous pH</td>
<td>7.49</td>
<td>7.20-7.50</td>
<td>88 (68%)</td>
<td>29 (15%)</td>
</tr>
<tr>
<td>Venous PCO2 (mmHg)</td>
<td>48.7</td>
<td>36.4-48.2</td>
<td>29 (15%)</td>
<td>65 (60%)</td>
</tr>
<tr>
<td>Venous pCO2 (mmHg)</td>
<td>198</td>
<td>123-254</td>
<td>29 (15%)</td>
<td>52 (28%)</td>
</tr>
<tr>
<td>Venous HCO3 (mmol/L)</td>
<td>8.1</td>
<td>5.0-10.6</td>
<td>63 (43%)</td>
<td>38 (40%)</td>
</tr>
<tr>
<td>Total base (mmol/L)</td>
<td>29</td>
<td>20-41</td>
<td>47 (29%)</td>
<td>52 (28%)</td>
</tr>
<tr>
<td>Sodium (mmol/L)</td>
<td>131</td>
<td>130-136</td>
<td>5 (3%)</td>
<td>95 (61%)</td>
</tr>
<tr>
<td>Potassium (mmol/L)</td>
<td>3.7</td>
<td>3.4-4.0</td>
<td>5 (3%)</td>
<td>95 (61%)</td>
</tr>
<tr>
<td>Anion (mmol/L)</td>
<td>6.5</td>
<td>4.9-8.0</td>
<td>9 (6%)</td>
<td>91 (51%)</td>
</tr>
<tr>
<td>Carboxyhemoglobin</td>
<td>17.3</td>
<td>16.0-18.5</td>
<td>1 (0.5%)</td>
<td>99 (56%)</td>
</tr>
<tr>
<td>Base excess (mmol/L)</td>
<td>4.7</td>
<td>3.0-6.0</td>
<td>7 (4%)</td>
<td>93 (53%)</td>
</tr>
<tr>
<td>Calcium (mg/dL)</td>
<td>9.3</td>
<td>9.0-9.8</td>
<td>9 (6%)</td>
<td>91 (51%)</td>
</tr>
<tr>
<td>Lactate (mmol/L)</td>
<td>1.6</td>
<td>0.0-1.2</td>
<td>99 (56%)</td>
<td>1 (0.5%)</td>
</tr>
</tbody>
</table>


Effects of Hyperkalemia

- “Classic” ECG changes
  - “Spiked” T waves – earliest
  - Shortened QT interval
  - Prolonged P-R interval
  - Diminished to absent P waves
  - Widened QRS complexes
  - Bradycardia

- Can also see…
  - Ventricular tachycardia
  - Ventricular fibrilation
  - Atrial standstill
  - Asystole
Effects of Hyperkalemia

- Changes become more severe as K+ increases
- Cannot predict K+ level from ECG and vice versa
- Affected by several factors
  - Patient
  - Acute versus chronic
  - Acid-base status
  - Calcium level
  - Magnesium level

Cardiovascular Effects of Obstruction

- Bradycardia leads to decreased CO and MAP
  - CO = HR X SV
  - MAP = CO X SVR
- Hyperkalemia causes vasodilation
  - Especially in skeletal muscle – venous pooling of blood
- Acidosis decreases sensitivity to catecholamines
  - Decreased vasoconstrictive response, contractility
- Anorexia/decreased water intake/vomiting
- Dehydration and hypovolemia
- End result: Hypotension and cardiovascular collapse

History

- Unproductive straining in the litter box
- Attempting to urinate outside the litter box
- Vocalizing
- Hematuria
- Lethargy
- Anorexia
- Vomiting
- Painful/distended abdomen
- Recumbency
- Mentation change
- ANY “SICK” MALE CAT!!!

Physical Exam

- Altered mentation
- Tachycardia/bradycardia
- Cardiovascular collapse
- Hyper/hypoventilation
- Hypothermia
- Dehydration
- Firm, distended bladder

Predictors of severe hyperkalemia

- Associations in blocked cats with K+ > 8
  - Approximately 12% of presenting blocked cats
  - Decreased rectal temperature < 96.6°F
  - Decreased heart rate < 140 bpm
  - Weak pulses femoral (90%)
  - First time obstruction (75%)
  - Vomiting (55%)
  - Anorexia (46%)
Initial treatment - Hyperkalemia

- Calcium gluconate
  - Raises threshold potential to reestablish rate of depolarization
  - Cardioprotective but no effect on K+
  - Also beneficial if hypocalcemic
  - Fast acting (seconds) but short duration (20-30 minutes)
  - General dose: 100mg/kg or 1 ml/kg of 10% solution but titrate to effect
  - Patient should be on ECG while being administered

- Initial treatment – IV Fluids
  - Helps to resolve azotemia, acidosis, hyperkalemia, dehydration and hypovolemia
  - Fluid choice
    - 0.9% NaCl?
      - No K+ but acidifying solution
    - Balanced electrolyte (P-lyte, LRS, etc)?
      - Has some K+ (less dilutional effect) but bicarb precursors
  - Prospective study – NaCl vs Norm R
    - Similar decline in K+ values
    - More rapid correction of acid-base with Norm R
    - No difference in outcome – survival, LOS, cost, etc.
    - Doesn’t matter if adequate amount given and obstruction is relieved

- Hyperkalemia (con’t)_insulin
  - Drives K+ into intracellular space by activation of Na/K ATPase and associated glucose transport
  - Use IV regular insulin, typically 1U/cat
  - Onset of action around 15-30 minutes to effect K+ drop
  - MUST give in conjunction with dextrose bolus or hypoglycemia could result. Need to monitor glucose, potentially place on CRI

- Dextrose
  - Can be given alone or in conjunction with insulin
  - Stimulates release of endogenous insulin which drives K+ into cells
  - Dextrose bolus 0.5 g/kg of 50% solution – 1 ml/kg. Should dilute

- Hyperkalemia (con’t)_Terbutaline
  - Benefits
    - Drives K+ into cells by B2 activation of Na/K+ antiporter
    - Fairly rapid onset of action (15-20 min)
    - Dose at 0.01 mg/kg IM or IV
  - Adverse affects
    - B2 spill over onto B1 receptors – tachycardia. Could be issue if occult heart disease
    - B2-mediated vaso/venodilation
    - Potentially a little safer IM, but slower onset of action

- Hyperkalemia (con’t)_Sodium bicarbonate
  - Benefits
    - Drives K+ into cells by activation of H+/K+ antiporter.
      - As pH increases protons shifted out and K+ taken in
    - Can also help with metabolic acidosis
    - Dose generally about 1ml/kg NaHCO3
  - Adverse affects
    - Sodium retention leading to hypernatremia and overhydration
    - Decreased iCa++ from increased binding to albumin
    - Usually NOT required with appropriate fluid therapy
    - Alkalemia as bad if not worse than acidemia if overshoot

- Hyperkalemia (con’t)_When to treat?
  - Calcium gluconate
    - Significant bradycardia, ECG changes
  - Dextrose alone
    - K+ > 6 - 8.0 mmol/L
  - Insulin/dextrose
    - If had to give calcium gluconate
    - K+ > 8.0 mmol/L
  - Sodium bicarb
    - K+ > 10 mmol/L, pH < 7.1
Decompression

- Need to re-establish tubular flow by relieving pressure
- Cystocentesis
  - Benefits
    - Immediate decompression
    - Allow patient to become more stable pre-catheterization
    - (Usually) Doesn’t require sedation
    - Obtain uncontaminated urine sample
    - Potentially decrease difficulty in passing urinary catheter
  - Adverse affects
    - Damage or rupture turgid, friable bladder leading to unabsorbomen with increased morbidity and mortality?

Decompression (con’t)

- Cystocentesis
  - Technique
    - 22g needle, extension tubing, 3-way stopcock, syringe
    - Insert needle tangential toward bladder neck
    - Optimize emptying, diminish leaking

Decompression (con’t)

- Urethral catheterization
  - Requires heavy sedation/anesthesia and analgesia
  - Maximize urethral relaxation, minimize trauma
  - Cardiovascularly stable
    - Acepromazine + hydro/bup/methadone
    - Ketamine + diazepam/midazolam
    - Alfaxalone + midazolam
    - Propofol (+ premed)
    - Isoflurane (+ premed and induction)
  - Cardiovascularly unstable
    - Hydro/bup/methadone + diazepam/midazolam
    - Alfaxalone + midazolam
    - Epidural administration – coccygeal
  - Vocalizing/moving = give more drugs!

Decompression (con’t)

- Urethral catheterization
  - Massage tip with warm gauze – sometimes all it takes!
  - Use open-tipped cath (tomcat, slippery sam, mila)
    - 3.5 vs 5 Fr catheter?
    - If tomcat, need to replace with softer indwelling cath
  - Hydropulsion with saline-lubricant mixture
  - Gentle pressure while extending prepuce caudally
  - Empty bladder and flush with saline
  - Suture in place with butterfly tape to stay loops
  - Attach sterile collection system
Additional diagnostics

- Urinalysis
  - Can expect RBCs, WBCs, look for crystals
  - Evidence of bacterial infection – uncommon
  - Feline urine often has material misinterpreted as cocci on sediment!
  - Really change plan or approach?
- Urine culture
  - Less than 2% FLUTD secondary to bacterial infection
  - Culture on initial catheterization usually not worthwhile
  - Culture after catheter removed?
- CBC
  - Not likely to offer too much insight
- Abdominal radiographs
  - Rule out urethral calculi as cause of obstruction
  - Include entire lower urinary tract!

Post-obstructive care

- Continue intravenous fluids
  - Match fluid rate to UOP once patient has been rehydrated
- Monitor urine output
  - Urine output lower than expect (<1 ml/kg/hr)
  - Catheter/collection system obstructed
  - Still dehydrated, need to increase fluid rate?
  - Acute renal failure
  - Uroabdomen
- Urine output greater than expected
  - Post-obstructive diuresis
  - Osmotic diuresis
  - Medullary washout
  - Pressure necrosis
  - ADH resistance
  - Keep up by giving UOP/hr

Post-obstructive care (con’t)

- Monitor electrolytes/azotemia/acid-base status
  - Should see fairly rapid drop in renal values, almost normal in 1-2 days
  - Metabolic acidosis should also resolve quickly
- Pain management
  - Obstruction and catheterization is PAINFUL!!!
  - Inflammation and urethral spasm can exacerbate obstruction
  - Buprenorphine (0.01-0.02 mg/kg IV, SQ, PO)
  - Methadone (0.2-0.3 mg/kg IV) q6h
  - Acepromazine (0.05 mg/kg IV, IM, SQ or 0.5 mg/kg PO)
    - Sedation as well as antispasmodic affects on urethra

Post-obstructive care

- Antibiotics?
  - Bacterial infection unlikely if first time catheterization
  - Reports from Europe with a higher incidence (25-50%)
  - Prophylactic antibiotics do not decrease risk of UTI
- Prospective study
  - Urine culture by cysto at presentation
  - Culture q24 while catheter in place
  - Culture at time of catheter removal (if >12hrs since previous)
- Preliminary results
  - 34 patients enrolled, range 4hrs – 3 days with cath in place
  - None positive for growth at the time of presentation
  - 4 positive for growth by 24 hours, 3 positive by day 3
  - Incidence appears to be low
- Use based on culture results – cysto after cath removal?

Post-obstructive care

- Phenoxylbenzamine?
  - Takes several days to a week to have effect, limited benefit
- Prazosin?
  - Has α₁ antagonisit effects, shown to reduce pressure profiles
  - May have benefit alone or as adjunct with acepromazine
  - Potential for combined hypotensive effects
- Steroids?
  - Yes there is inflammation but do not appear to have benefit in treatment of cystitis
  - Increased risk of UTI/pyelonephritis while catheterized
  - Single dose at time of catheter removal?
- NSAID?
  - Oncior – may help with inflammation and discomfort
  - Only used after resolution of azotemia
**Post-obstructive care**

- **Length of catheterization**
  - No set minimum time, based on criteria:
    - Resolution of azotemia, acid/base imbalance and hyperkalemia
    - Resolution post-obstructive diuresis, down to near-maintenance fluid rate
    - "Clean-running" urine with minimal blood/debris

- **Length of hospitalization**
  - Observe for at least 12 hours after catheter removal in case of immediate re-obstruction

---

**But what if the client cannot afford traditional management?**

---

**A protocol for managing urethral obstruction in male cats without urethral catheterization**

**Edward S. Cooper, vmd, MS, dacvcs; Timothy J. Owen, DVM; Donna J. Chen, DVM, DACVN; C. A. Tony Bollinger, DVM, DACVN**

**Rationale**

- Obstruction largely functional rather than physical
- Underlying cystitis with urethral spasm and edema
- Could be manipulated pharmacologically
- Catheterization could add to urethral injury and increase risk of re-obstruction
- Alternative to euthanasia with decreased cost compared to traditional management?

---

**Protocol for managing urethral obstruction in male cats without urethral catheterization**

**Protocol**

- Acepromazine - 2.5 mg PO or 0.25 mg IM q8
- Buprenorphine – 75 mcg PO or IM q8
- PRN cystocentesis depending on bladder size
- Minimize stress - dark, quiet area with minimal handling
- SQ fluids 100-200 mL SQ PRN
- Medetomidine – 0.02 mg/kg IM q24 PRN
  - (0.01 mg/kg for equivalent dosing with dexmedetomidine)
- Continued for up to 3 days

---

**Protocol for managing urethral obstruction in male cats without urethral catheterization**

**Results**

- A total of 15 cats treated
- Successful outcome in 11/15 (73%)
  - Spontaneous urination in 4hr–3d (mean 34 hours)
  - Several cats passed large mucous plugs
  - Significant complications in 4/15 (27%)
  - Developed uro/hemoabdomen by day 3-4 of treatment

---

**Protocol for managing urethral obstruction in male cats without urethral catheterization**

**Results – Blood work**

<table>
<thead>
<tr>
<th></th>
<th>Success (11)</th>
<th>Failure (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUN (mg/dL)</td>
<td>62 (19-128)</td>
<td>105 (83-140)</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>4.4 (1.1-12.7)</td>
<td>10.1 (6.3-19.5)*</td>
</tr>
<tr>
<td>Potassium (meq/L)</td>
<td>4.3 (3.4-7.0)</td>
<td>5.8 (4.1-8.0)</td>
</tr>
</tbody>
</table>

* = significant difference from success group
**Outpatient Management**

- One-time decompression
  - Catheterization
    - Pros: Help relieve physical obstruction and allow flushing
    - Cons: May damage urethral and contribute to re-obstruction, requires heavier sedation/anesthesia, costs more
  - Cystocentesis
    - Pros: Less expensive, less injurious to urethra, mild sedation
    - Cons: Relief on temporary if physical obstruction present
- Provision of sedation and analgesia
  - Acepromazine and buprenorphine to go home

---

**Outpatient Management**

- Reserved as a last resort
  - Financial limitations preclude hospitalization
  - Clinical signs are mild to moderate
  - If patient is severely affected, euthanasia should be first option
  - No proven efficacy, some clinical success
  - Owners must be prepared for potential treatment failure or recurrence

---

**At-home care**

- Pain medication
  - Oral buprenorphine 0.01-0.02 mg/kg q8
  - +/- Tramadol 2-4 mg/kg q8
  - Continue for 5-7 days after hospital discharge
- Antispasmodics
  - Oral acepromazine 0.5 mg/kg q8-12
  - +/- Prazosin 0.25-0.5 mg/cat q12-24
  - Continue for 5-7 days after hospital discharge
- Anti-inflammatory
  - NSAID – Onsior can be used
  - Steroids – not likely beneficial
  - Antibiotics?
    - Based on C/S

---

**Prevention**

- Change environment and decrease occurrence of cystitis which can predispose to obstruction
  - Environmental enrichment/decreasing stress
    - Indoor Cat Initiative – www.vet.ohio-state.edu/indoorcat.htm
  - Increase water intake
    - Switch to wet food
    - Flavor water
    - Fresh running water, multiple bowls available
  - Increase number of litter pans \((N+1)\)
  - Diet change?
    - Based on presence of crystals in urine
    - Little benefit shown from alkalinizing or acidifying diet
    - Wet food most important!
  - NO MEDICATION has been proven to decrease risk of recurrence!

---

**Recurrence**

- Risk for re-obstruction
  - Variable depending on the study
  - Follow up for 2 months or 2-3 years
  - Ranged from 24%-40%
  - Most common reason for euthanasia
- Uni-blockers vs multi-blockers
- Reasonable to consider PU with second episode