Critical Aspects of Feline Urinary Obstruction:

- Hyperkalemia
  - Cardiac effects
  - Shock
- Unblocking procedure
- Acute kidney injury
- Bladder / urethral tear
- Marked diuresis
- Repeat obstruction

Incidence/Signalment of FLUTD

- Common
- Any breed
- Males = Females
- Males obstruct more readily, therefore are seen more frequently
- Young adult (1-5 yrs) 1st time onset
No Single Pathogenesis Explains “Syndrome”

- ~50% of cats: no identifiable underlying cause for obstruction
- Remaining 50%: Calculi, diverticulum, urethral plug, (diet???)
- <2% have bacterial infection
- Virus? Never proven
- Stress contributes
- Frustrating!

Phone Triage
- Pollakiuria
- Unable to urinate
- Straining
- Vocalizing
- Vomiting, anorexia
- Pain
- Collapsed, comatose

Initial Survey Triage
- Urine odor
- Large / firm bladder
- Bradycardia (<130 bpm)
- Collapsed
- +/- dehydrated

Turgid Bladder – not necessarily “large”

Neurologic function?
Stable UO vs. Critical UO?

Place IV Catheter at Admission

**Historical and physical parameters as predictors of severe hyperkalemia in male cats with urethral obstruction**

_Lucente, A. Lee, DVM, DACVECC and Kenneth J. Dohbat, DVM, MSCE, DACVECC, DACVIM_

**Historical factors:**
- First-time obstruction
- Outdoor cat
- Anorexia
- Vomiting

**Physical exam factors:**
- Hypothermia
- Bradycardia
- Tachypnea
- Arrhythmia

Bradycardia (<120/min) + Hypothermia (<95F): 98% specific for hyperkalemia
Rapid Electrolyte Testing?

Why is Hyperkalemia So Bad?

![Graph showing the effects of hyperkalemia on ECG waves.]

<table>
<thead>
<tr>
<th>Potassium concentration (mEq/l)</th>
<th>EKG abnormality/ arrhythmia</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5-6.5</td>
<td>Increase in T wave amplitude</td>
</tr>
<tr>
<td>6.6-7</td>
<td>Decrease in R wave amplitude, prolongation of QRS and P-R intervals, S-T segment depression</td>
</tr>
<tr>
<td>7.1-8.5</td>
<td>Decreased P wave amplitude, increased P wave duration, prolongation of Q-T interval</td>
</tr>
<tr>
<td>8.6-10</td>
<td>Lack of P waves (atrial standstill) and sinoventricular rhythm</td>
</tr>
<tr>
<td>&gt; 10</td>
<td>Widening of QRS complex and eventual development of ventricular flutter or fibrillation or asystole</td>
</tr>
</tbody>
</table>

Figure 1. The normal cardiac cell action potential (black line). The normal resting cell membrane potential is approximately 70 mV. The normal threshold cell membrane potential is approximately 70 mV. All cells at rest have high intracellular potassium concentrations and low intracellular sodium concentrations. The membrane potential decreases as sodium enters and potassium leaves the cell. In normal sodium-potassium balance, the cell is depolarized and electrical activity is generated. When the threshold potential is reached, an action potential occurs followed by an electrical repolarization or relaxation of the cell. The normal ECG waves are generated by these changes in membrane potential. A, B, C, D, E, F, G, H, I, J waves are generated by these changes in membrane potential.
Hyperkalemia

- Treat if K+ >7-7.5 mmol/L, clinical
- Improve urine output

Rule of thumb:
DON’T LET THE CAT DIE WAITING ON AN ELECTROLYTE RESULT
Cardiovascular Protection

- 10% Calcium Gluconate
  - Increases cell resting membrane potential to reestablish difference between resting membrane and threshold potential
  - 0.2-0.3 mL/kg IV slow bolus
  - Monitor EKG

Drugs to Lower Potassium

- Dextrose +/- IV Regular Insulin
  - Insulin shifts K into cells, but causes hypoglycemia
  - Dextrose alone? 0.25-0.5 g/kg once
  - Insulin: 1/4 Unit/kg IV bolus
    - 1 unit per cat
  - 2g of dextrose per unit insulin, 1/2 IV bolus, 1/2 in fluids over 6 hours
  - 10-15 minutes to effect

IV Fluids to Lower Potassium?

<table>
<thead>
<tr>
<th>Fluid type</th>
<th>Na (mM/L)</th>
<th>Cl (mM/L)</th>
<th>mOsm/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9% NaCl</td>
<td>154</td>
<td>154</td>
<td>308</td>
</tr>
<tr>
<td>LRS</td>
<td>130</td>
<td>109</td>
<td>~ 300</td>
</tr>
<tr>
<td>Normosol®</td>
<td>140</td>
<td>98</td>
<td>~ 300</td>
</tr>
<tr>
<td>Plasma</td>
<td>145</td>
<td>105</td>
<td>~ 300</td>
</tr>
</tbody>
</table>
More Drugs to Lower Potassium: Sodium Bicarbonate

- Shifts K into cells
- (BW Kg)(base deficit)(0.3)
- ¼ IV slow bolus, ¼ in fluids over 6 hours
- OR 1 mEq/kg
- Rapid administration = vomiting
- Can cause hypocalcemia
- 10-15 minutes to effect

Unblocking Procedure: Extruding the Penis

Sedation/Anesthesia for Unblocking?

- Place IV catheter!
- Combination:
  - Buprenorphine
  - Ketamine
  - Diazepam/Midazolam
- Propofol?
- Inhalant?
- Epidural injection?
Unblocking Procedure

- Sterile gloves
- Tom cat catheter (IV cath, olive-tipped metal)
- Ample sterile lubricant (Lidocaine ointment?)

Catheters

- Avoid trauma

- Introduce catheter into urethral orifice
- Direct penis caudodorsal to straighten urethra
- Gently advance catheter
Unblocking Procedure

• If resistance is met, attempt to flush with sterile saline while advancing
  – pulsatile flow
  – use extension set
• Acidic flush solutions?
  – No data
  – Tissue injury

Is Cystocentesis Safe?

• danger of rupturing bladder
• relieves pressure, improving chance of retropulsion
• place needle closer to neck than apex
• Be careful!

Unblocking Procedure

• After passing catheter into bladder, empty bladder
  – severe hematuria, grit common
• Replace “tom cat” catheter with more permanent
• Should have well established urine stream
Unblocking Procedure

- Replace with sterile red rubber feeding tube (3.5 or 5 French size?)
  - freezing catheter provides stiffening
- Penis and prepuce frequently swollen/erythematous
- Newer catheter options

Unblocking Procedure

- Placing red rubber catheter

Unblocking Procedure

- Premeasure length to be inserted
- Suture tape wings to prepuce
Unblocking Procedure
• Attach closed urinary collection system
• Tape remainder of catheter to tail
• Allow sufficient slack to raise tail

Can’t Unblock?
• Cystocentesis and take a break to make a plan
  – Avoid additional urethral trauma
• Complete anesthesia/ epidural anesthesia
• Antegrade catheter placement
  – Fluoroscopic imaging and percutaneous wire
  – Surgical approach and placement
• Tube cystopexy

Urinary Catheter Care Protocol
• Q 4-6 hours
• 5 mL dilute chlorohexadine solution to clean perineal area
• Wipe chlorohexadine solution around urinary catheter and line, away from patient
• Can flush U-cath with 3 mL sterile saline to insure patency if needed
E-Collar Always!

- Cats are crafty...

Initial Fluid Therapy

- Maintenance
  - 50-60 ml/kg/24 hrs
- Dehydration – calculate, don’t guess!
  - (% dehydration)(BW kg)(1000ml/kg)
- Ongoing losses
  - Vomiting, diarrhea, urine output
- Monitor urine output!
Analgesia Post-Unblocking? YES!
- Makes cats more comfortable!
- Opioid analgesia
  - Buprenorphine IV / PO
- Epidural for unblocking also provides analgesia
- Avoid NSAIDs – increased risk of renal injury

The Next Issues to Consider...
- Ongoing fluid plan
- Catheter issues
- Reblocking
- Urethral tear
- Persistent azotemia
- Risk of infection
- Perineal urethrostomy

Gizmo, 5 kg M/C
- Severe UO
  - Blocked ~24 hrs, critical
  - Appropriate Tx
- 18 hours: Catheter flowing, hydrated
- Current fluid treatment: LRS @ 30 mL/hr
- Hourly urine output, last 4 hours: 60 mL/hr
- Why?
Post-obstructive Diuresis

- 46% of cats with UO, 1-2 days post
  - Acidemia at presentation significant

- Why?
  - Back-pressure on tubules
  - Uremic waste products

- What’s the issue?
  - Recurrent dehydration
  - Permanent kidney injury
  - Electrolyte abnormalities

When Urine Output is Excessive: “Ins and Outs” Fluid Dosing

- Must have normal hydration status
- 24-hour care, competent nursing staff

<table>
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<tr>
<th>Maintenance Fluids</th>
<th>Vs. “Ins and Outs”</th>
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<tr>
<td>~60 mL/kg/day</td>
<td>20 mL insensible loss + exact measurement of sensible loss</td>
</tr>
<tr>
<td>~20 mL loss + ~40 mL sensible loss estimate</td>
<td>No extra dehydration replacement Frequent (~Q 4 hours) decision points</td>
</tr>
<tr>
<td>Can add dehydration component</td>
<td></td>
</tr>
</tbody>
</table>

“Ins and Outs”

- “Insensible” losses
  - Water used for metabolic functions, respiratory losses (Can’t measure)
  - ~20 mL/kg/day

- “Sensible” losses
  - Measurable (e.g. urine, vomitus, etc.)

- “Maintenance” fluid formulas combine these
Calculating Ins and Outs

- Calculate insensible losses for patient:
  - 20 ml/kg/day
- Measure urine output from previous time point
  - Usually every 4 hours...
- Administer fluid therapy at hourly rate for insensible losses, plus hourly urine output
- Recalculate fluid rate every 1-6 hours

Gizmo

- 5 Kg, normally hydrated
- Polyuric: post-obstructive diuresis
- Urine output average: 50 mL/hr x 4 hours
- Fluid dose:
  - Insensible loss: 20 mL/kg/day x 5 kg = 100 mL/day, or 4 mL/hr
  - Sensible loss: 50 mL/hr
  - Hourly rate: 54 mL/hr for next 4 hours

4 hours later...

- Urine output average: 60 mL/hr x 4 hours
- Fluid dose:
  - Insensible loss: 4 mL/hr
  - Sensible loss: 60 mL/hr
  - Hourly rate: 64 mL/hr for next 4 hours
- And so on...
How do you know you aren’t creating polyuria with your fluid treatment?

- Good question…
- Lasts 2-5 days
- Is cat feeling better?
  - Maintain hydration?
- Begin fluid taper
- Monitor

Hypokalemia:
Kidneys waste potassium when polyuric

Potassium Replacement

- Intravenous therapy:
  - Potassium chloride
  - BE CAREFUL!
- Oral therapy usually not needed
  - Resolves when urine output normalizes
Clinical features and risk factors for development of urinary tract infections in cats
Ivan Martinez-Ruzafa1, John M Krupan1, RoseAnn Miller1, Cheryl L Swanson1, Carol A Bolsin1 and John B Kaneana1

- Cats with a history of urethral catheterization are 8.37 times more likely to develop UTI than control group
- Clinical signs, pyuria, or bacteriuria not always consistent with UTI
- USG mean 1.030 (+) vs. 1.041 (-)
- Top isolates: E. coli (78%), Enterococcus spp. (21%) Staph. Spp. (17%) Strep. sop (12%)

The Drill...
- Catheter in
- 24-48 hrs – remove

3 situations:
- Catheter in but bladder not emptying
- Re-obstruct when catheter first removed
  – Physical blockage
  – Functional blockage
- Re-obstruct over time
Catheter Frustrations!

- Monitor bladder emptying (even with catheter)

1 mL = 1 gm

Other reasons for no flow with catheter in:

- Blood clots
  - Solution: Time
- Has catheter moved?
- Catheter too small (???)
- Is a “large” bladder necessarily “full”?
  - Ultrasound helpful here

**Initial treatment factors associated with feline urethral obstruction recurrence rate: 192 cases (2004–2010)**

- Retrospective over 7 years
- 37 of 157 cats = repeat obstruction
- Fewer obstructions:
  - With 3.5 Fr catheter instead of 5 Fr
  - With prazosin instead of phenoxybenzamine
Do Cats Have Urethralspasm?

- Internal sphincter: Smooth MM
  - Alpha receptors
- Prazosin (Phenoxybenzamine)
  - \(\alpha_2\) blocker relaxes internal urethral sphincter
  - Hypotension
    - Withhold in critically ill or sedated cats
    - Useful or not?
- External sphincter? Striated MM
  - Muscle relaxants
  - Diazepam?

Evaluation of risk factors associated with recurrent obstruction in cats treated medically for urethral obstruction

- Prospective observational study
- 68 enrolled, 10 re-obstructed
- Increased risk: Older cats
- Decreased risk:
  - Longer duration of catheterization (???)
  - Owner increased water intake at home

If Repeat Obstruction After Catheter Removal?

- Immediately?
  - Blood clots
  - Urethritis/Spasm
  - Undiagnosed urethral calculus?
  - Is it obstruction or atony?
- Over time?
  - Stricture
  - Continued FLUTD
  - Undiagnosed calculi
Urethritis/ “Urethral Spasm”
- Practice atraumatic catheterization

Why Detrusor Atony?
- Over-distention of detrusor MM damages tight junctions between cells
- Temporary vs. permanent?
- Management:
  - Manual expression 😊
  - Intermittent catheterization 😊
  - Bethanecol
    - Will increase urethral tone

Are you contributing to the problem?
Stressed out?

The Ohio State University
COLLEGE OF VETERINARY MEDICINE

Indoor Pet Initiative

Feline Life Stressor

What is a life stressor?

Life Stressors of Cats: How to Make Your Cat More Comfortable When Stress Occurs

Indoorpet.osu.edu

When to perform perineal urethrostomy?

- It depends...
  - Number of times blocked
  - Tolerance for life-threatening obstruction
  - Money
  - Complications
Short- and long-term outcome after perineal urethrostomy in 86 cats with feline lower urinary tract disease

- 11/86 (13%) – repeat urethral disease within 6 months
- 87% - Owners reported good quality of life, deaths unrelated to urinary issues
- 10% of long-term group – repeat FLUTD episodes

No money to unblock?

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

- 15 cats, unblocking declined, R/O calculi, etc.
- Quiet kennel, low stress
- Acepromazine (0.25 mg, IM, or 2.5 mg, PO, q 8 h), buprenorphine (0.075 mg, PO, q 8 h), and medetomidine (0.1 mg, IM, q 24 h) and decompressive cystocentesis and SC administration of fluids as needed
- 11 cats responded, 4 cats = uroabdomen

Oops...
A clinical review of pathophysiology, diagnosis, and treatment of uroabdomen in the dog and cat

- Persistent or worsening azotemia & hyperkalemia after unblocking
- Loss of serosal detail/ free fluid on US
- Abdominal fluid creatinine: serum creatinine ratio > 2:1

- Place urinary catheter
  - Not always possible
  - Cystostentesis or peritoneal drainage
- Abdominal drainage
  - Temporary drainage catheter
  - Stabilize prior to definitive repair
- Urethral tear vs. bladder rupture