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

Journal of Veterinary Emergency and Critical Care **16**(2) 2006, pp 104–111

Justine A. Lee, DVM, DACVECC and Kenneth J. Drobatz, 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?

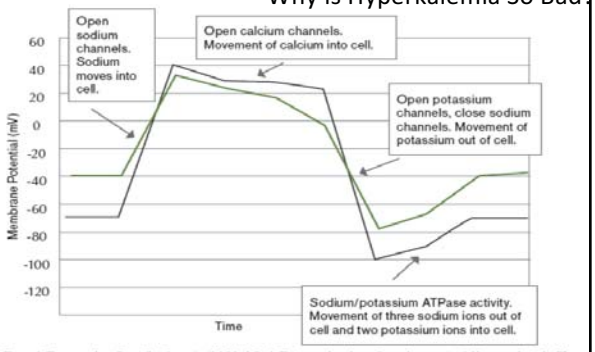
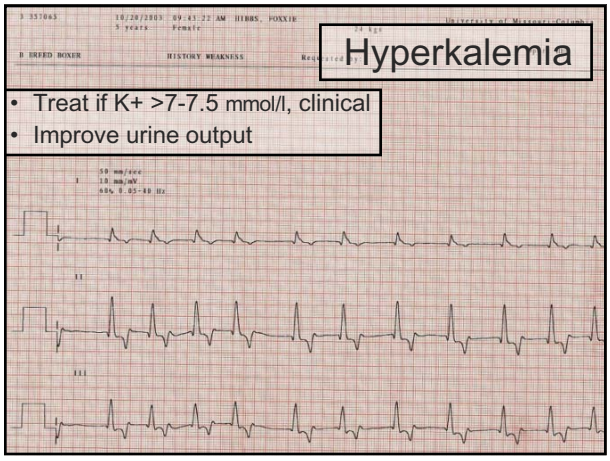
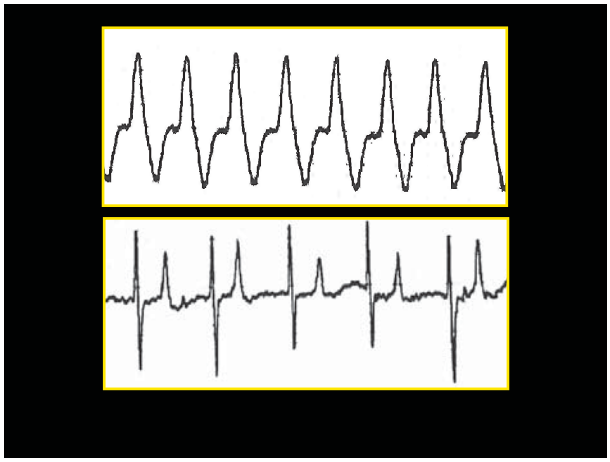


Figure 1. The normal cardiac cell action potential (black line). The normal resting cell membrane potential is approximately -70 mV. The normal threshold cell membrane potential is approximately -50 mV. All cells at rest have high intracellular potassium concentrations and high extracellular sodium concentrations. All channels allow for movement of ions from an area of high concentration to an area of low concentration. The green line indicates alterations that occur when the body is hyperkalemic.

Thomovsky, Veterinary Medicine, 2011

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

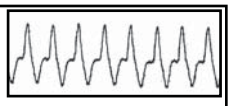




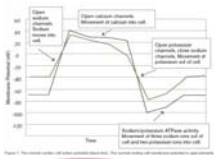
Rule of thumb:

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: ¼ Unit/kg IV bolus
    - 1 unit per cat
  - 2g of dextrose per unit insulin, ½ IV bolus, ½ in fluids over 6 hours
  - 10-15 minutes to effect

IV Fluids to Lower Potassium?

Fluid type	Na (mmol/l)	Cl (mmol/l)	mOsm/L
0.9% NaCl	**154**	**154**	**308**
LRS	**130**	**109**	**~ 300**
Normosol ®	**140**	**98**	**~ 300**
Plasma	**145**	**105**	**~ 300**

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?

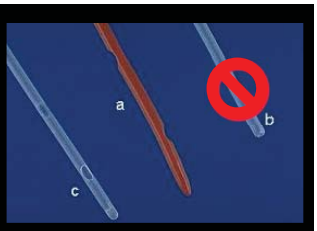
- Place IV catheter!
- Combination:
  - Buprenorphine
  - Ketamine
  - Diazepam/ Midazolam
- Propofol?
- Inhalant?
- Epidural injection?

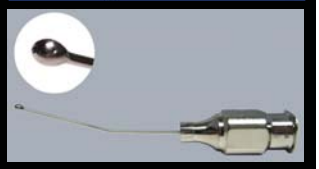
Unblocking Procedure

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

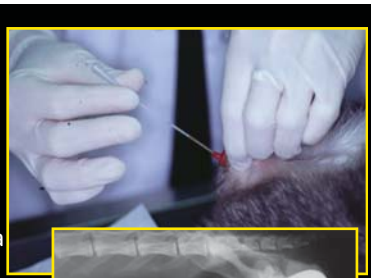
Catheters

- Avoid trauma





- Introduce catheter into urethral orience
- Direct penis caudodorsal to straighten urethra
- Gently advance catheter

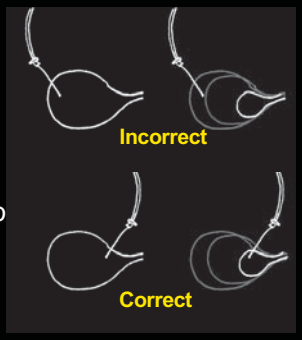


Unblocking Procedure

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

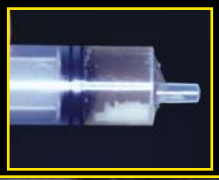
Is Cystocentesis Safe?

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



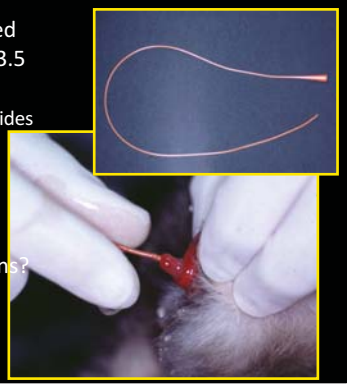
Unblocking Procedure

- After passing catheter into bladder, empty bladder
  - severe hematuria, grit common
- Replace "tom cat" catheter with more permanent
- Should have well established urine stream



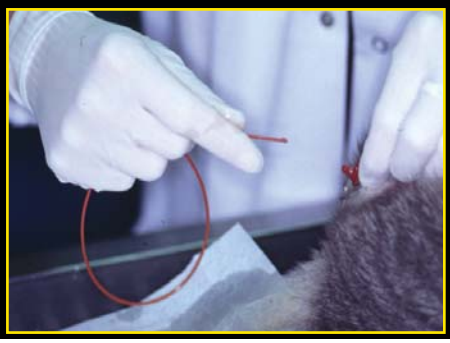
Unblocking Procedure

- 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?



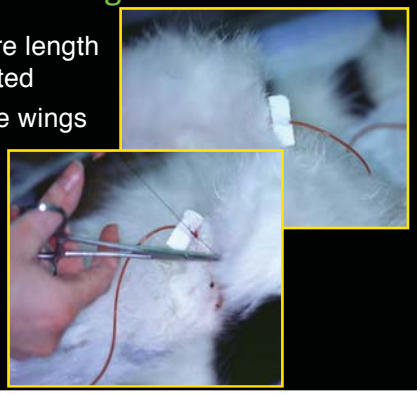
Unblocking Procedure

- 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!

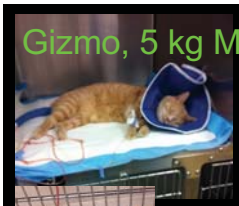
Analgesia Post-Unblocking? YES!

- 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

Francis et al, J Fel Med Surg, 2010; 12:406

When Urine Output is Excessive: "Ins and Outs" Fluid Dosing

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

Maintenance Fluids	Vs.	"Ins and Outs"
• ~60 mL/kg/day • = 20 mL insensible loss + ~40 mL sensible loss estimate • Can add dehydration component		• 20 mL insensible loss + exact measurement of sensible loss • No extra dehydration replacement Frequent (~Q 4 hours) decision points

"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?

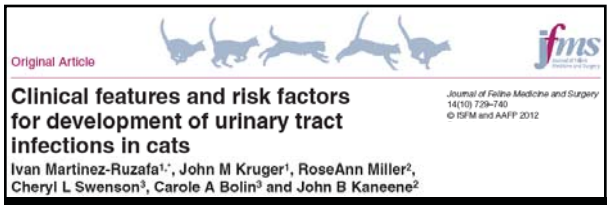
- Good question…
- Lasts 2-5 days
- Is cat feeling better?
  - Maintain hydration?
- Begin fluid taper
- Monitor

Hypokalemia:

Kidneys waste potassium when polyuric

Potassium Replacement

- Intravenous therapy:
  - Potassium chloride
  - BE CAREFUL!
- Oral therapy usually not needed
  - Resolves when urine output normalizes


Original Article

Clinical features and risk factors for development of urinary tract infections in cats

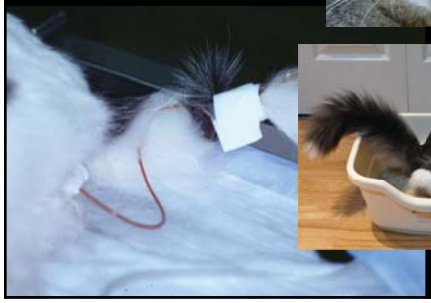
Ivan Martinez-Ruzafa[1,*], John M Kruger[1], RoseAnn Miller[2], Cheryl L Swenson[3], Carole A Bolin[3] and John B Kaneene[2]

Journal of Feline Medicine and Surgery
14(10) 729–740

- Cats wit 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

Saline flush

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)

JAVMA, Vol 243, No. 4, August 15, 2013

Peter F. Hetrick, DVM, and Elizabeth B. Davidow, DVM, DACVECC

- Retrospective over 7 years
- 37 of 157 cats = repeat obstruction
- Fewer reobstructions:
  - With 3.5 Fr catheter instead of 5 Fr
  - With prazosin instead of phenoxybenzamine

Do Cats Have Urethraspasm?

- Internal sphincter: Smooth MM
  - Alpha receptors
- Prazosin (Phenoxybenzamine)
  - α2 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

JAVMA, Vol 243, No. 8, October 15, 2013

Beth W. Eisenberg, DVM; Jennifer E. Waldrop, DVM, DACVECC; Sarah E. Allen, DVM, DACVECC; Jennifer O. Brisson, DVM, DACVR; Kathryn M. Aloisio; Nicholas J. Horton, SCD

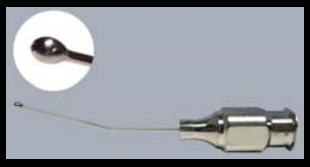
- Prospective observational study
- 68 enrolled, 10 re-obstructed
- Increased risk: Older cats
- Decreased risk:
  - Longer duration of catheterization (???)
  - Owner increased water intake at home

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/ "Urethraspasm"

- Practice atraumatic catheterization

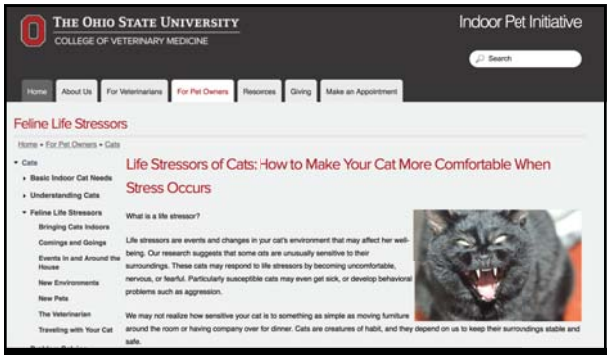


Why Detrusor Atony?

- 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?



Indoorpet.osu.edu

When to perform perineal urethrostomy?

- It depends…
  - Number of times blocked
  - Tolerance for life-threatening obstruction
  - Money
  - Complications

Journal of Small Animal Practice (2012) 53, 693–698

PAPER

Short- and long-term outcome after perineal urethrostomy in 86 cats with feline lower urinary tract disease

L. Ruda and R. Heiene

- 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.

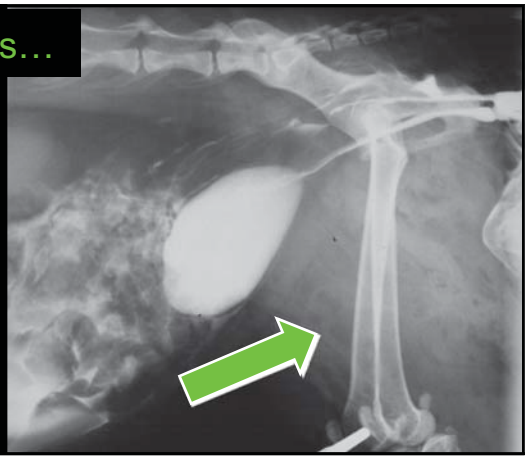
J Am Vet Med Assoc. December 1, 2010;237(11):1261-6.

Edward S Cooper[1]; Tammy J Owens; Dennis J Chew; C A Tony Buffington

[1]Department of Veterinary Clinical Sciences, College of Veterinary Medicine, The Ohio State University, Columbus, OH 43210, USA. cooper.1697@osu.edu

- 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…



Journal of Veterinary Emergency and Critical Care

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

Journal of Veterinary Emergency and Critical Care 23(2) 2013, pp 216–229
doi: 10.1111/vec.12033

Jennifer R. Stafford, DVM, DACVECC, DACVIM and Joseph W. Bartges, DVM, PhD, DACVIM, DACVN

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

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Jennifer R. Stafford, DVM, DACVECC, DACVIM and Joseph W. Bartges, DVM, PhD, DACVIM, DACVN

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