Urethral obstruction in cats

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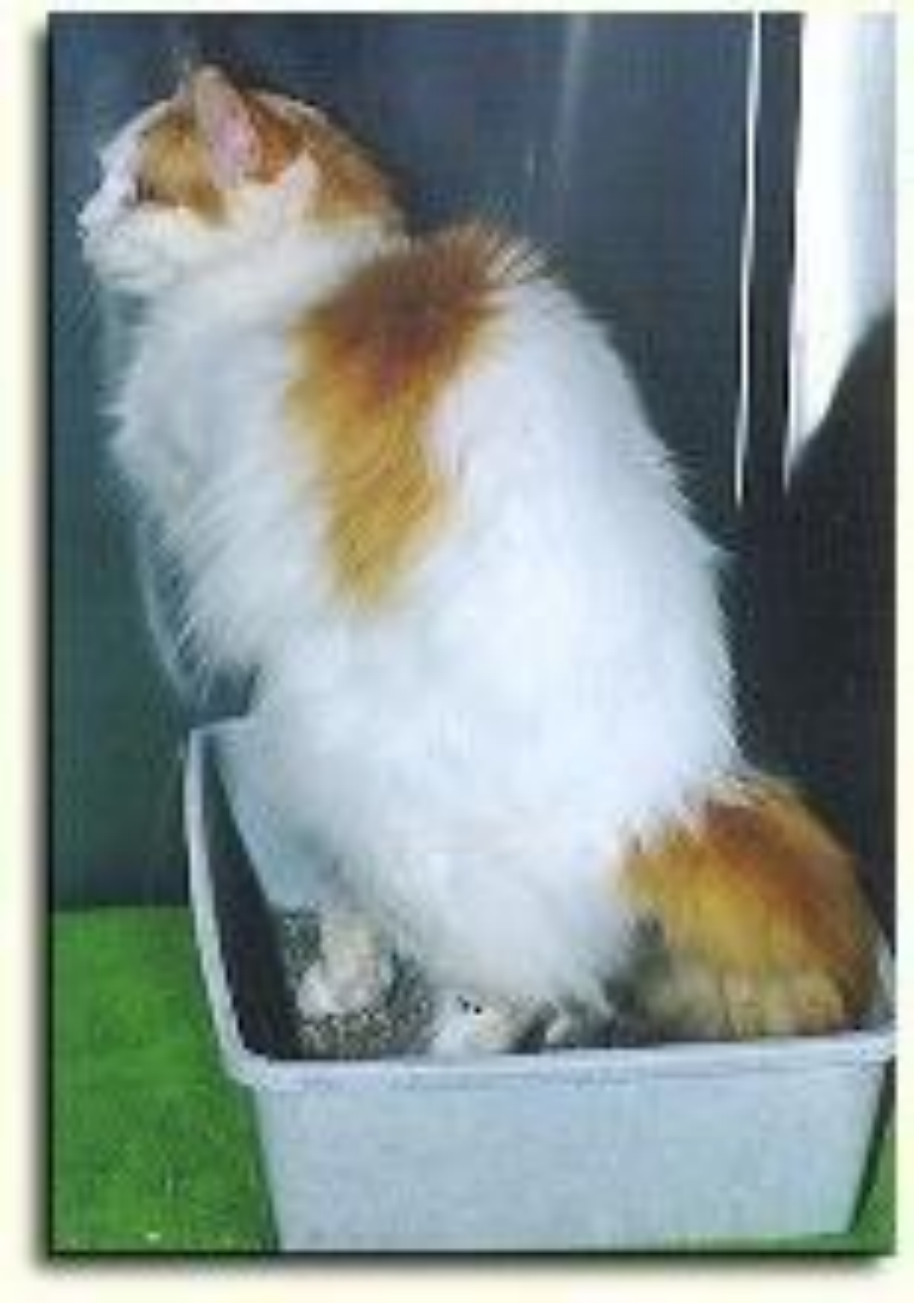
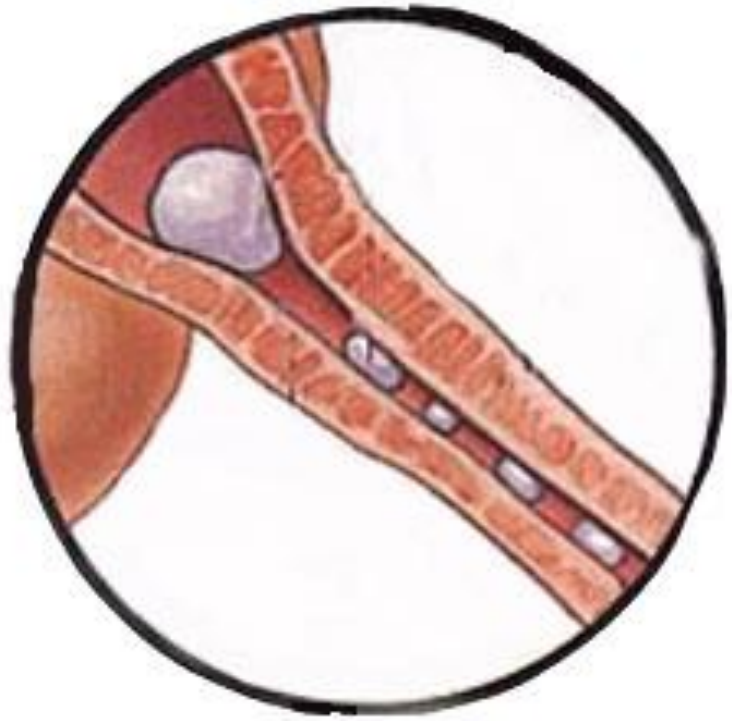
Overview

- Pathogenesis/pathophysiology
- History/clinical signs
- Clinical management
  - Emergent care
  - Deobstruction
  - Post-obstructive care
- Immediate at-home care



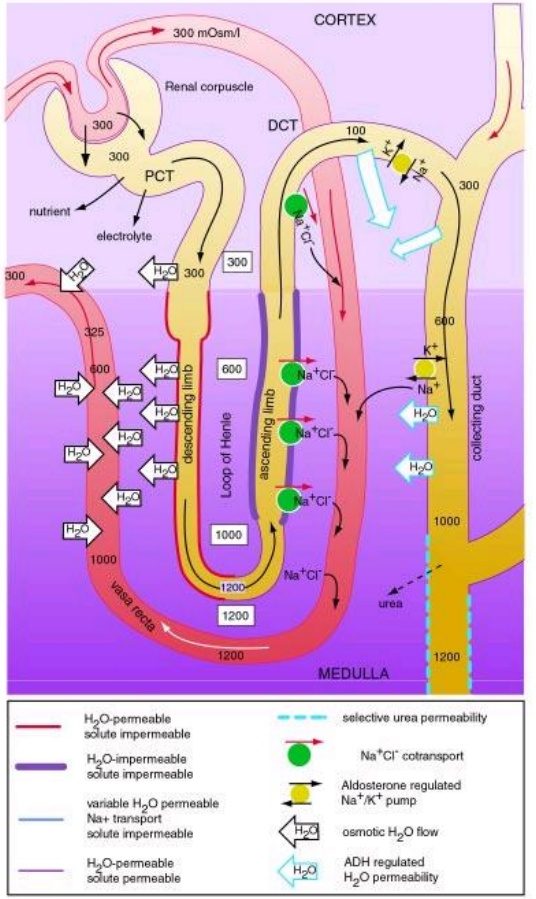
Underlying causes

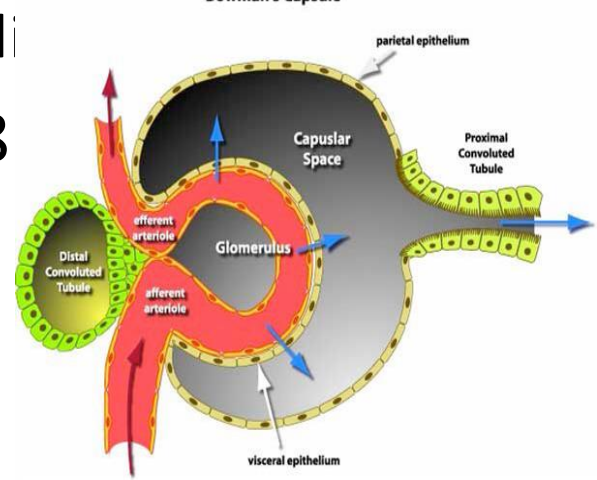
- Idiopathic cystitis
  - Urethral plug (20-60%)
    - Inflammatory debris
    - Crystalline matrix
    - Proteinaseous material
  - Urethral spasm/edema? (20-50%)
- Urethral calculi (10-30%)
- Stricture (2-3%)
- Neoplasia (1-2%)



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 abili
- Severe metabolic and cardiovascular derangement in 24-48 in 3-5 days without intervention





Pathophysiology of Obstruction

- Uremia
  - Mental depression
  - 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 1: Clinicopathologic values measured at admission[a]

Variable	*n*	Median	Range	Reference range	% of cats below the reference range	% of cats above the reference range
Venous pH	198	7.29	7.02–7.45	7.30–7.40	80 (40%)	9 (4.5%)
Venous pCO_2 (mmHg)	198	40.2	26.6–74.2	33–43	25 (13%)	60 (30%)
Venous pO_2 (mmHg)	197	49.2	4.03–111	41–51	55 (28%)	120 (61%)
Venous base excess (mmol/L)	195	−7.4	−23 to +3.2	−1 to −7	10 (5%)	84 (43%)
Venous bicarbonate (mmol/L)	195	19.2	7–27.8	17.3–24.1	59 (30%)	13 (7%)
PCV (%)	185	44.6	20–61	32–48	4 (2%)	50 (27%)
Total solids (g/dL)	182	8.0	5.8–10.3	6–8.6	1 (0.5%)	36 (20%)
Sodium (mmol/L)	191	152	132–165	148–157	36 (19%)	18 (9%)
Potassium (mmol/L)	199	5.2	3.4–10.5	3.6–4.6	12 (6%)	81 (41%)
Chloride (mmol/L)	186	114	96–180	113–121	56 (30%)	5 (3%)
Ionized calcium (mmol/L)	199	1.10	0.57–1.6	1.10–1.22	68 (34%)	39 (19%)
Glucose (mg/dL)	196	174.7	31–378	67–168	1 (0.5%)	106 (54%)
BUN (mg/dL)	183	40	10–100*	15–32	10 (5%)	127 (69%)
Lactate (mmol/L)	188	2.2	0.2–8.4	1.0–2.0	21(11%)	85 (45%)

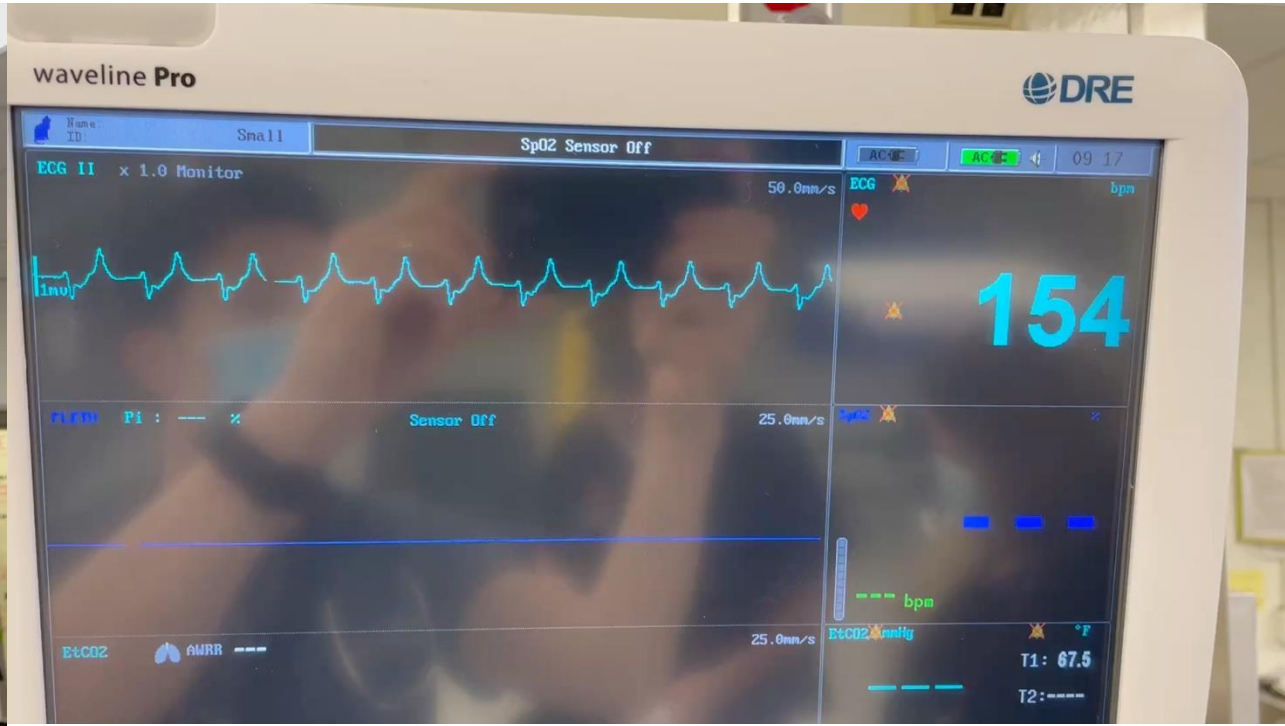
*Highest concentration that the machine will measure (100 mg/dL).

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 fibrillation
  - Atrial standstill
  - Asystole

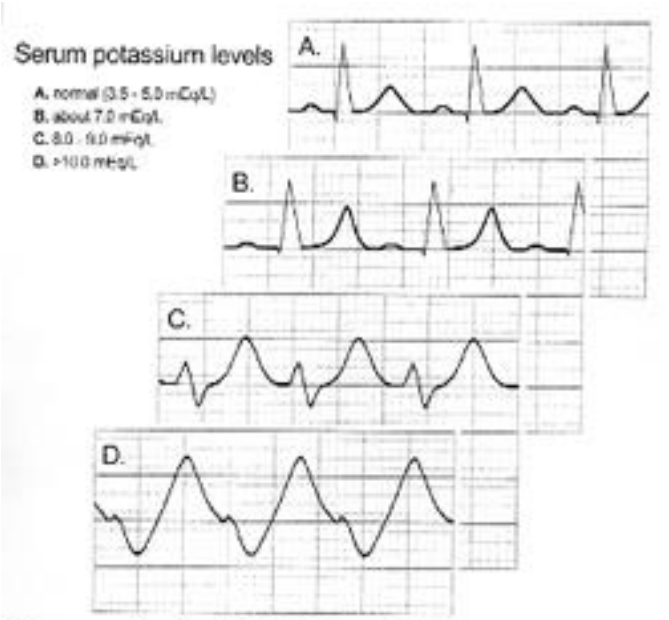
Effects of Hyperkalemia

- Always auscultate, palpate pulses



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 verses chronic
  - Acid-base status
  - Calcium level
  - Magnesium level



Changes in the ECG in lead II caused by hyperkalemia

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
- Need for quick recognition and intervention!

History

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

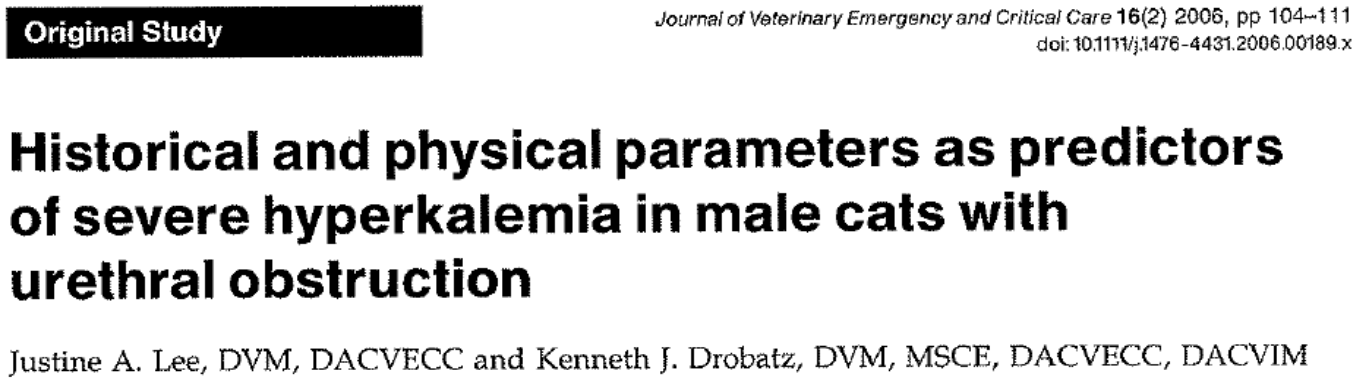
Physical Exam

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

Note: Cat is just sleeping. No animals were harmed in the making of this powerpoint presentation.

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%)



Original Study

Journal of Veterinary Emergency and Critical Care **16**(2) 2006, pp 104–111
doi: 10.1111/j.1476-4431.2006.00189.x

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

Justine A. Lee, DVM, DACVECC and Kenneth J. Drobatz, DVM, MSCE, DACVECC, DACVIM

Initial diagnostic evaluation

- ECG
- PCV/TS
  - Elevated from hemoconcentration
- Blood gas analysis/electrolytes/chem
  - Hyperkalemia
  - Azotemia
  - Metabolic acidosis +/- respiratory compensation
  - Hyperphosphatemia
  - Hypocalcemia
  - Hyperglycemia

pH	7.118	N
PCO_2	45	40
HCO_3	11.7	22
BE	-9.7	-3 +3
Na+	155	150
K+	8.1	4.5
lCa+	1.04	1.15
BUN	132	15
Creat	7.9	1

Patient management

JOURNAL OF Veterinary Emergency AND Critical Care

Clinical Practice Review | Full Access

Controversies in the management of feline urethral obstruction

Edward S. Cooper VMD, MS, DACVECC

First published: 15 January 2015 | https://doi.org/10.1111/vec.12278 | Citations: 16

Journal List > Can Vet J > v.61(6); 2020 Jun > PMC7236633

The Canadian Veterinary Journal
La Revue vétérinaire canadienne

Journal Web site
How to Submit

Can Vet J. 2020 Jun; 61(6): 595–604.

PMCID: PMC7236633
PMID: 32675811

Language: English | French

In-hospital medical management of feline urethral obstruction: A review of recent clinical research

Patient management

- Two populations with different priorities:
  - Really sick blocked cat – bradycardic, hypothermic, hypotensive
    - Priority – not dying
  - Not so sick blocked cat – normal heart rate, non-azotemic to moderately azotemic, stable
    - Priority – pain, stress, obstruction
  - Interventions should have different priorities for these two groups!

Patient management

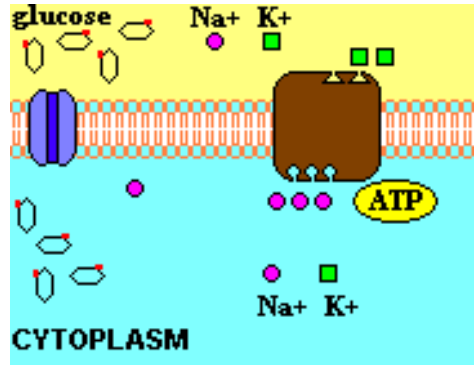
- Two populations with different priorities:
  - Really sick blocked cat – bradycardic, hypothermic, hypotensive
    - Priority – not dying
- Main life-limiting aspect – hyperkalemia
- Initial treatment should be geared toward interventions that impact this in the most immediate way
  - Hint…it is not passing a urinary catheter!

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
  - Most important intervention for life-threatening hyperK!!!

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 with dextrose bolus or hypoglycemia could result. Also need to monitor glucose and potentially place on dextrose 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 $NaHCO_3$
  - 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)

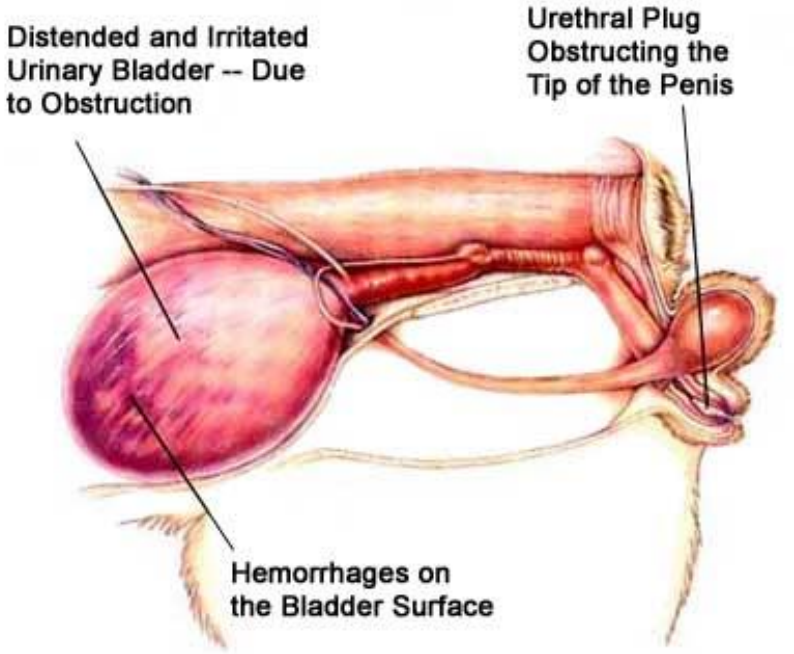
- When to treat?
  - Calcium gluconate
    - Significant bradycardia, ECG changes
- Dextrose alone
  - K+ > 6 - 8.0 mmol/L
- Insulin/dextrose or terbutaline
  - If had to give calcium gluconate
  - K+ > 8.0 mmol/L
- Sodium bicarb
  - K+ > 10 mmol/L, pH < 7.1

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
  - Doesn’t matter if adequate amount given and obstruction is relieved

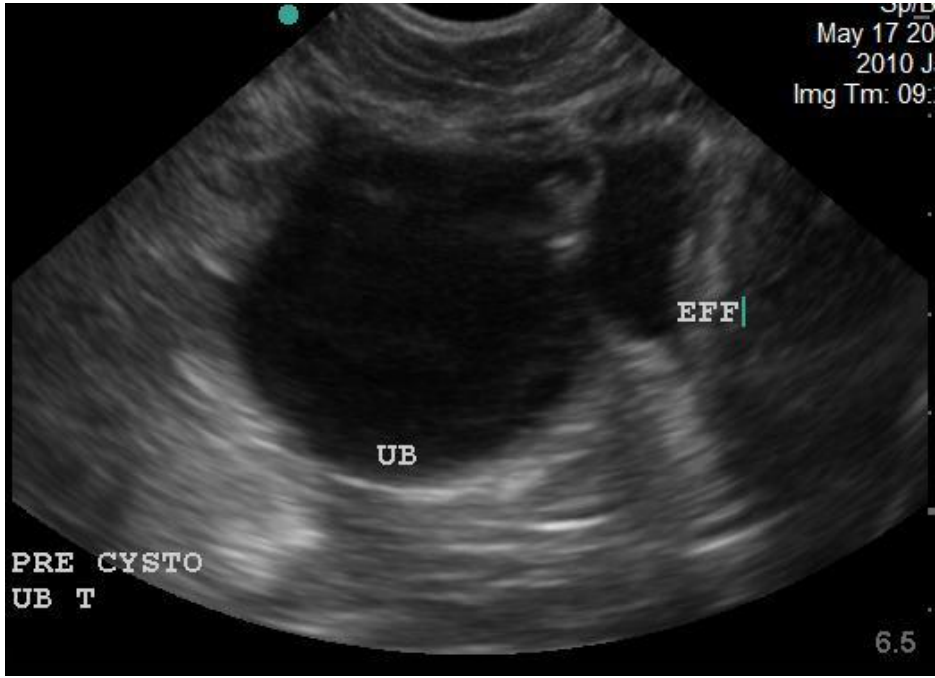
Decompression

- Need to re-establish tubular flow by relieving pressure
- Cystocentesis
  - Benefits
    - Immediate decompression
    - Allow patient to become more stable pre-catheterization
    - Minimal sedation if ill
    - Obtain uncontaminated urine sample
    - Potentially decrease difficulty in passing urinary catheter
  - Adverse affects
    - Damage or rupture turgid, friable bladder leading to uroabdomen with increased morbidity and mortality?



Decompression

- Incidence of complications from cystocentesis
  - Prospective clinical study
  - Cats with UO admitted for standard treatment
  - Abdominal ultrasound performed - FAST
    - At presentation, prior to cysto
    - 15 minutes after cysto performed
    - “The next day”
  - Result
    - 45 cats enrolled
    - 16 with scant effusion at presentation – bladder neck
    - 23 with scant effusion after cysto performed
    - 2 with scant effusion present the following day
    - No major complications reported



Decompression

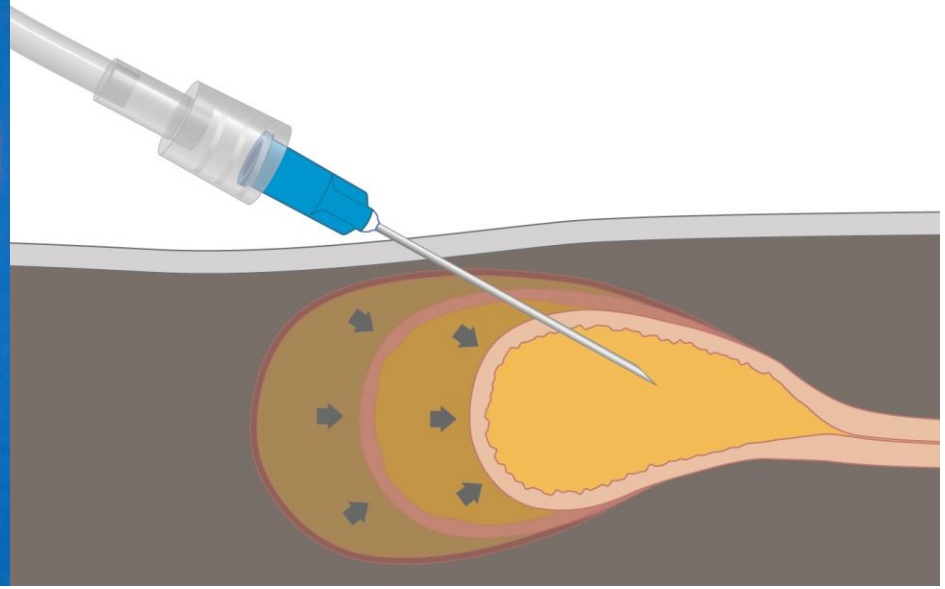
- Incidence of complications from cystocentesis
  - Retrospective study (Hall et al)
  - Cats with UO admitted for standard treatment that had decompressive cystocentesis performed
  - Review of abdominal radiograph reports and medical records to determine complications
  - Result
    - 47 cats included
    - 34 cats had radiographs, 19 had evidence of effusion
      - Unclear whether radiographs obtained before or after cysto
    - No major complications reported

Decompression

- Incidence of complications from cystocentesis
  - Randomized, blinded, prospective clinical study (Reineke et al)
  - Cats with UO admitted for standard treatment
  - Abdominal ultrasound performed
    - At presentation, prior to cysto
    - 4 hours after cysto performed
  - Time and difficulty score for catheter placement recorded
  - Result
    - 88 cats enrolled (44 cysto, 44 without)
    - Many cats had effusion at the time of presentation (62/67), no significant change in effusion after cysto
    - No significant difference in time to unblock or difficulty scores
    - 1 cat in cysto group developed hemoabdomen, 1 cat in u cath only group developed bladder rupture/uroabdomen
    - No other complications reported

Decompression (con’t)

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



Patient management

- Two populations with different priorities:
  - Hopefully the first population is now more stable…and this is where the second population would enter
  - Not so sick blocked cat – normal heart rate, non-azotemic to moderately azotemic, stable
    - Priority – pain, stress, obstruction
  - Interventions geared toward analgesia, sedation, and deobstruction

Decompression (con’t)

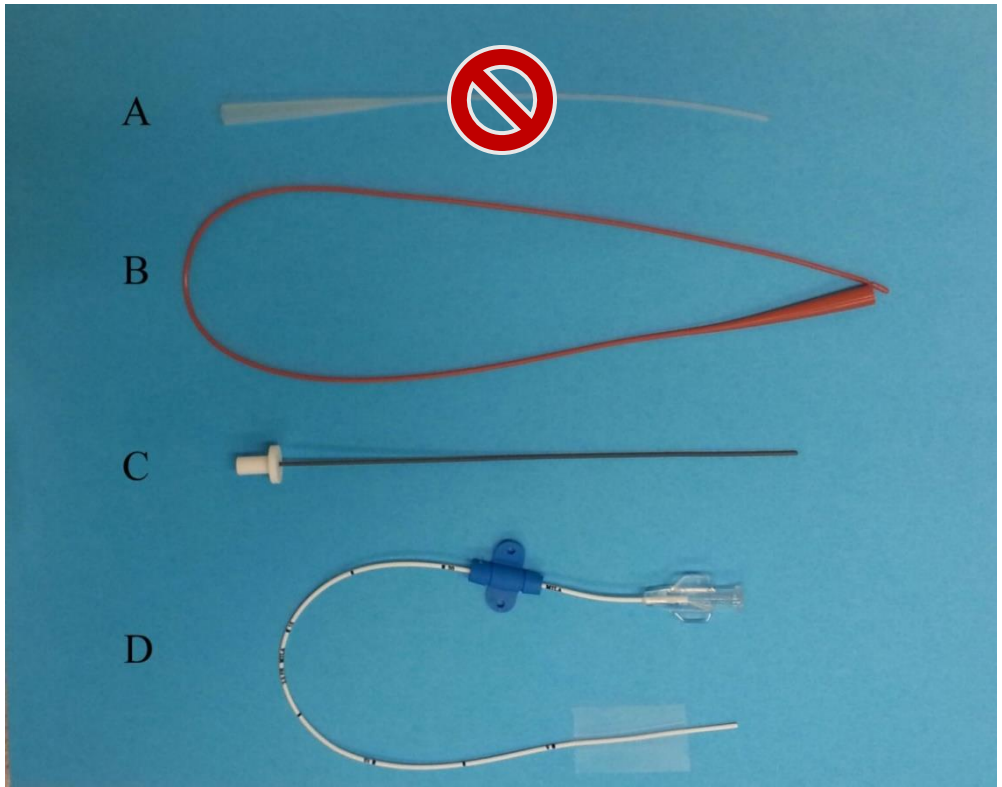
- Urethral catheterization
  - Requires heavy sedation/anesthesia and analgesia
    - Maximize urethral relaxation, minimize trauma
    - Cardiovascularly stable
      - Acepromazine + hydro/bup/methadone
      - Ketamine + diazepam/midazolam
      - Opioid + alfaxalone + midazolam
      - Propofol (+ premed)
      - Isoflurane (+ premed and induction)
    - Cardiovascularly unstable
      - Hydro/bup/methadone + diazepam/midazolam
      - Opioid + 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?
    - Suggested lower incidence of rUO with 3.5
    - Limitations to study

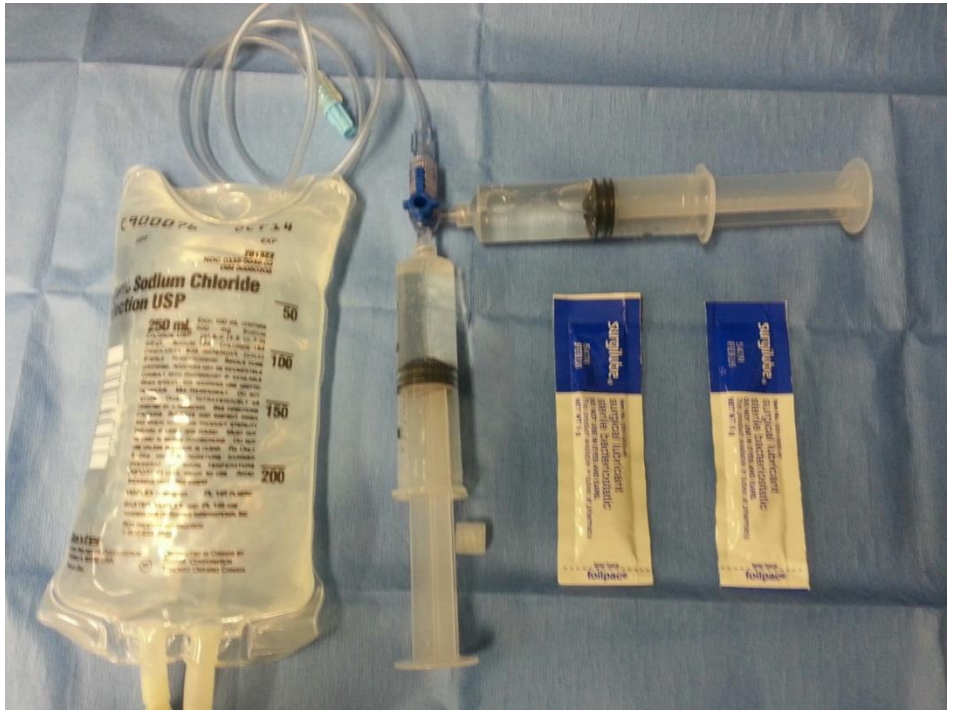
Initial treatment factors associated with feline urethral obstruction recurrence rate: 192 cases (2004–2010)

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



Decompression (con’t)

- Urethral catheterization
  - Hydropulsion with saline-lubricant mixture
    - Consideration of lidocaine jelly? No evidence
    - Bladder instillation of lidocaine failed to show any benefit in reobstruction rates or post-obstructive clinical signs



Journal of Veterinary Internal Medicine
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Intravesical Application of Lidocaine and Sodium Bicarbonate in the Treatment of Obstructive Idiopathic Lower Urinary Tract Disease in Cats

L. Zezza, C.E. Reusch, B. Gerber

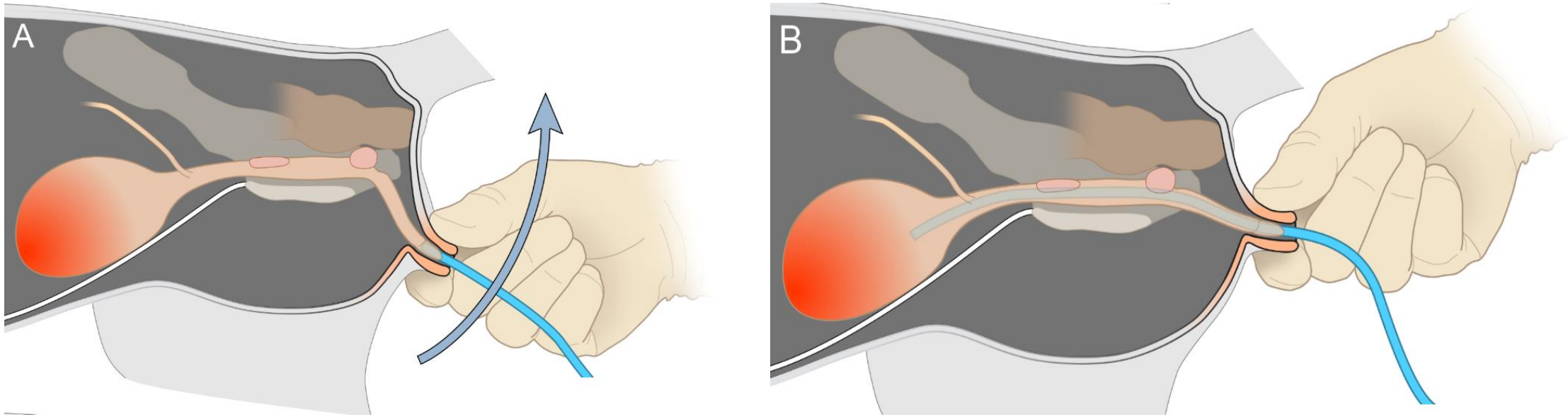
First published: 22 March 2012 | https://doi.org/10.1111/j.1939-1676.2012.00911.x | Citations: 8

Decompression (con’t)

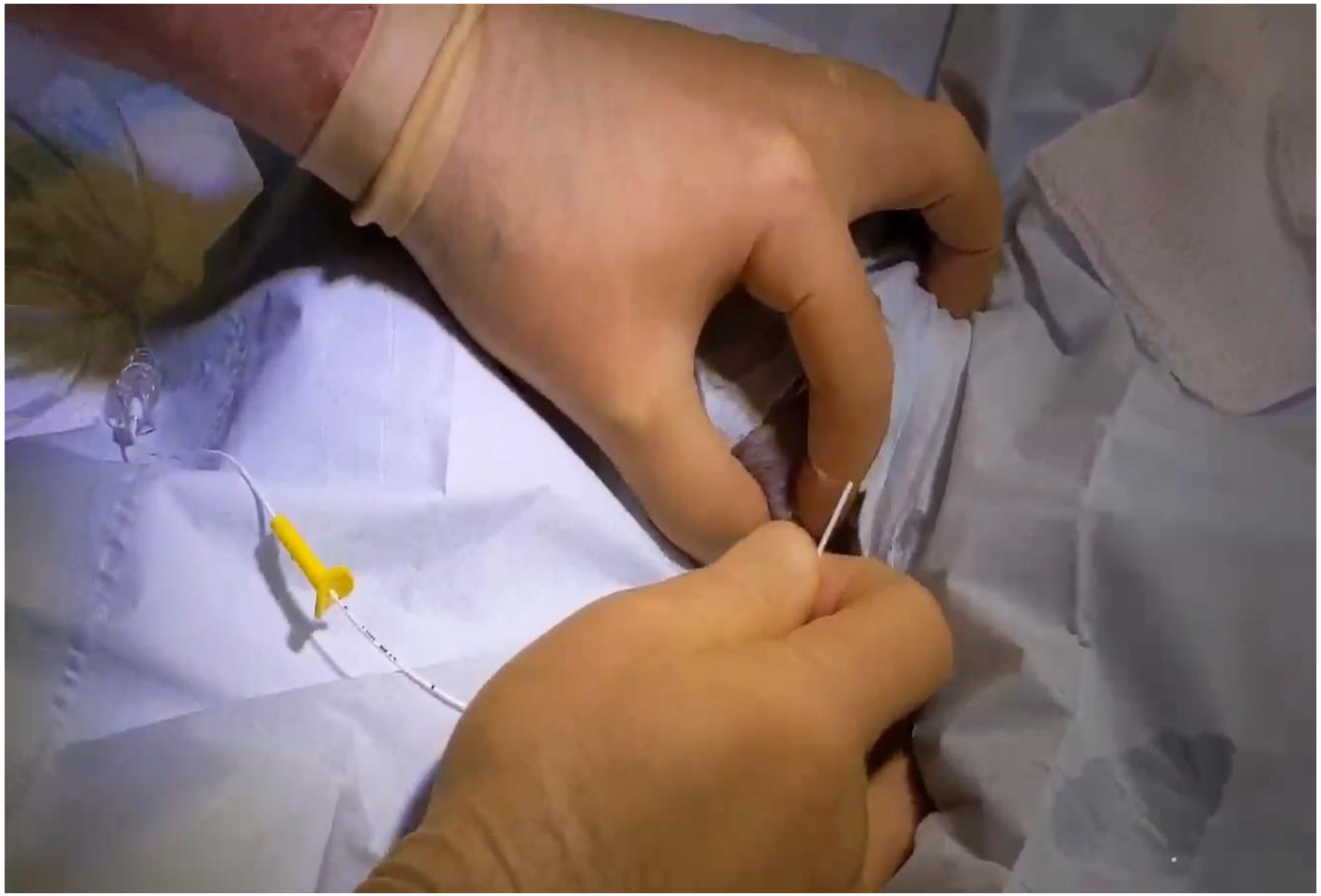
- Urethral catheterization
  - Hydropulsion with saline-lubricant mixture
    - Consideration of lidocaine jelly? No evidence
    - Bladder instillation of lidocaine failed to show any benefit in reobstruction rates or post-obstructive clinical signs
  - Gentle pressure while extending prepuce caudally
  - Empty bladder and flush with saline
    - Study failed to show benefit of flushing relative to in-hospital reobstruction, duration of ucath, or length of hosp
  - Suture in place to prepuce or stay loops
  - Attach sterile collection system

Decompression (con’t)

- Straighten the distal urethra

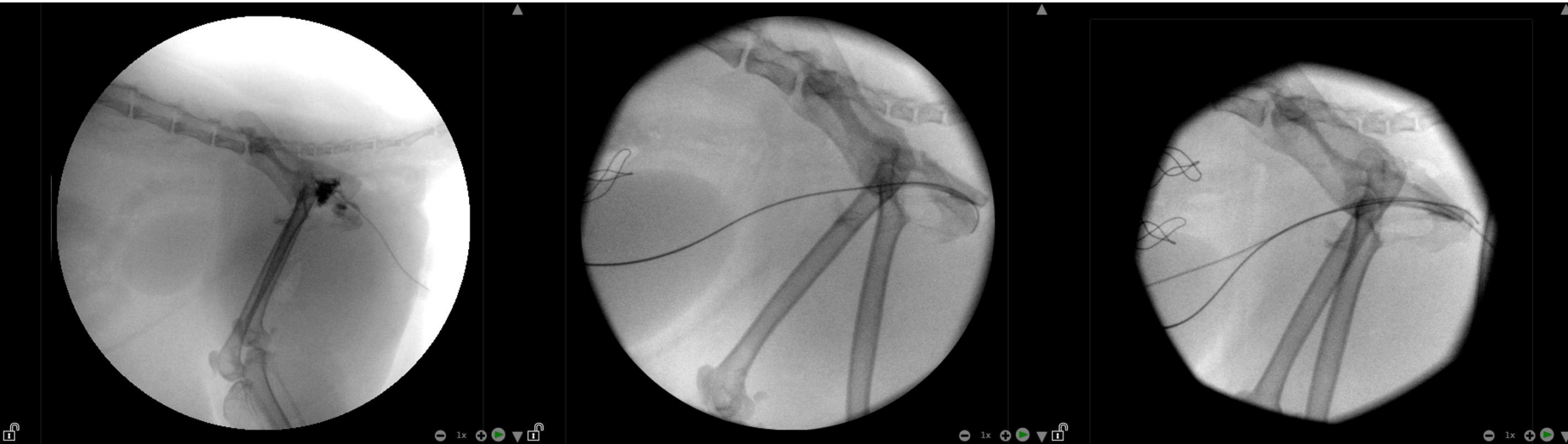


Decompression (con’t)



PAUC

- Fluoroscopically guided percutaneous antegrade urethral catheterization
- Good candidates: iatrogenic urethral tears preventing retrograde placement

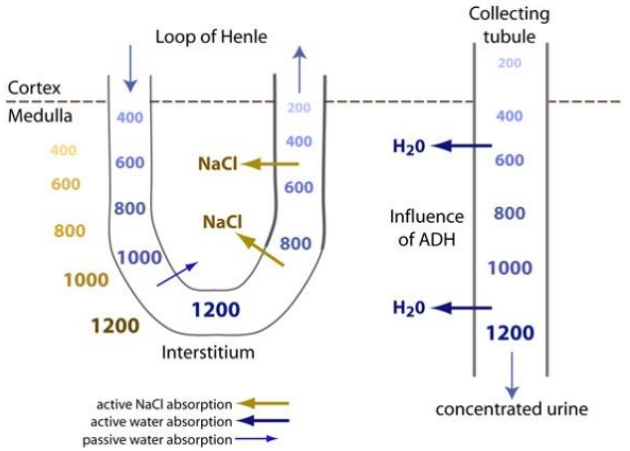


Additional diagnostics

- 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, set minimum



Post-obstructive care

- Monitor electrolytes/azotemia/acid-base status
  - Should see fairly rapid drop in renal values, almost normal in 12-24 hours
  - Metabolic acidosis should also resolve quickly
  - Hypokalemia – potassium can drop significantly with diuresis
- Pain management
  - Obstruction and catheterization is PAINFUL!!!! Inflammation and urethral spasm can exacerbate obstruction
  - Buprenorphine (0.01-0.02 mg/kg IV, SQ)
  - **Methadone (0.2-0.3 mg/kg IV) q6**
  - **Acepromazine (0.05 mg/kg IV, IM)**
    - Sedation as well as antispasmotic affects on urethra
    - Only given once BP stable!!!

Post-obstructive care

- Phenoxybenzamine?
  - Takes several days to a week to have effect, limited benefit
- Prazosin?
  - Has α_1- antagonist 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
- NSAID?
  - Oncior – may help with inflammation and discomfort
  - Only used after resolution of azotmeia

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 8-12 hours after catheter removal in case of immediate reobstruction

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 only temporary if physical obstruction present
- Provision of sedation and analgesia
  - See “At Home Care”

Outpatient management

- Clinical signs are mild to moderate
- Reserved as an alternative to standard of care
  - Financial limitations preclude hospitalization
- If patient is severely affected, euthanasia should be first option
- Study showed higher risk of 30d rUO with one-time cath and outpatient management vs in-hospital (31% vs 11%)
  - Viable alternative to euthanasia
  - Owners must be prepared for potential treatment failure or recurrence

At-home care

- Pain medication
  - ~~Oral buprenorphine 0.01-0.02 mg/kg q8?~~
  - Gabapentin 5-10 mg/kg q8-12
  - Continue for 5-7 days after hospital discharge

Journal of Veterinary Internal Medicine Open Access ACVIM

Review | Open Access |

A Review of the Studies Using Buprenorphine in Cats

P.V.M. Steagall, B.P. Monteiro-Steagall, P.M. Taylor

First published: 21 March 2014 | https://doi.org/10.1111/jvim.12346 | Citations: 44

At-home care

- Pain medication
  - Oral buprenorphine 0.01-0.02 mg/kg q8?
  - **Gabapentin 5-10 mg/kg q8-12**
  - 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

At-home care

- Pain medication
  - Oral buprenorphine 0.01-0.02 mg/kg q8?
  - Gabapentin 5-10 mg/kg q8-12
  - 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 culture and susceptibility testing

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 acidfying 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 10~40%
- Most common reason for euthanasia
- Uni-blockers vs multi-blockers
- Reasonable to consider PU with second episode


THANK
YOU!