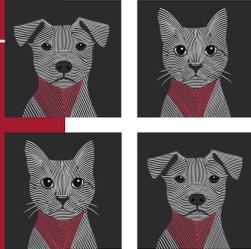


Interventional Urinary Cases Imaging & Different Management Options

Marnin A. Forman DVM, DACVIM

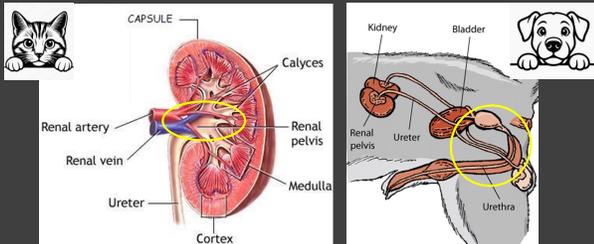


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Game Plan

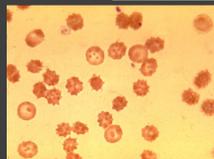


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Ureteral Obstructions in Cats

- Acute ureteral obstruction is a common cause of AKI in Cats
- Presenting clinical signs
 - ✓ Anorexia, weight loss
 - ✓ Vomiting/diarrhea
 - ✓ Lethargy
 - ✓ Polyuria, polydipsia
 - ✓ Hematuria



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Ureteral Obstructions in Cats

- Physical Examination
- ✓ Dehydration
 - ✓ Poor or normal BCS
 - ✓ Renal asymmetry
 - ✓ Renal irregularity & pain
 - ✓ Abdominal pain



Unilateral disease?
Big kidney, little kidney?
Bilateral obstruction?



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Epidemiology & Composition of Ureteroliths

- Ureteroliths have been reported in cats for >50 years
 - Ryan and Smith, 1971
- From 1984 to 1993 not a single diagnosis in cats at NCSU
 - Kyles, et. al., 2003
- 11 surgical cases were reported in a 3-year period from 1993-1996 at NCSU
 - Kyles, et. al., 2003

Calcium oxalate



Blood stone



Mineralized

- ✓ Calcium oxalate
- ✓ Calcium phosphate
- ✓ Other

Non-mineralized

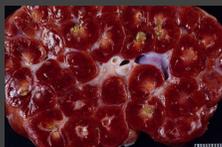
- ✓ 'Blood stone'
- ✓ Mucous plug
- ✓ Renal papilla tissue?



5

Ureteral Obstructions

- Reported Causes
- Neoplastic
 - Iatrogenic surgical
 - Retroperitoneal fibrosis
 - Ureteroliths
 - Slough renal tissue
 - Strictures



© 2010

6

Imaging the Normal Kidney

- Clipping hair: ventral abd. ± intercostal spaces
- Higher frequency probe for best resolution
- Obtain sagittal & transverse images
- **Size:**
 - **Cat:** Normal Length 3.66±0.46, Width 2.53±0.3, Height 2.21±0.28cm
 - **Dog:** Length of the kidney (K) / Aortic diameter
Normal ratio of 5.5-9.1
 - Renal cortex: Cat 2-5mm, Dog 3-8mm
- **Echotexture:**
 - Symmetrical in size and shape



7

Imaging the Normal Kidney

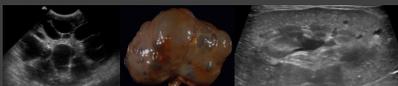
- **Echogenicity**
 - Renal cortex (± cat) is ↑ echogenic to medulla
 - Renal sinus & peripelvic fat is hyperechoic
- **Echotexture**
 - Corticomedullary (CM) junction: arcuate arteries → short, paired, hyperechoic lines
 - Linear echoic lines (interlobar vessels & diverticuli) divide the medulla
 - Renal pelvis: Normal <2mm
 - Renal arteries / veins → aorta / caudal vena cava



8

Renal Cysts

- Solitary or multiple, within medulla or cortex
- If 'true' cyst: smooth, thin walls, echo-free contents with strong acoustic enhancement
- ± deform renal contour / distort collecting system
- **Primary:** Polycystic kidney disease
- **Secondary:** Obstruction of renal tubules
- **Differentials:** Infected cyst / abscess, cancer, hematoma, granuloma



9

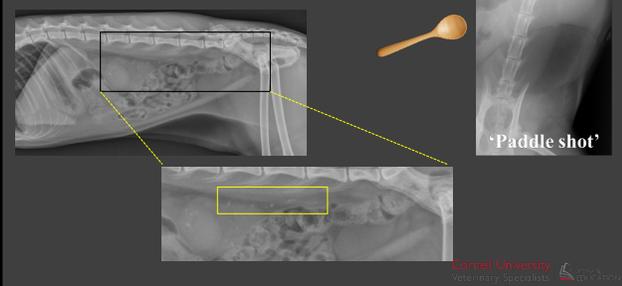
Peri-Renal Pseudocyst

- Encapsulated fluid surrounding renal cortex
- Cats > Dogs
- Elliptical anechoic or hypoechoic fluid collecting subcapsularly, distant enhancement
- ± Internal septa or low levels of echoes
- **Differentials:** Idiopathic, trauma, neoplasia, ureteral obstruction, infections



10

Diagnosis of Ureteral Obstruction



11

Ultrasound of Suspected Ureteral Obstruction

A pelvic diameter ≥ 3.5 mm should be interpreted as potentially abnormal and further investigation considered.



J Feline Med Surg, 2020 Aug 22(9):847-865



12

Pyelectasia vs. Hydronephrosis

- **Physiologic or Therapeutic Diuresis**
 - ✓ 2-3mm bilateral or unilateral pyelectasis
 - ✓ Medulla ↑ in size, ↓ in echogenicity
 - ✓ No ureteral dilation
- **Pyelonephritis**
 - ± 3-4mm pyelectasia, anechoic or hyperechoic debris
 - ± Renomegaly (acute), microrenal (chronic)
 - ± Perirenal hyperechoic fat/mesentery
 - Often a decrease in CM differentiation
 - ± Generalized hyperechoic cortex or medulla
 - ± Hyperechoic line paralleling renal pelvis or recesses
 - ± Proximal ureteral dilation (chronic?)



13

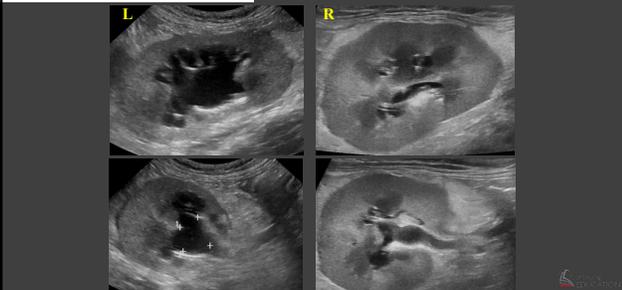
Pyelectasia vs. Hydronephrosis

- **Chronic kidney disease without obstruction**
 - ✓ 3-4mm pyelectasia, anechoic pelvis
 - ✓ Microrenal (chronic)
 - ✓ No to minimal ureteral dilation
 - ✓ Decreased CM differentiation
- **Obstructions (renal, ureteral, trigonal, urethra)**
 - ✓ (D) 15mm (5.1mm), (C) 6.8mm (1.2mm) pyelectasia
 - ✓ Pelvic width ≥ 13mm always indicates obstruction
 - ✓ Proximal, distal or diffuse ureteral dilation
 - ✓ Circumcaval ureters
 - ✓ Ureteral stones or mass
 - ✓ Ureteral strictures



14

Ultrasound Kidney Findings



15

Ultrasound Ureters Findings

• Normal

- ✓ Paired retroperitoneal strictures
- ✓ Thin-walled tubular structures
- ✓ Proximal ureter image transverse plane
- ✓ Doppler to distinguish renal artery or vein
- ✓ Normal ureteral lumen ~0.4mm



Circumcaval Ureter

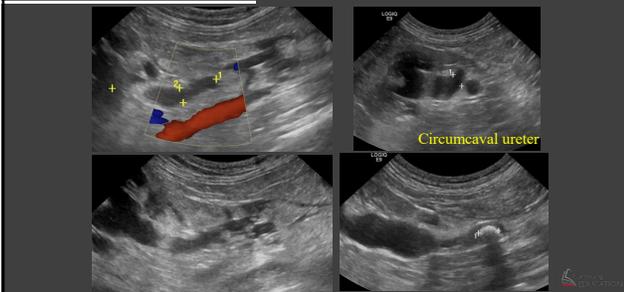
• Abnormal

- ✓ Ureteral calculi: ± Multiple, 1/3 of cats bilateral
- ✓ Sensitivity 77-98%, + Radiographs 90%
- ✓ Other causes of obstruction
- ✓ Ureteral dilation: Proximally First
- ✓ Ureteral thickening, echogenic luminal contents
- ✓ Hyperechoic periureteral fat



16

Ultrasound Ureters Findings



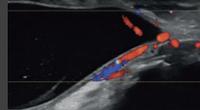
17

Ultrasound Directed Testing



Ureteral jet using color Doppler

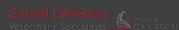
- Mean frequency, peak velocity, duration: 9.86 ± 3.09 jets/min, 34.07 ± 10.02 cm/sec, 2.82 ± 1.08 sec.



Resistive index (RI)

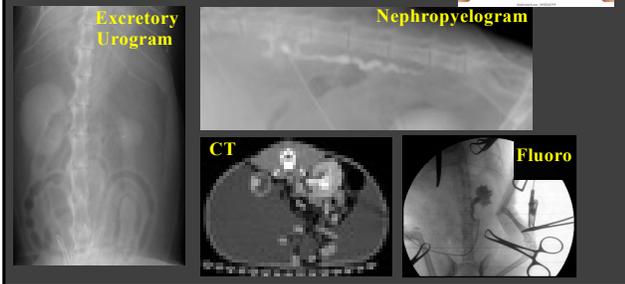
- ≥0.70 indicating obstruction, sensitivity of 73% and a specificity of 77%

J Feline Med Surg. 2020 Aug 26;22(9):847-865



18

Confirmation Ureteral Obstruction



19

Time Matters with Ureteral Obstructions

Effect of ureteral obstruction on renal function
 • 40% decline in renal function within 24 hours
 • 80% decline in renal function within 2 weeks

Benefit of removing ureteral obstruction on renal function (study performed in non-azotemic cats)
 • If removed within 5 days → full function returned immediately.
 • If removed within 7 days → full function is returned in 35 days.
 • If removed within 15 days → full function is returned in 530 days.



20

Treatment Options

Medical therapies

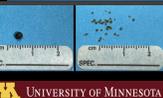
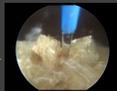
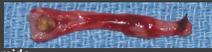
- IV fluids, Mannitol, Furosemide
- Amitriptyline, Pain medications
- Manage hyperkalemia

Surgery

- Ureterotomy
- Ureteroneocystostomy
- Renal transplant

Minimally Invasive Therapy

- Lithotripsy
- Ureteroscopy
- Nephrostomy catheters
- Ureteral stents
- Subcutaneous Ureteral Bypass (SUB)



21

Ureteral Stent Placement

PROS

- Less invasive
- Less ureteral leakage or stricture
- Less reobstructions with concurrent nephroliths?
- Successful with multiple ureteroliths
- Palliation of neoplastic ureteral obstruction

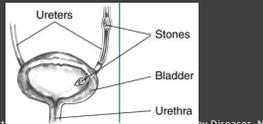
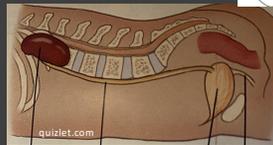
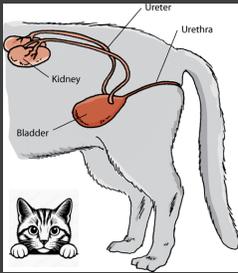
CONS

- Cystitis and pollakiuria
- Stent infection
- Stent obstruction
- Stent migration
- Ureteral trauma during stent placement
- Challenges in placement

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The Ureter: A One Health Story



National Institute of Diabetes and Digestive and Kidney Diseases, NIH.

23

Ureteral Stent Placement Techniques

- **Cystoscopic** guided placement: female dogs, >8 kg)
- **Percutaneous** antegrade placement: TCC dogs with obstruction of the ureteral orifice(s)
- **Surgical retrograde** placement: smaller dogs & cats with ureterolithiasis or ureteral stricture
- **Surgical antegrade** placement: cats with ureterolithiasis or ureteral stricture, or TCC dogs with obstruction of the ureteral orifice(s) (when percutaneous placement is unsuccessful)

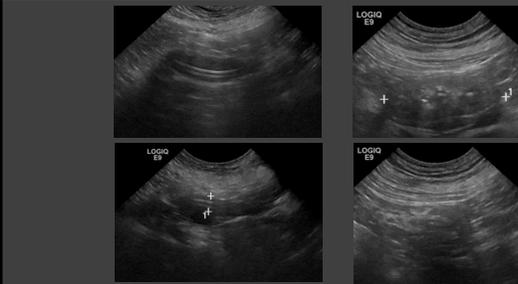
24

Ureteral Stents



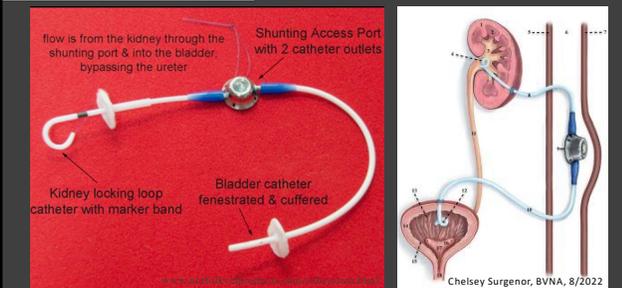
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Ureteral Stents



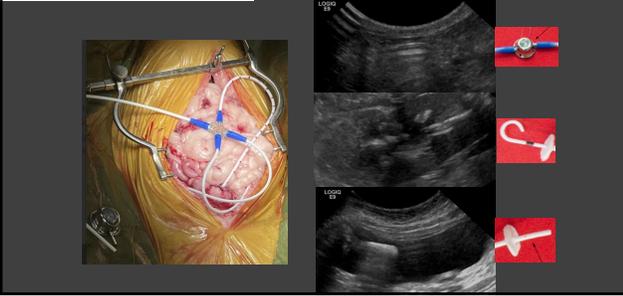
26

Subcutaneous Ureteral Bypass (SUB)



27

Subcutaneous Ureteral Bypass (SUB)



28

SUB Flushing Procedure



29

Urethral Obstructions

Reported Causes

- Neoplasia (i.e., TCC, prostatic carcinoma)
- Prostatitis, BPH
- Urethra stones
- Strictures
- Foreign bodies
- Blood clots



30

Diagnosis of Urethral Obstruction



Retrograde Cystourethrogram

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Ultrasound Dx Urethral Outflow Obstruction

• Urinary Bladder (±upper tract findings)

- ✓ Bladder wall thickening
- ✓ Echogenic urine sediment
- ✓ Pericyclic effusion
- ✓ Hyperechogenicity of pericyclic fat
- ✓ Cystolithiasis
- ✓ Masses

• Urethral Findings

- ✓ Cystolithiasis
- ✓ Masses



32

Treatment Urethra Obstruction 2nd to Prostatic Cancer

• Cancer-directed therapies

- ✓ Radiation therapy
- ✓ Chemotherapy
- ✓ Surgery

• Urethral-directed therapies

- ✓ Intermittent or indwelling urinary catheterization
- ✓ Low-profile cystostomy tubes
- ✓ Transurethral stents



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Low profile Cystostomy tubes

• Benefits

- ✓ Reversible
- ✓ Minimally invasive

• Complications

- ✓ Chronic infections
- ✓ Tube leakage
- ✓ Dislodgement
- ✓ Need for manual drainage
- ✓ In 1 study, 49% has complications



34

Transurethral stents

- ✓ Balloon-expandable stents, self-expanding stainless metallic stents, self-expanding (laser cut) Nitinol stents

Complications

- Blood clots formation, urethral edema
- Urinary incontinence
- Progressive cancer (local, metastatic)
- Stent fracture and not stent shortening
- Palliative

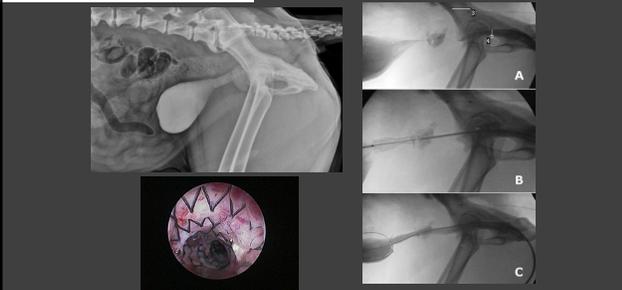
Techniques to limit complications

- Primary cancer therapy (Radiation, chemotherapy)

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Transurethral stents



36

Questions / Comments



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