Abdominal Trauma

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Outline

Abdominal trauma	Etiologies Diagnostics Stabilization
Hemoabdomen	Etiologies Use of antifibrinolytics Prognostication
Uroabdomen	Etiology Diagnostics Treatment/Stabilization

ABDOMINAL TRAUMA

Abdominal Trauma: Etiology

- Blunt trauma
  - HBC
  - High-rise falls
  - Intentional trauma
- Penetrating trauma
  - Bite wounds
  - Gunshot wounds
    - High likelihood of concurrent internal injuries
  - Impalement injuries
  - HBC
- Blast Injuries (Military dogs): Wounds secondary to compressive forces

Blunt Trauma

- Injuries secondary to blunt trauma
  - Hemoperitoneum (23%), abdominal hernia (5%), urinary tract rupture (3%)
  - Liver (31%) is the most commonly damaged organ; urinary bladder, diaphragm, and kidney injuries possible
- Soft tissue HBC injuries more commonly associated with closed body wall hernias (prepubic hernia) in dogs and cats
- High-rise falls
  - Dogs falling from a height of > 3 stories are more likely to experience abdominal injury than those falling $\leq$ 3 stories
  - Thoracic trauma is most common than abdominal trauma in both dogs & cats
- Physical abuse (kicking)
  - 6% of dogs experienced rupture of an organ (spleen, liver, bladder, kidney)
  - Cats tend to experience abdominal muscle rupture


Case Report

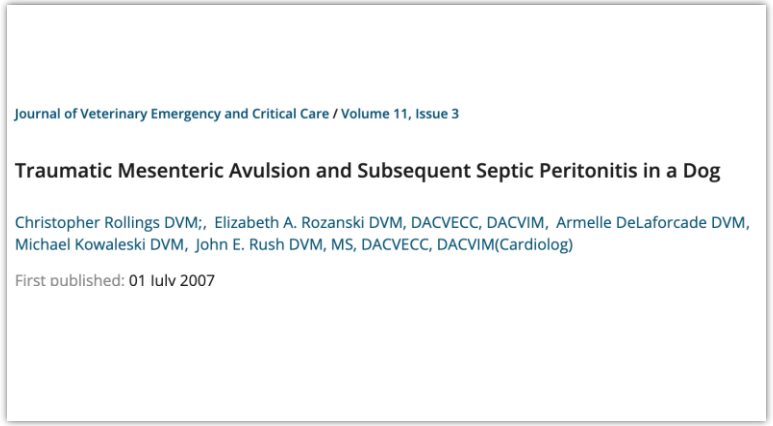
Delayed intestinal perforation secondary to blunt force abdominal trauma in a cat

A Taylor[1], E Cooper[2] and K Ham[3]


J Small Anim Pract. 1970 Sep;11(9):575-84. doi: 10.1111/j.1748-5827.1970.tb05618.x.

The diagnosis of injuries to the intestines, gallbladder and bile ducts in the dog

P F Suter, S E Olsson


Journal of Veterinary Emergency and Critical Care / Volume 11, Issue 3

Traumatic Mesenteric Avulsion and Subsequent Septic Peritonitis in a Dog

Christopher Rollings DVM;, Elizabeth A. Rozanski DVM, DACVECC, DACVIM, Armelle DeLaforcade DVM, Michael Kowaleski DVM, John E. Rush DVM, MS, DACVECC, DACVIM(Cardiolog)

First published: 01 July 2007

Delayed intestinal injuries

- Caused by ischemia, stricture, and increased intraluminal pressure
  - Mesenteric injuries due to compressive or deceleration forces
  - Ischemia and necrosis of corresponding bowel segments
  - Increase in intraluminal pressure → Punctate perforations on the anti-mesenteric border of the intestines → Septic peritonitis
- Reported in 2 dogs and 1 cat
  - Dog: Presented with mesenteric avulsion 4 days after initial event. Mid-jejunum was necrotic and perforated, mesentery attached to jejunum had avulsed
  - Cat: Presented 4h post HBC and had inguinal herniation with no intestinal pathology on initial abdominal explore → Developed delayed jejunal perforation 72h after initial presentation

Dogs

Pelvic fractures and Intraabdominal injuries

- Pelvic fx associated with polytrauma due to the high energy required to fracture the pelvis
- Concurrent intraabdominal injuries (IA) found in 37.2% of dogs
  - Hemoabdomen (32.5%) > uroabdomen (3.6%) > septic abdomen (3.6%)
- Most common fracture: Pubic fx
  - Ischial fx > SI lux > iliac fx > acetabular fx > sacral fx
  - Dogs with sacral fractures were more likely to have IA
- Dogs were more likely to have IA if they had cardiac dysrhythmia
- Overall survival: 89%

Retrospective Study

Journal of Veterinary Emergency and Critical Care **26**(2) 2016, pp 288–294
doi: 10.1111/vec.12430

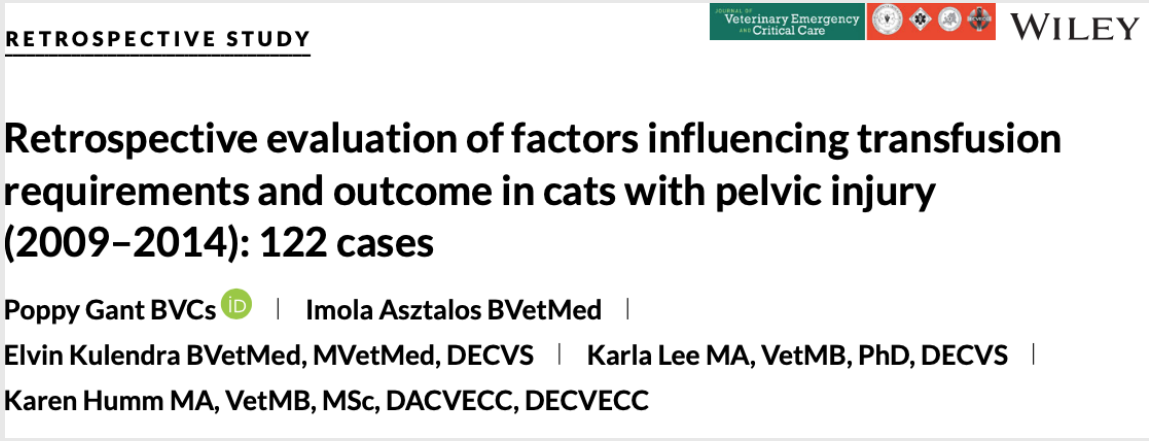
Retrospective evaluation of concurrent intra-abdominal injuries in dogs with traumatic pelvic fractures: 83 cases (2008–2013)

Jamie E. Hoffberg, DVM, DACVECC; Amy M. Koenigshof, DVM, MS, DACVECC and Laurent P. Guiot, DVM, DACVS

Cats

Pelvic Injuries

- Traumatic pelvic fx are associated with acute, severe hemorrhage from the pelvis or abdomen
- 22% of cats with pelvic fx have concurrent injuries
- Young male cats most common
- 19% of cats with pelvic injuries required blood transfusion
  - Associated with increased ATT score at admission
  - SI lux and pubic fxx most common in those requiring transfusions
- 86% required surgical stabilization
- Overall survival: 91%


RETROSPECTIVE STUDY

Journal of Veterinary Emergency and Critical Care

WILEY

Retrospective evaluation of factors influencing transfusion requirements and outcome in cats with pelvic injury (2009–2014): 122 cases

Poppy Gant BVCs | Imola Asztalos BVetMed |
Elvin Kulendra BVetMed, MVetMed, DECVS | Karla Lee MA, VetMB, PhD, DECVS |
Karen Humm MA, VetMB, MSc, DACVECC, DECVECC

Penetrating Trauma

- Most commonly due to bite wounds
  - Commonly seen in small (<10 kg), mixed breed, male intact dogs
  - Thoracic injuries > abdominal injuries
- Other causes: Missile injuries (gunshot), impalement/stab injuries, evisceration
  - Utilize water soluble contrast (e.g. iohexol) to evaluate for extent of injury
- Those with gunshot injuries tend to have more cardiovascular compromise than those without abdominal injuries
- Mortality
  - Penetrating trauma: 11.7% (Risselada et al, Vet Comp Orthop Traumatol 2008)
  - Coyote attack: 15.6% (Frauenthal et al, JVECC 2017)

DSH with impalement injury
Omentum seen protruding through full thickness abdominal wall defect.

Physical Exam

- Extent of skin injuries and visibility of external wounds do not correlate to underlying damage and trauma
- Evaluate for prepubic hernia/prepubic tendon avulsion in those with pelvic trauma
- Cardiovascular compromise

Body wall rupture/abdominal evisceration

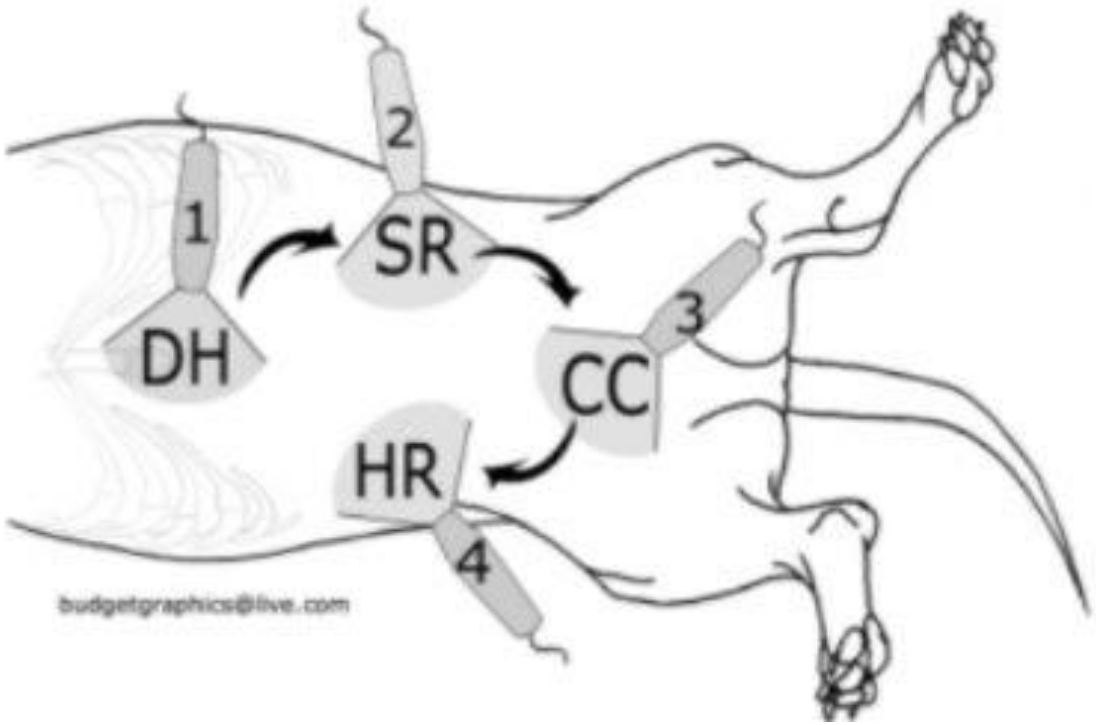
- Evisceration = Herniation of abdominal contents of the peritoneal cavity through the body wall
- Penetrating trauma → Opening of abdominal cavity → Evisceration +/- organ rupture
  - 68-88% of abdominal body wall rupture is a results of bite wounds or vehicular trauma
  - Always assess for concurrent orthopedic injuries
- If unrelated to trauma, recent OVH is the most common recent sx (Gower et al, JAVMA 2009)
- Organ can be entrapped in defect → Strangulation
  - Risk of bacterial translocation (esp. intestinal) and ischemia/reperfusion injury
  - 54% of cases had intestinal displacement, often require R&A due to tissue devitalization
    - Other displaced tissues: Omentum, liver, urinary bladder

Body wall rupture/abdominal evisceration

- Mean interval from surgery to fascial dehiscence and evisceration in humans ~7days, usually d/t technical failure of suture through fascial layer
- Prognosis
  - 100% survived to discharge even with intestinal exposure + gross contamination (Gower et al JAVMA 2009)
    - Evisceration 2ry to trauma, higher lactate (>3) at admission and smaller body size (7kg) associated with longer LOH.
  - 73% of dogs and 80% cats survived to discharge after surgical repair of a body wall rupture (Shaw et al, JAAHA 2003)

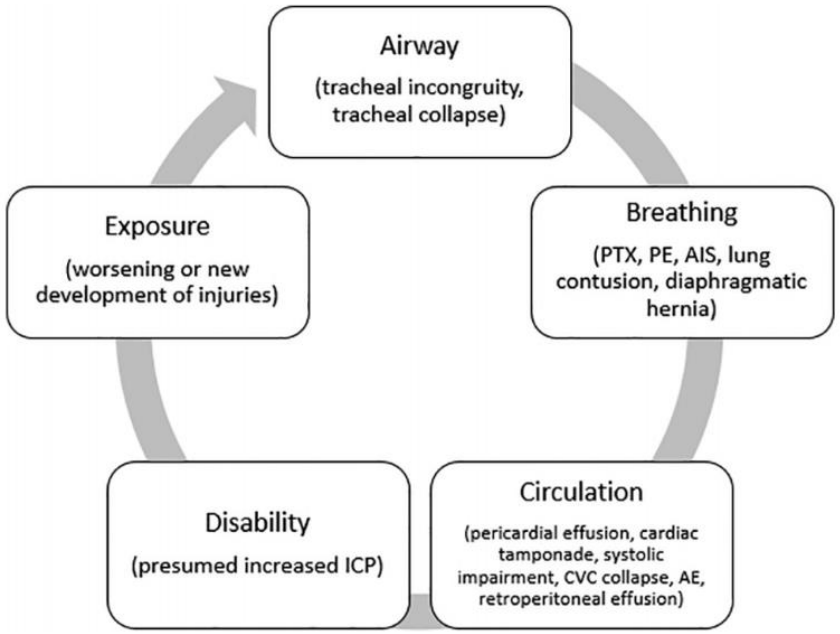
Diagnostics

- Minimum database:
  - Stress leukogram
  - Anemia and thrombocytopenia (hemorrhage)
  - Elevated ALT and AST, elevated ALP and GGT
  - Azotemia
- Imaging
  - Radiographs helpful but does not provide specific diagnosis
    - SQ emphysema, effusion, pneumoperitoneum, rib fractures
    - Usually underestimates the amount of body wall damage present in fight wounds
  - POCUS/AFAST
- Peritoneal effusion analysis: PCV/TS, Cr, K, Bilirubin, Glucose, Lactate, Cytology



AFAST

- 4 sites: diaphragmatico-hepatic (DH), splenorenal (SR), hepatorenal (HR), and cystocolic (CC)
- Score fluid on a 4-point scale
- AFS 3-4 more likely to be anemic from intraabdominal bleed and requires transfusion (Lisciandro et al, JVECC 2009)
- Reliable for fluid but not reliable for pneumothorax (Walters et al JVECC 2018)



VetFAST-ABCDE exam

- Armenise et al, JSAP 2019
- Mirrors the FAST-ABCDE exam in human medicines – evaluates for:
  - Airway: Airway patency, laryngeal/tracheal trauma
  - Breathing: Pleural space disease, alveolar-interstitial syndrome diaphragmatic lesions
  - Circulation: Intravascular volume estimation, cardiac function, abdominal effusion
  - Disability: Neurological impairment
  - Exposure: In a repeated manner
- Good agreement between this technique and radiography for pnemo, pleural effusion, alveolar-interstitial syndrome and abd effusion
- Novel findings: Alveolar-interstitial syndrome, DH, retroperitoneal effusion and tracheal injury

Stabilization and Treatment

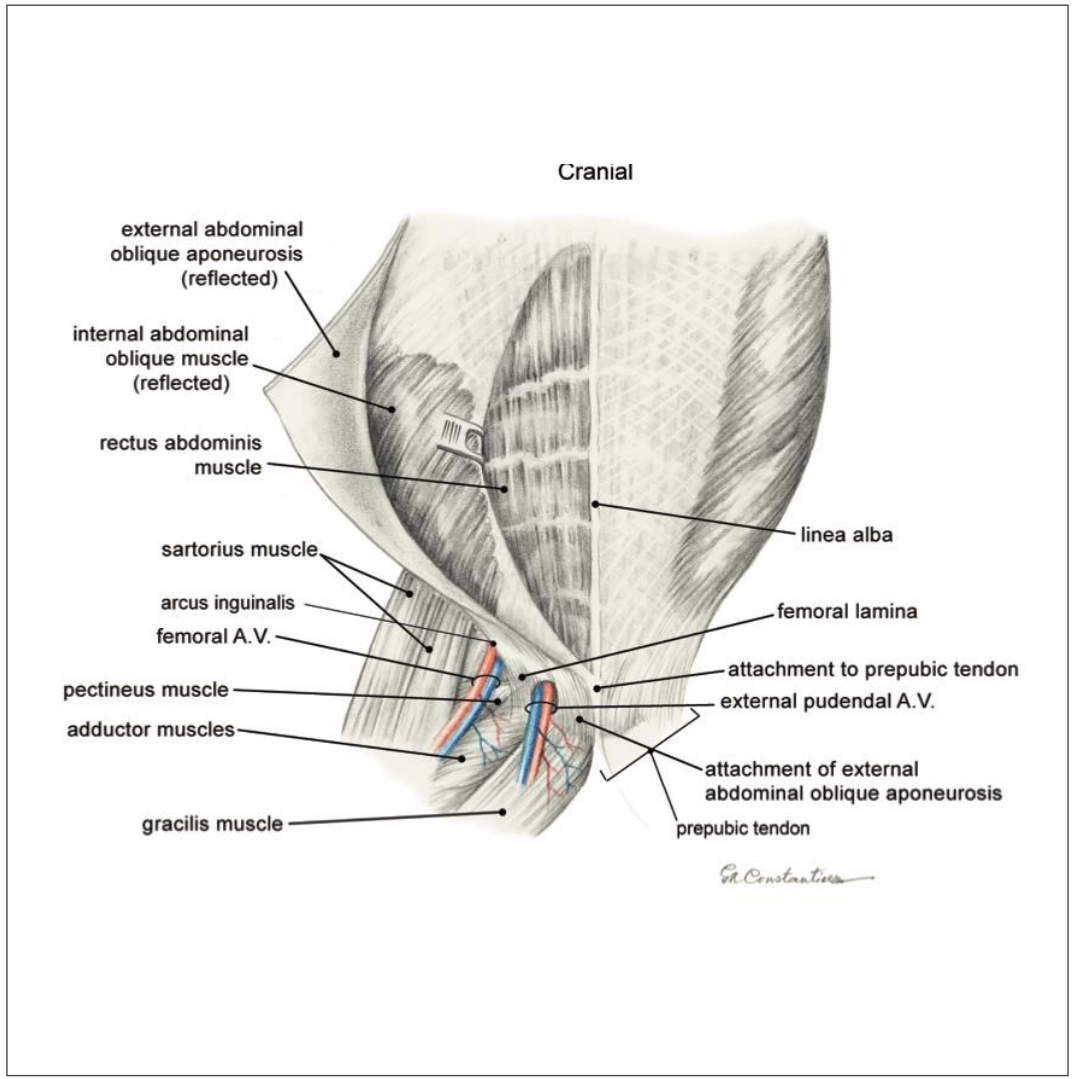
State of the Art Review

Journal of Veterinary Emergency and Critical Care 25(1) 2015, pp 63–75
doi: 10.1111/vec.12279

The impact of surgical timing and intervention on outcome in traumatized dogs and cats

Nathan W. Peterson, DVM, DACVECC; Nicole J. Buote, DVM, DACVS and James W. Barr, DVM, DACVECC

- Antimicrobials
  - Bite wounds, penetrating abdominal injuries, evidence of septic peritonitis
- Pain relief
- Fluid therapy +/- hemostatic resuscitation +/- hypotensive resuscitation
- Evisceration
  - Thoroughly lavage exposed viscera and replace into the abdomen (if possible), sterile lubricating jelly and moistened lap sponges applied, place sterile bandage until surgery
- Stabilize → Transfer to Sx ASAP
  - Deep wounds with disruption of deeper tissue plans warrants surgical explore
- Most body wall hernias can be repaired with autologous tissue



Prepubic Hernia

- Prepubic tendon = A dense mass of collagenous tissue attaching the ventral abdominal muscles to the cranial border of the pubis
  - Composed of the tendons of the paired rectus abdominis and pectineus muscles, and attachments of the abdominal oblique and transversus abdominis
- Prepubic hernia occurs secondary to trauma
  - HBC, dog fights, kicked by large animals

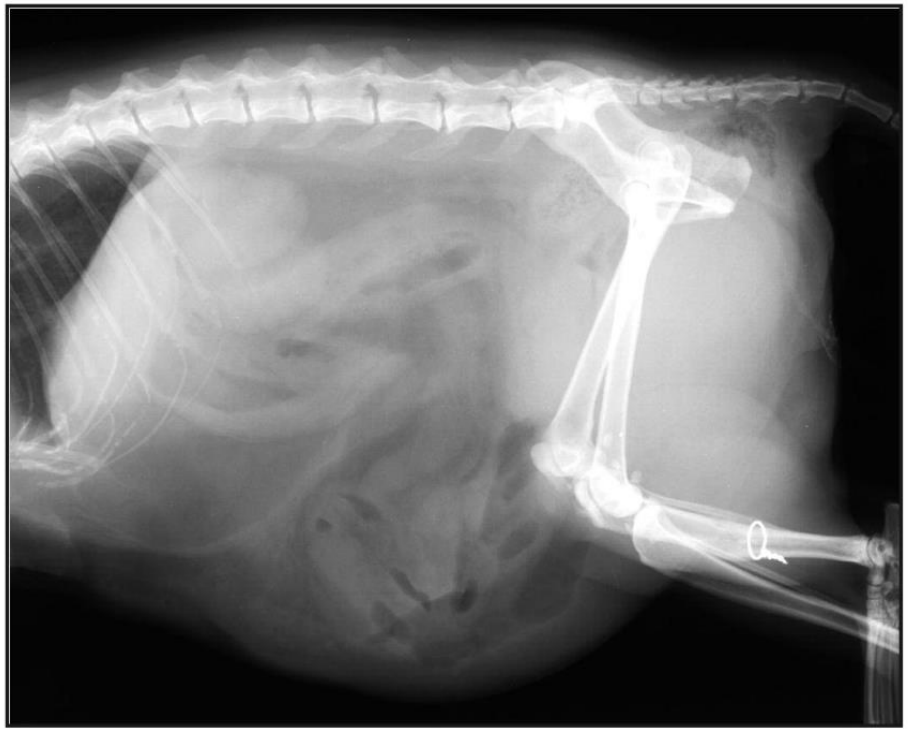


Figure 4—Radiograph of a 10-year-old, castrated male, domestic longhaired cat that was hit by a car. Radiographic findings associated with prepubic hernia include loss of the ventral abdominal stripe and evidence of subcutaneous intestinal loops.

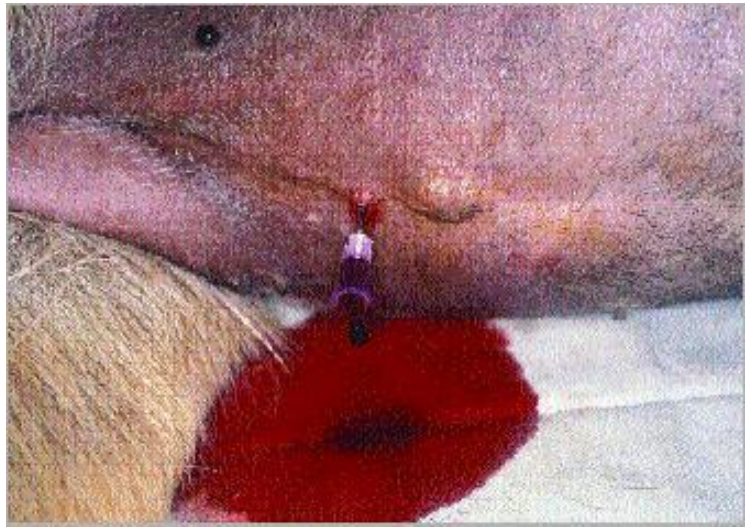
Prepubic Hernia

- Cx: Defect at ventral abdominal wall, +/- acquired femoral and/or inguinal hernias, concurrent orthopedic injuries
- AXR: Loss of the ventral abdominal stripe and evidence of subcutaneous intestinal loops
- AUS may be helpful
- Sometimes require surgical explore to confirm

Prepubic Hernia Treatment

- Requires drilling of bone tunnels for reattachment of tendon to pubis
- Timing of surgery depends on overall stability of the patient, the size of defect (i.e. likelihood of organ entrapment) and concurrent injuries
- In those with a large defect without organ damage or communicating wounds, repair can be delayed for several days to allow stabilization

HEMOABDOMEN



Hemoabdomen

- Traumatic
  - Major vessel laceration, organ rupture/laceration
- Non-traumatic/Spontaneous
  - Rupture of a benign or malignant abdominal mass
  - Coagulopathies
  - Organ torsion
  - Anaphylaxis (dogs)
  - Hepatic necrosis (cats)
- Abdominal effusion PCV should be within 10-25% of peripheral blood

Stabilization and Treatment

- Conventional (large volume, shock dose) resuscitation is no longer recommended
  - Increased infusion time, dilutional effects, risk of fluid overload, and redistribution of crystalloids leading to tissue edema
- Limited fluid volume resuscitation (LFVR) is the preferred approach - restore perfusion to vital organs without exacerbating hemorrhage
  - Small volume of crystalloids (iso- or hypertonic) + colloid solution
  - Aim for low-normal resuscitation goals (MAP 60-70 mmHg) until definitive hemostasis
- Utilize blood products +/- autotransfusion
- Abdominal counterpressure → stop hemorrhage of vessels or organs through direct pressure and tamponade effect
- Antifibrinolytics

Autotransfusion

- Sterile acquisition of shed blood and reinfusion IV via a filter (hemonate or blood administration filter)
  - Collection: Percutaneously or at sx via sterile suction set-up
  - 2-syringe technique
  - Collection into blood bag and re-infuse via extension set
- Pros: Lower cost, readily available materials, no need to type or crossmatch and no need to warm the blood.
- Cons: Inadvertent administration of air or clot emboli or the administration of blood that was contaminated with gastrointestinal contents, bile or urine, or tumor cells.

Retrospective Study

Journal of Veterinary Emergency and Critical Care **25**(6) 2015, pp 731–738
doi: 10.1111/vec.12338

Autologous blood transfusion in dogs with thoracic or abdominal hemorrhage: 25 cases (2007–2012)

Veronica A. Higgs, DVM; Elke Rudloff, DVM, DACVECC; Rebecca Kirby, DVM, DACVIM, DACVECC and Andrew K.J. Linklater, DVM, DACVECC

- Complications: hypocalcemia, hemolyzed serum, and prolonged coags
- 68% required additional blood products
- 68% survived to discharge
- Direct aspiration technique
  - Butterfly catheter attached to 60 mL syringe -> reinfused into a vein from collection syringe using 3-way stopcock, extension fluid tubing, and in-line 18 um hemonate filter
- Surgical collection technique
  - Collected via Poole suction tip, sterile tubing, sterile canister (pressure <100 mmHg) --> transferred into sterile empty crystalloid fluid bag and reinfused via 210 um blood administration filter

2-syringe technique

Case Series

Journal of Veterinary Emergency and Critical Care **26**(6) 2016, pp 766–774
doi: 10.1111/vec.12476

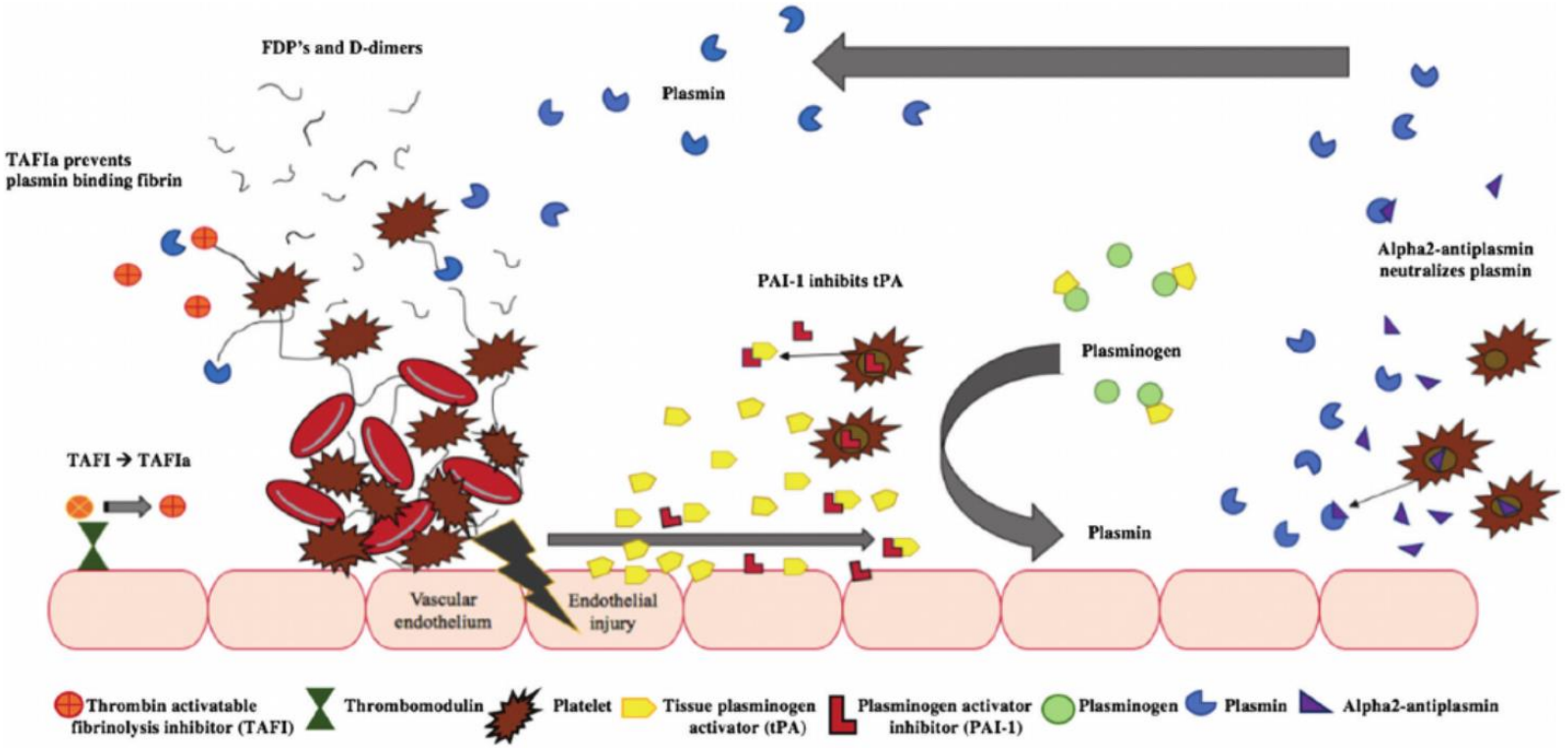
Autotransfusion in dogs using a 2-syringe technique

Duane A. Robinson, DVM, PhD, DACVS-SA; Kristina Kiefer, DVM, PhD, CCRP, DACVSMR; Rachel Bassett, CVT, VTS(Anesthesia) and Jane Quandt, DVM, MS, DACVAA, DACVECC

Figure 1: A 60-mL catheter tip syringe that has been used to collect blood from the abdomen.

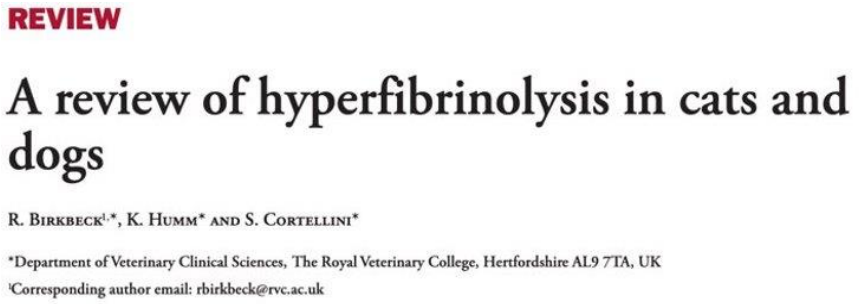
Figure 2: Luer tip of 60 mL syringe (*) is inserted in to catheter tip to transfer blood.

Figure 3: Luer tip syringe, blood filter, extension set, and needle used to autotransfuse the blood.



HYPERFIBRINOLYSIS

Hyperfibrinolysis



REVIEW

A review of hyperfibrinolysis in cats and dogs

R. Birkbeck[1,*], K. Humm* and S. Cortellini*

*Department of Veterinary Clinical Sciences, The Royal Veterinary College, Hertfordshire AL9 7TA, UK
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- Hyperfibrinolysis can result in premature clot lysis and hemorrhage, further exacerbated by the development of a consumptive coagulopathy
- 30% of human trauma patients develop acute traumatic coagulopathy (ATC) and its associated with 4x increase in mortality
- 2 case reports in veterinary medicine documenting ATC with hyperfibrinolytic phenotype in dogs based on viscoelastic testing (Yoo et al JVECC 2016; Muri et al Schweiz Arch Tierheilkd 2018) and in cats following trauma (Sigrist et al Vet J 2018)
- Dogs who developed spontaneous hemoperitoneum (I.e. non-trauma induced) have also been shown to be hyperfibrinolytic, hypocoagulable, and have protein C deficiency (Fletcher et al JVECC 2016)

Clinical Practice Review

Journal of Veterinary Emergency and Critical Care 24(1) 2014, pp 63–74
doi: 10.1111/vec.12130

Traumatic coagulopathy-Part 1: Pathophysiology and diagnosis

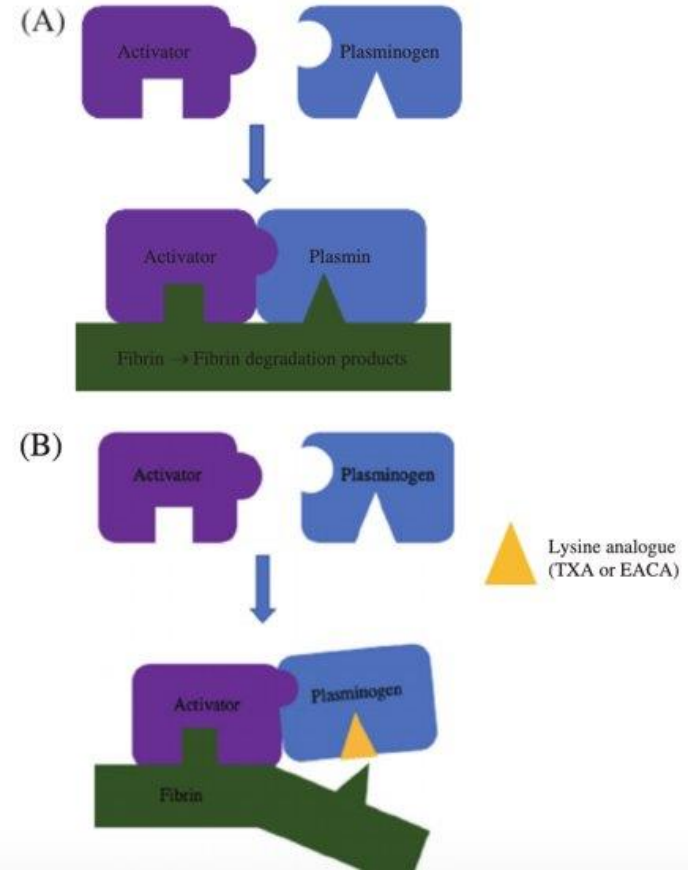
Lee Palmer, DVM, DACVECC and Linda Martin, DVM, MS, DACVECC

Antifibrinolytics

- CRASH-2 trial: In trauma patients with or at risk of significant hemorrhage, does the early administration of a short course of tranexamic acid (TXA) affect the mortality, incidence of occlusive events and the amount of blood transfused?
  - TXA safely reduced the risk of death in bleeding trauma patients
- Hyperfibrinolysis is suggested to be an important cause of hemorrhage in ATC and dogs with hemoperitoneum

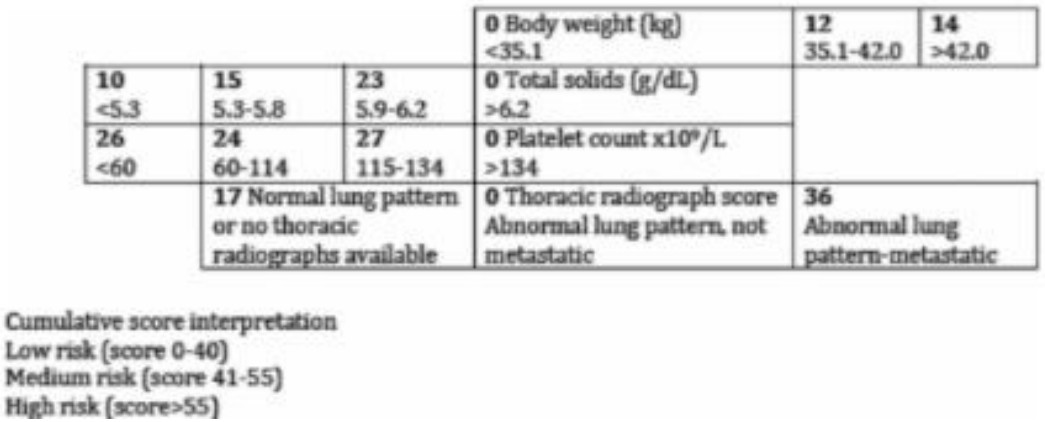
Antifibrinolytics

- MoA: Binds to plasminogen C-terminal lysine sites --> Inhibits activation of plasminogen to plasmin on the surface of fibrin
- Epsilon-Aminocaproic acid (ACA)
  - Numerous types of dose ranges…
    - 50-100 mg/kg IV or PO q6-8h
    - 50 mg/kg IV loading dose, then 15 mg/kg IV q8h
    - 50 mg/kg IV bolus then 15 mg/kg/hr
  - Lethal dose: 2.3 g/kg
- Tranexamic acid (TXA)
  - 10x more potent than ACA
  - More sustained action
  - 15 mg/kg IV or PO q8h



Prognosis of Hemoabdomen: Dogs

- Spontaneous hemoabdomen
  - 2/3 malignant and 1/3 benign; 2/3 of malignant masses are hemangiosarcoma (Pintar et al JAAHA 2003, Lux et al JAVMA 2013)
    - The same for small breed dogs except Wheaten terriers had a higher likelihood of malignant neoplasia (Corbin JAVMA 2017)
  - Larger masses more likely to be benign than malignant (Mallinckrodt JAVMA 2011)
  - Perioperative mortality rate ~ 7.6% undergoing splenectomy
    - Increased risk with thrombocytopenia, PCV <30%, and intra-operative arrhythmias
  - Negative prognostic indicators: Tachycardia, pleural effusion, massive transfusion, and post-op resp distress (Lux et al JAVMA 2013)



			0 Body weight (kg) <35.1	12 35.1-42.0	14 >42.0
10 <5.3	15 5.3-5.8	23 5.9-6.2	0 Total solids (g/dL) >6.2		
26 <60	24 60-114	27 115-134	0 Platelet count x10⁹/L >134		
	17 Normal lung pattern or no thoracic radiographs available		0 Thoracic radiograph score Abnormal lung pattern, not metastatic	36 Abnormal lung pattern-metastatic	

Cumulative score interpretation
Low risk (score 0-40)
Medium risk (score 41-55)
High risk (score>55)

Received: 18 January 2017 | Revised: 8 May 2017 | Accepted: 24 May 2017
DOI: 10.1111/vec.12838

ORIGINAL STUDY

Journal of Veterinary Emergency and Critical Care WILEY

Development and validation of a hemangiosarcoma likelihood prediction model in dogs presenting with spontaneous hemoabdomen: The HeLP score

Ashley R. Schick DVM[1] | Galina M. Hayes BVSc, DVSc, PhD, DACVECC, DACVS[1] |
Ameet Singh BSc, DVM, DVSc, DACVS[2] | Kyle G. Mathews DVM, MS, DACVS[3] |
Mary Lynn Higginbotham DVM, MS, DACVIM[4] | J. Matthew Sherwood DVM, MS, DACVS[5]

Scoring system: HeLP score

- Goal to help predict hemangiosarcoma preoperatively
  - Hemangiosarcoma likelihood prediction score
- Score maybe helpful in identify low risk patients when clients are struggling with euthanasia decision
- Not recommended for predicting high risk

JOURNAL OF Veterinary Emergency AND Critical Care

Feline Hemoperitoneum 16 Cases (1986-1993)

Deborah C. Mandell VMD, Kenneth Drobatz DVM

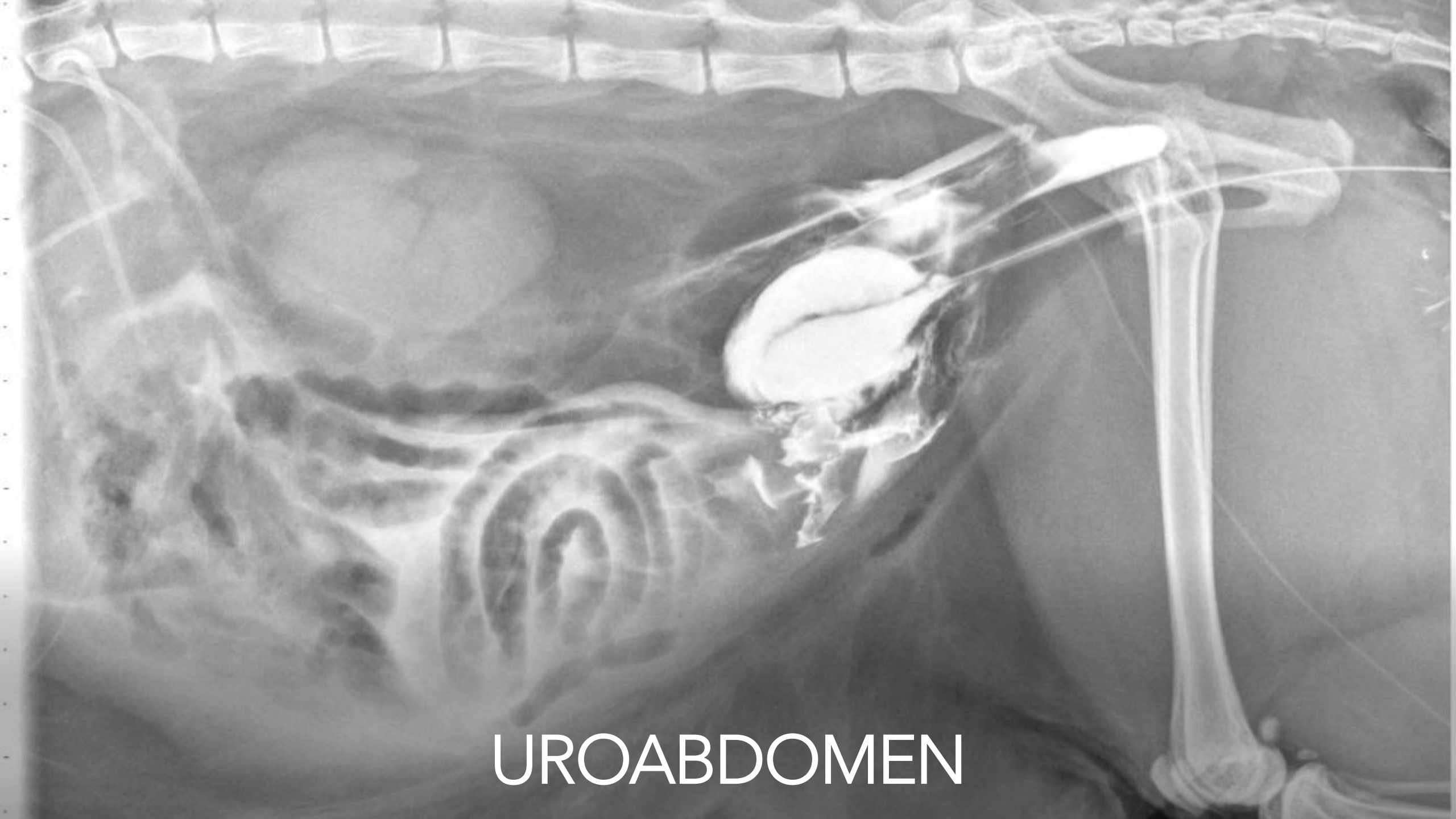
First published: July 1995 | https://doi.org/10.1111/j.1476-4431.1995.tb00121.x | Citations: 14

Spontaneous hemoperitoneum in cats: 65 cases (1994–2006)

William T. N. Culp, VMD, DACVS; Chick Weisse, VMD, DACVS; Melissa E. Kellogg, DVM; Ira K. Gordon, DVM, DACVR; Dana L. Clarke, VMD; Lauren R. May, VMD, DACVS; Kenneth J. Drobatz, DVM, MSCE, DACVECC, DACVIM

Prognosis of Hemoabdomen: Cats

- Mandell study:
  - Hepatic neoplasia (31%), hepatic necrosis (19%), hepatic amyloidosis (13%), non-hepatic neoplasia (13%), hepatopathy (6%), hepatic rupture (6%), necrotic/hemorrhagic cystitis (6%), and ruptured bladder (6%)
- Culp study:
  - 46% due to neoplasia
  - Hemangiosarcoma most common (60%) and in the spleen (37%)
  - 54% due to coagulopathy or acute hepatic necrosis
- 12% survived to discharge (Culp)



UROABDOMEN

Uroabdomen

- Leakage of urine into the peritoneal and/or retroperitoneal space
- Loss of integrity of the urinary tract anywhere from the kidneys to the distal end of the intra-abdominal portion of the urethra
- Probabiliy of injury correlates to degree of bladder distension
- Males are overrepresented
  - Male urethra is narrower and has greater attachment to bones --> Less adept at coping with fast and profound increase in intravesicular pressure
- Concurrent pelvic fx increases risk of uroabdomen

Uroabdomen

- Trauma is the most common cause
- Blunt trauma (50%)
  - Fx of spine or last 3 ribs with uroabdomen should raise concern for ruptured kidney
- Nontraumatic
  - Spontaneous rupture secondary to UO, bladder neoplasia, manual bladder expression cystocentesis, urethral catheterization, recent sx or accidental injury to urinary tract intra-op
- For cats, iatrogenic cause is the 2nd most common

Location of rupture

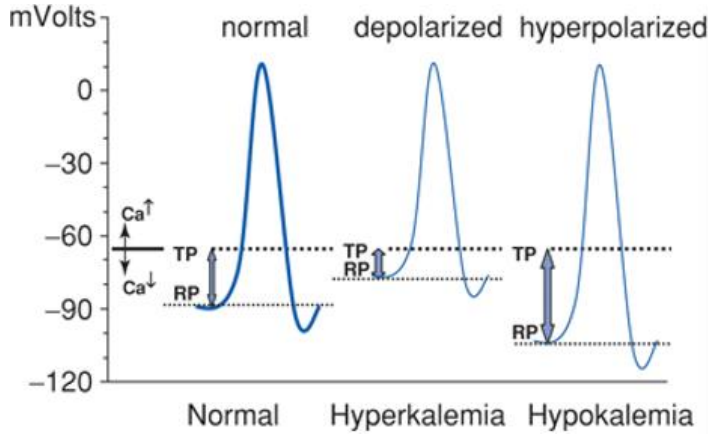
- Bladder (56%) is the most common in both species
- Others: urethra (26%), undetermined (9%), the kidney (5%), a ureter (2%), and a combination of both kidney and bladder (2%).
  - Ureter --> Usually proximal portion
    - Crushing of the ureter into the lumbar vertebrae, excessive tension on the ureters, sudden cranial movement of the kidney against a relatively immobile uteropelvic junction, or a combination of spinal hyperextension and sudden acceleration/deceleration
  - Prostatic or membranous portion of urethra rupture associated with pelvic injuries
  - Injuries to renal parenchyma uncommon

Pathophysiology

- Hyperosmolar urine accumulates in the peritoneal cavity and causes an osmotic pull of ECF into the peritoneal cavity
  - Third spacing + decreased fluid intake/increased GI loss contributes to dehydration +/- hypovolemic shock
- Creates a concentration gradient of urea and creatinine across the peritoneum
  - Urea is relatively small (60 Da) and equilibrates quickly
  - Creatinine is larger (112 Da) and takes longer to diffuse
- Progressive azotemia develops due to the inability to excrete BUN and Cr
  - Metabolic acidosis due to accumulation of uremic toxins, lactic acidosis and retention of H+ within the peritoneal/retroperitoneal space with subsequent reabsorption into the circulation and impairment of the intrinsic buffering system
- Accumulation of K+ rich urine results in hyperkalemia
  - K+ is typically excreted in the collecting ducts and distal tubules faster than reabsorption across the peritoneal cavity --> K+ will be higher intraabdominal
- Chemical peritonitis direct contact from urine to peritoneum

Hyperkalemia

- Increases the resting membrane potential of cells
- Reduces the gradient between resting membrane and threshold potential --> Incr in cell membrane excitability
- Cardiac myocytes: Increased excitability results in bradycardia to v-fb to asystole
  - Correlated to degree of hyperkalemia



Serum K^+ concentration	ECG abnormalities
≥5.5–6.5 mmol/L	Increased T wave amplitude
≥6.6–7.0 mmol/L	Decreased R wave amplitude Prolonged QRS and P-R intervals S-T segment depression
≥7.1–8.5 mmol/L	Decreased P wave amplitude, increased P wave duration Prolongation of Q-T interval
≥8.6–10.0 mmol/L	Lack of P waves (atrial standstill) Sinoventricular rhythm
≥10.1 mmol/L	Widened and biphasic QRS complex Ventricular flutter, fibrillation, or asystole

Clinical Findings

- History
  - Trauma
  - Atraumatic: Hematuria, stranguria, dysuria, or anuria
- PE findings: lethargy, tachy- or bradycardia, abdominal pain, palpable fluid wave, bruising of inguinal region or perineum
- May see signs of hypovolemic shock
- Palpation of a "seemingly" intact bladder does not rule out a uroabdomen!

Diagnostics

- Most common findings on bloodwork
  - Azotemia
  - Metabolic acidosis
  - Hyperkalemia
  - Hyponatremia and hypochloremia
  - Hyperphosphatemia
- UA and UCS +/- IH sediment evaluation
- Evaluate abdominal effusion
- Abdominal imaging

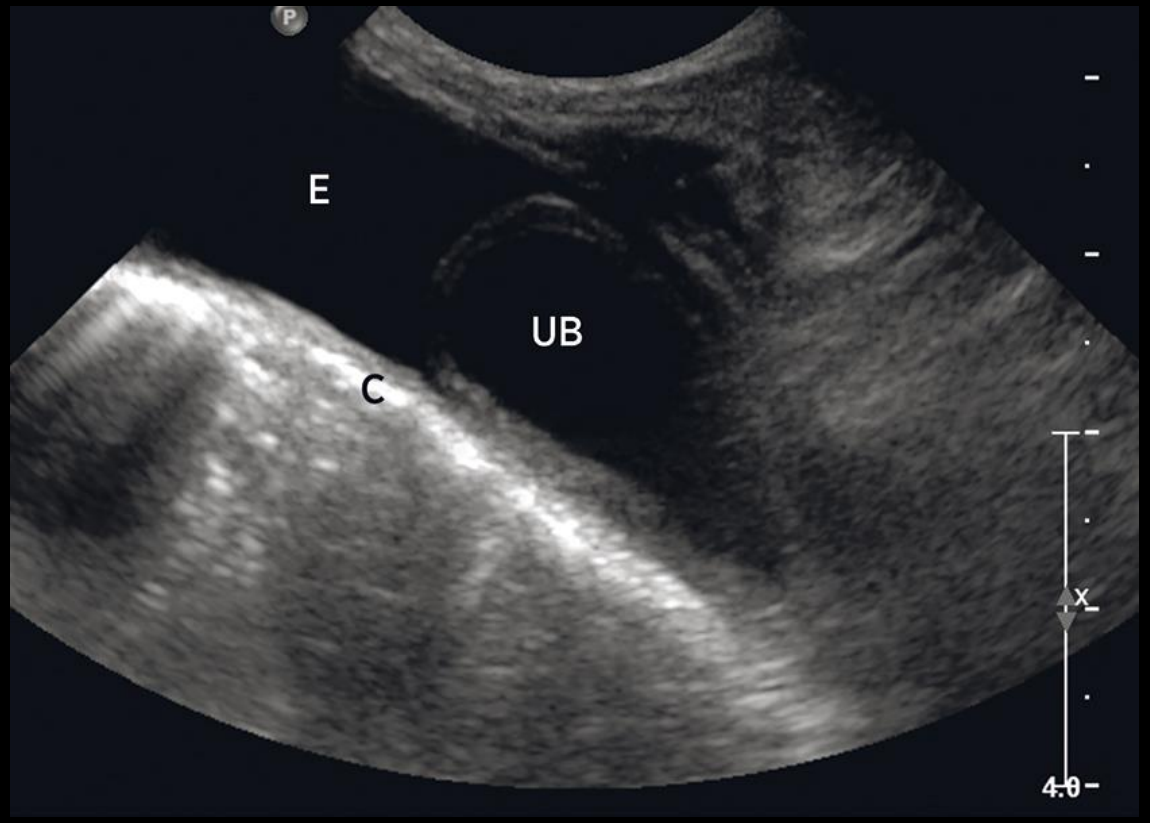
Abdominal effusion

- Urine is a chemical irritant and causes nonseptic inflammation
  - TNCC >5000/mL, SpGr >1.025, TTS >3 g/dL
- Ratio of potassium and creatinin in abdominal effusion compared to peripheral blood

	Abd:Peripheral Creatinine	Abd:Peripheral Potassium
Dogs	>2:1 (86%, 100%)	>1.4:1 (100%, 100%)
Cats	>2:1	>1.9:1

Abdominal Imaging

- CT
  - Gold standard in human medicine
- AUS
  - Not able to identify the location of leak
  - Microbubbled sterile saline contrast cytosonography
- AXR
  - Retrograde positive contrast cystography
    - 10-20% of water-soluble contrast solution –iohexol- instilled
    - 10 ml/kg to distend bladder
    - Obtain post-contrast AXR immediately --> An irregular pattern within the peritoneal cavity or outlining the intraperitoneal viscera
  - Excretory urography
    - If no leakage found from bladder or urethra
    - Infuse IV bolus of iohexol then obtain radiographs 5s and 20s afterwards, 5 min, 20 min, 40 min after
    - Not recommended in those with CKD due to contrast-induced nephropathy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Treatment

- Fluid resuscitation
- Analgesia
  - Avoid NSAIDs and ketamine
- +/- Antibiotics
- Stabilization of hyperkalemia
  - Calcium gluconate for cardioprotection
  - Stimulate intracellular movement of K+: Regular insulin, terbutaline, albuterol, sodium bicarbonate
- Urinary diversion

Urinary Diversion

- Place u-cath as long as urine is being produced and at least 1 kidney and ureter are intact
- Consider repeat cystocentesis or percutaneous cystotomy tube if urethral tear or unable to pass u-cath
- Peritoneal drainage

Peritoneal drainage

- Promotes removal of urine and expedite stabilization
- Performed via a needle or peritoneal catheter
- Peritoneal catheter
  - Same as placement of a percutaneous (non-surgical) peritoneal dialysis catheter
  - Utilizes peritoneum as a semi-permeable membrane where solutes equilibrate between plasma and dialysate via osmosis
  - Can use commercial PD catheter or any catheters with stylet
- Consider in those with severe azotemia and hyperkalemia (>7.5) refractory to treatment

Clinical Practice Review

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Current techniques in peritoneal dialysis

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Surgical Treatment

- Surgery is often necessary to repair the source of the leak, esp. if urosepsis is present
- Patient should be cardiovascularly stable with optimized electrolytes derangements
- For less severe urethral injuries or small urinary bladder tear, can consider medical management
  - Placement of u-cath until defect has healed (~ 7 days)

Complications and Prognosis

- Complications: Severe chemical peritonitis, septic peritonitis, surgical complications (failure, dehiscence, hemorrhage, infection etc)
- Post-op complications: Strictures, incontinence, ongoing urine leakage, and urinary tract infections
- 21% mortality rate in dogs
- 17.2-28.6% morality in cats
- Presence of polytrauma associated with higher mortality rate

Romney

- 5-year-old FS Yorkie-Poo
- Initially presented on 6/24/2019 for evaluation of being hit by car
  - Non-ambulatory paraparetic with hindlimb postural reaction deficits --> Bilateral SI luxation
  - No evidence of pre-pubic tendon or body wall injuries
  - Small volume hemoperitoneum (Peripheral PCV/TS 28/4.4 and abdominal 20/2)
  - Not azotemic on presentation
- Bilateral SI luxation repair performed 6/26
  - Blood work was never repeated
  - Patient reportedly urinating
  - Discharged 3 days post-op on meloxicam, gabapentin, tramadol and capromorelin

Romney

- Following discharge on 6/29, she was initially doing well
- Became progressively more lethargic starting 7/1. The owner reports she became inappetent and began to vomit overnight on 7/3 .She was also noted to be posturing but does not urinate
- PE on presentation: 6-7% dehydrated and tense on abdominal palpation
- Diagnostics:
  - Large volume of echogenic peritoneal effusion
  - Chem: BUN 120, Cr 2.9
  - Lytes: K 4.96
  - Abdominocentesis performed --> Abdominal effusion Cr 8.8 (3:1)
  - AXR with contrast urethrogram performed

Retrograde positive contrast cystography

Romney

- Romney was taken surgery the same day the uroabdomen was diagnosed
- A 5 mm, full thickness perforation of the urinary bladder was found on the left dorsal aspect adjacent to the UVJ
- The spleen was found to have fractured into multiple pieces with extensive adhesions
- She recovered well following surgery

ANY QUESTIONS?