



OSPEDALE VETERINARIO
UNIVERSITARIO DIDATTICO FACOLTÀ MEDICINA VETERINARIA



Treatment of Bladder Stones

Prof. Lucio Petrizzi DVM, DECVS
Università di Teramo





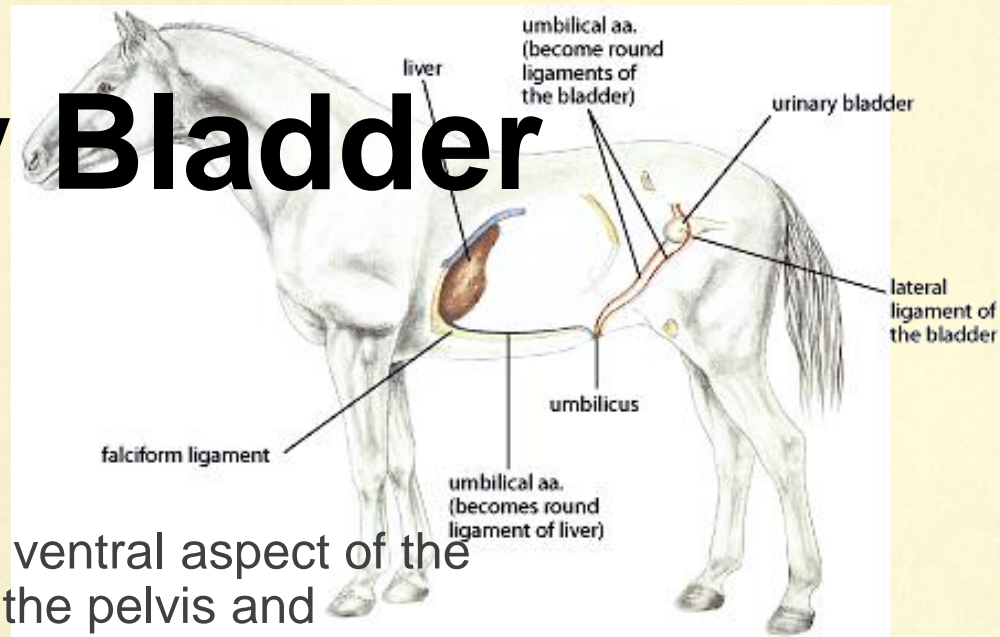
Urinary Bladder

- * **Storage**
- * **Musculomembraneus organ** (highly distensible, 4 L or more in a 500kg horse)
- * Can be divided into
 - * Cranial **apex** (*vertex vesicae*)
 - * Intermediate **body** (*corpus vesicae*)
 - * Caudal **neck** (*cervix vesicae*)
- * Wall consists of three layer
 - * **peritoneum** cranially at apex and **adventitial tissue** in the retroperitoneal space
 - * **smooth muscle** (*m. destrusor*), anatomic difference: dorsal wall weak
 - * **urothelium**





Urinary Bladder



* Three **peritoneal fold**

* **Middle ligament**

* median, triangular fold from the ventral aspect of the bladder onto the ventral wall of the pelvis and abdomen

* in the fetus extends to the umbelicus and is closely associated with the *urachus* which appears as mass of cicatricial tissue in the apex of adult bladder

* **Two lateral ligament**

* extends from the lateral aspect of the bladder to the lateral pelvic wall

* in the free edge of each is a round, firm band (*round ligament*) which is a remnant of the fetal ulmbilical artery

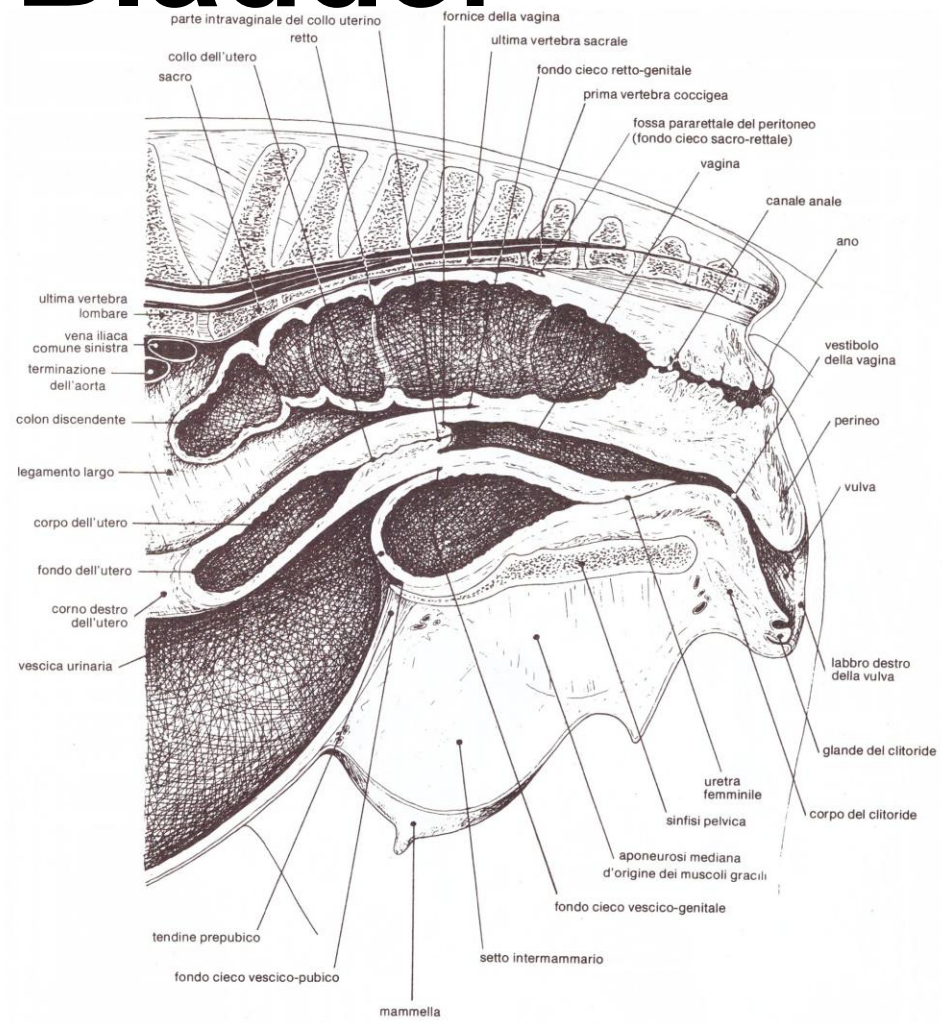
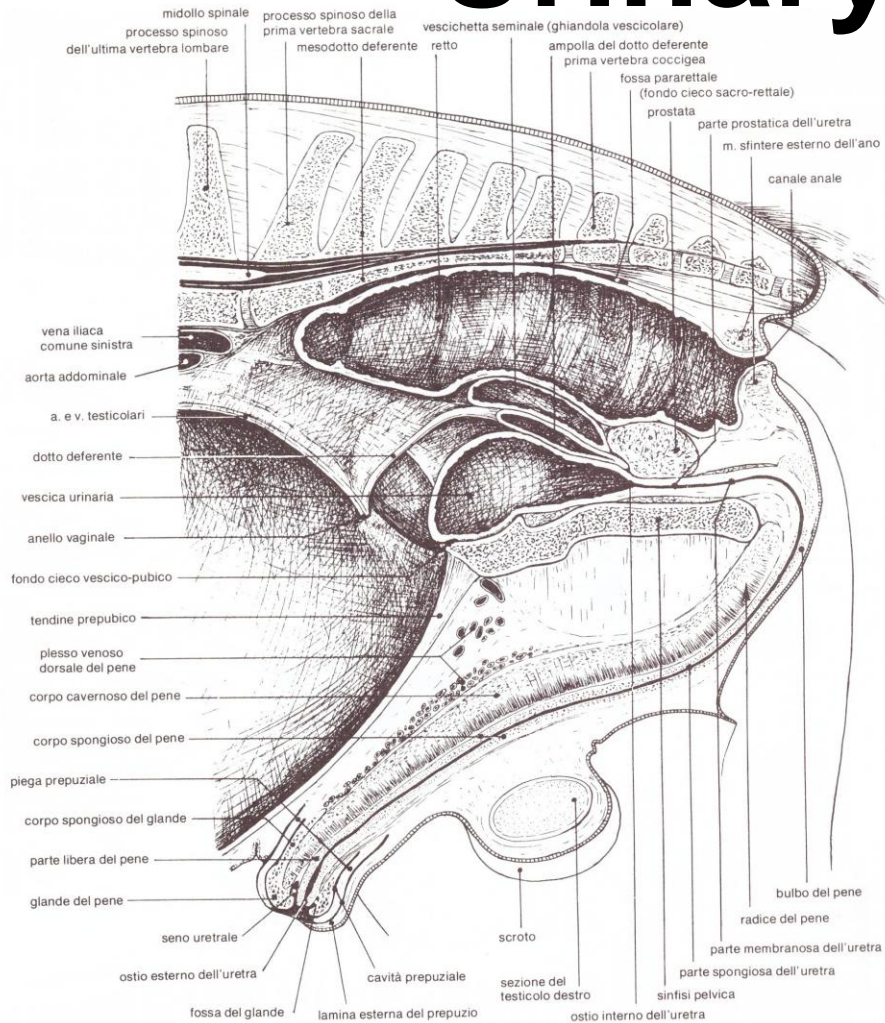


Urinary Bladder

- * **Form, size and position** varies (volume of urine)
 - * **Empty** and contracted is small and globular
 - * within the pelvic cavity, largely retroperitoneal and lies on the pubic bone
 - * **Moderately filled** pear-shaped
 - * apex and body into the abdominal cavity
 - * **Filled to capacity**
 - * apex may advance to the level of the umbilicus
 - * The neck always within the pelvic cavity



Urinary Bladder



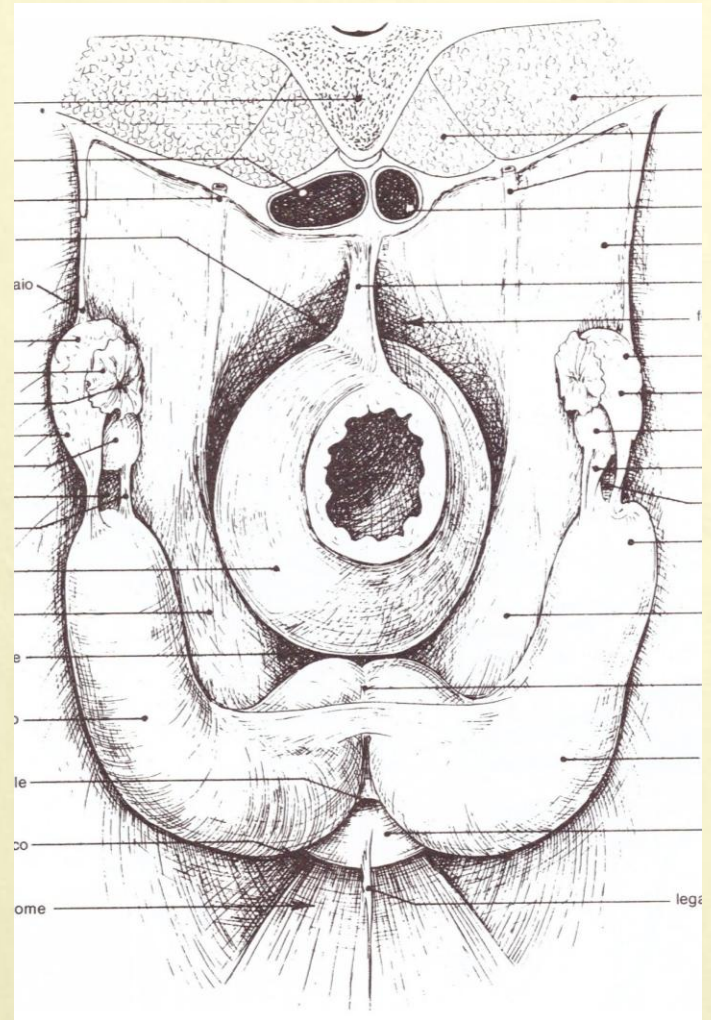
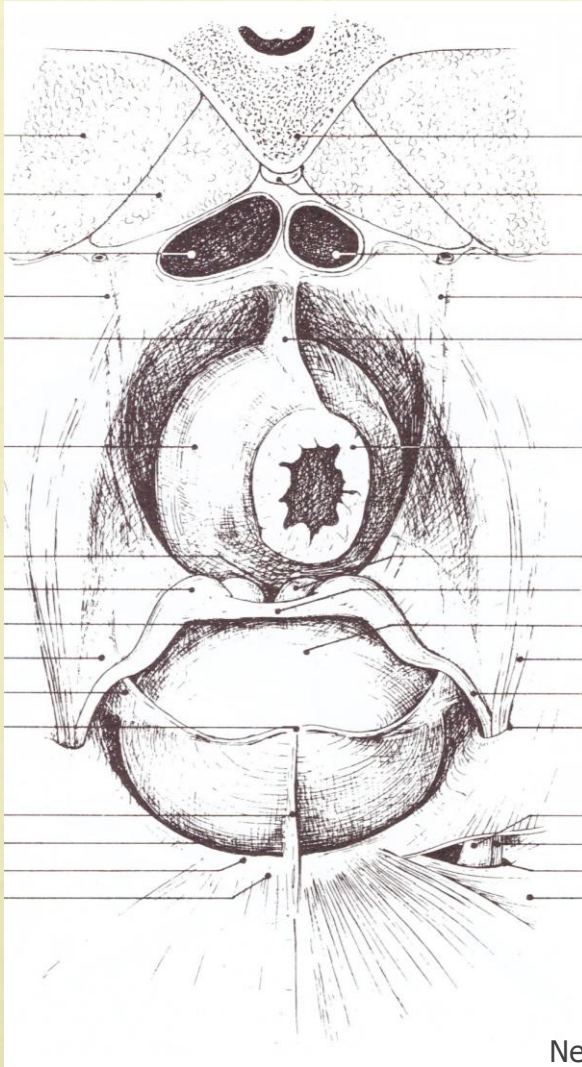


Urinary Bladder

- * **Relations** degree of **filling** and **sex**
 - * **Empty**, with the pelvic flexure of the colon, but as
 - * **Enlarged**, more extensive and varied relationship to the intestine
 - * **Mare** dorsal surface in contact with vagina, cervix, part of the uterus, and sometimes the rectum
 - * **Male** genital fold, deferent ducts, vesicular glands, prostate, and rectum



Urinary Bladder





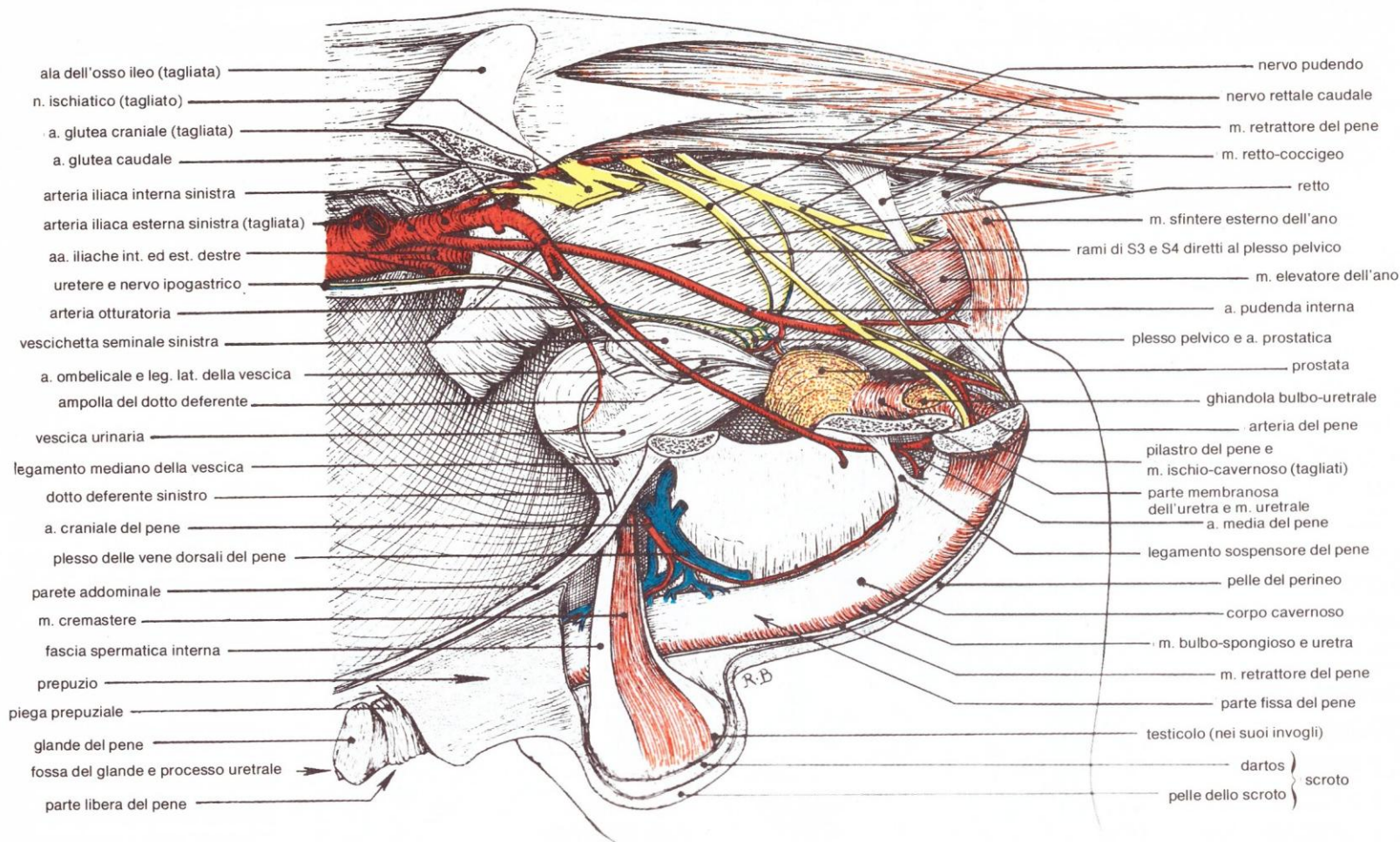
Urinary Bladder

- * Blood supply and Lymphatic drainage
 - * Arterial supply **internal pudendal a (obturator and umbilical aa)**
 - * Veins to **internal pudendal v**
 - * **Internal iliac and lumbar lymph nodes**

- * Innervation
 - * **Sympathetic** spinal segments L1–L4 via the **hypogastric nerve** (urine storage)
 - * **Parasympathetic** II,III, IV sacral vertebrae (**pelvic nerve** - bladder emptying)



Urinary Bladder





Bladder stone

Definition

* **Urolithiasis**

- * Macroscopic concretions of urine crystals (calculus or stone or urolith) in any portion of the urinary tract that may occur separately or together

* **Sabulous Urolithiasis**

- * Sandy or gritty macroscopic concretions within the bladder: accumulation of large mass of urine sediment in the ventral aspect of the bladder



Bladder stone

Epidemiology of Urolithiasis

- ✦ **0.11%** of equine **admissions** to 22 VTHs (1970-89), **7.8%** of the diagnoses of **urinary tract disease** (Lavery *et al.*, 1992)
- ✦ **Male** horses, especially **geldings** (76%)
- ✦ **Adult disease** (mean age 10.2 ± 6.5 years)
- ✦ **Bladder (59.7%), urethra (24%), kidneys (12.6%)** and **ureters (3.7%)**
- ✦ **9% multiple locations**



Bladder stone

Composition of equine calculi

- * **Two basic forms of uroliths** primarily of **calcium carbonate** (CaCO_3) in various hydrated forms
 - * **Type I urolith**: more than 90%, yellow-green spiculated easily fragmented
 - * **Type II urolith**: gray-white smooth stones, resistant to fragmentation; phosphate in addition to CaCO_3
- * Other components include **magnesium, ammonium, struvite, hydroxyapatite** and **uric acid** (infrequently)
- * **Crystals of CaCO_3 and mucoproteinaceous material** are **normal components of equine urine**



Bladder stone

Etiology of urolithiasis



Equine Type I cystic urolith.



Equine Type II cystic urolith.

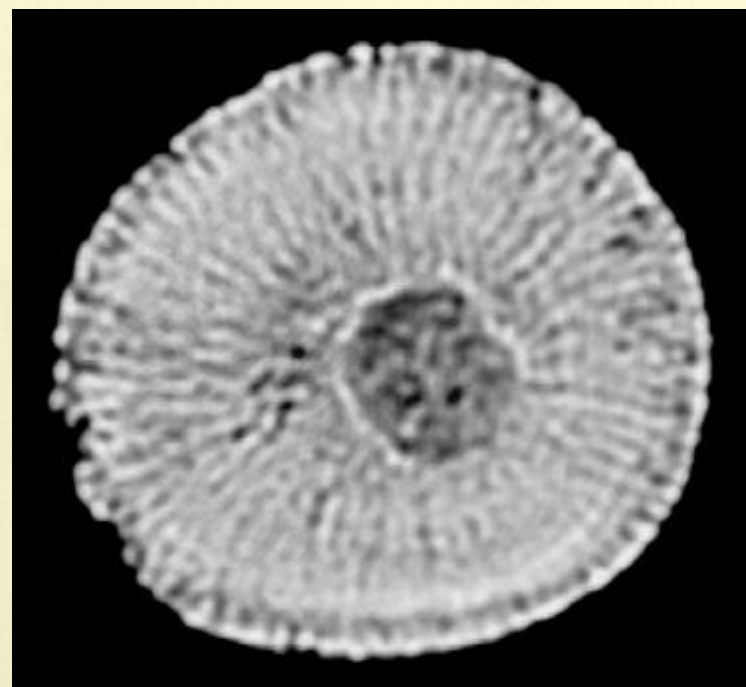


Bladder stone

Etiology of urolithiasis



Cystic calculus cut surface showing typical laminated appearance.
McAuliffe SB, 2014

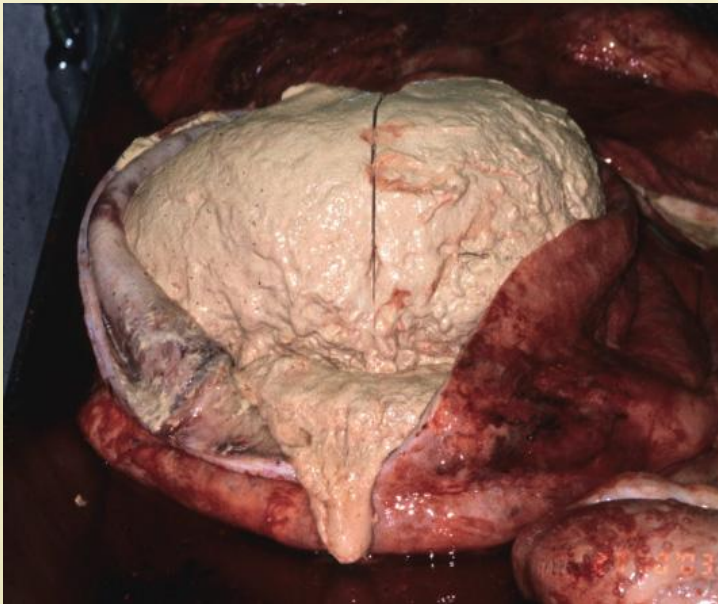


CT image of bladder urolith revealing a central nidus and concentric aggregations of calcium carbonate.
Ragle CA, 2009

Bladder stone

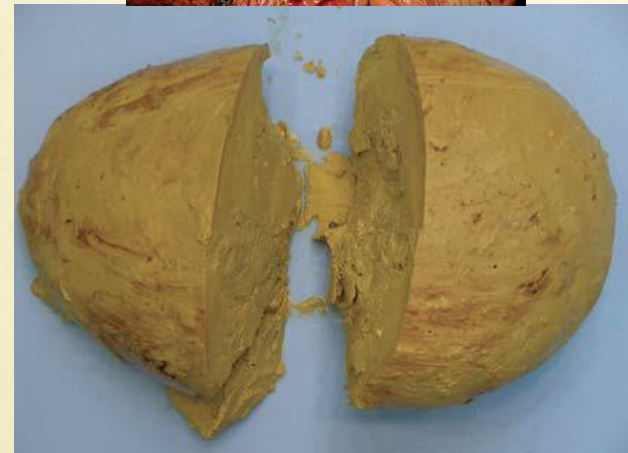
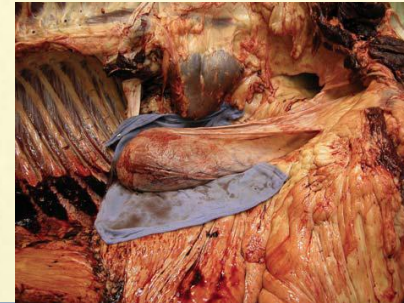
Etiology of urolithiasis

Sabulous urolithiasis can be mistaken for a true **cystolith**



Postmortem photograph of the bladder affected with sabulous urolithiasis.

Abutarbush SM, 2009



An enlarged bladder filled with a sphere of inspissated sabulous urine sediment at post mortem examination.

Schott II HC, 2010



Bladder stone

Etiology of urolithiasis

- * Not completely **understood**
- * **Two steps**
 - * **Nucleation**
 - * **Crystal growth**
- * **Mineralization** around a **nidus** under conditions favoring **crystal growth**
- * **Urine stasis, supersaturation, large quantities of calcium, and increased uric acid concentration** support **nidus** formation
- * **Stasis of urinary flow contact** between **crystalloid material** and **damaged uroepithelium**



Bladder stone

Etiology of urolithiasis

- * Nidus: **necrotic debris, mucoproteins, leukocytes, desquamated epithelial cells, or a foreign body** (such as fragment of suture material)
- * Subsequent **enlargement** of urolith by **aggregation** of CaCO_3 crystals (**spherules**) or **precipitation of crystals**
- * Horses large amounts of **CaCO_3 crystals** in the **urine** and **urine pH** is **alkaline** allowing for **calcite crystal** formation
- * **Inhibitors of crystal growth** in equine urine (high **mucus content**) likely to play a **protective role**



Bladder stone

Etiology of urolithiasis

- ✦ **UTI** and **development** of cystolithiasis
- ✦ Equine urolithiasis associated with an 11% rate of positive results of **bacteriologic culture of urine** (positive results only in females)
- ✦ **Bacteriologic culture** of the **center of uroliths** 63% rate of positive results (Laverty *et al.*, 1992)
- ✦ The **significance of finding bacteria** in the **center of equine uroliths** remains **unknown**



Bladder stone

Clinical signs

- * Clinical signs (**coral-like** uroliths)
 - * **Disuria - hematuria, stranguria, pollakiuria, pyuria, or incontinence**
 - * **Hematuria particularly after exercise or at the end of micturition**
 - * **Tenesmus**
 - * **Occasional recurrent signs of mild colic**
 - * **Reluctance to exercise, stiffness of the hindquarter or penile protrusion (less frequent)**



Urine samples collected before and after 15 minutes of exercise on the lunge

Edwards B and Archer D, 2011



Bladder stone

Diagnosis

* History

- * Lower urinary tract signs

* Findings from clinical examination

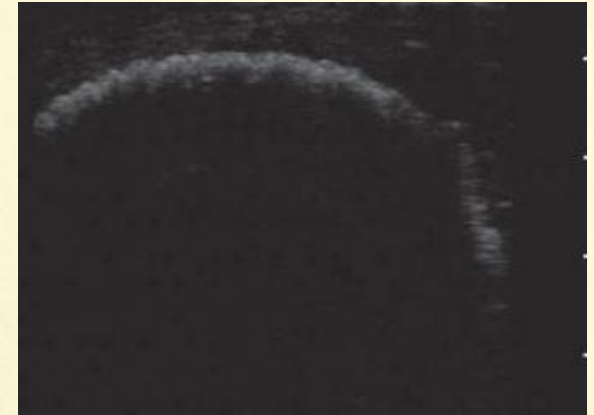
- * Disuria and possibly urine scalding

* Rectal palpation

- * Stone easily palpated when bladder is empty
- * Single urolith most common but multiple calculi may be present
- * Bladder wall is thickened

* Transrectal ultrasonography

- * The surface of the calculus is evident as an irregular, hyperechoic arch-like line





Bladder stone

Diagnosis

* **Videocystoscopy**

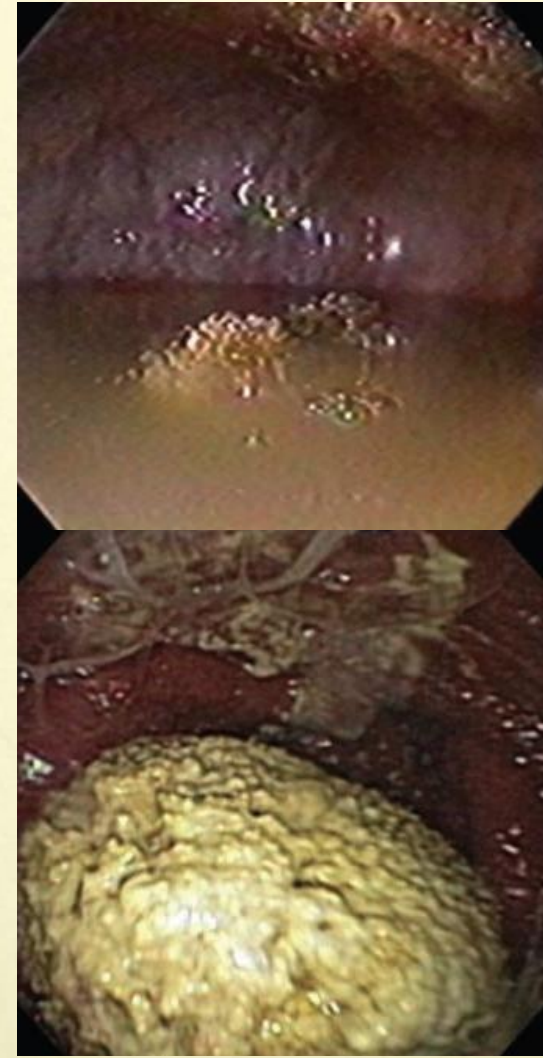
Important to **empty** the **bladder**

- * Evaluation of the **bladder mucosa**, the **ureteral openings**, the **urolith appearance**
identification of **multiple calculi**

* **Urinalysis** and quantitative culture

- * Microscopic or macroscopic **hematuria** and **pyuria**
- * **Bacteria** on sediment examination with **concurrent UTI**

The entire urinary tract should be assessed for the presence of the other urolith (calculi in multiple sites)





Bladder stone

Treatment

- * **Therapeutic goal**
 - * **Surgical removal** of the calculus **without** leaving behind **fragments** that can act as **nidus** for **recurrent stone formation**

- * **The appropriate technique** depends on
 - * **Gender**
 - * **Size** and **type** of urolith
 - * Availability of **surgical facilities** and **instrumentation**
 - * Familiarity of the **surgeon** with the approach
 - * **Anesthetic risk** (physical condition, concurrent disease and size of the patient)
 - * **Economic** consideration



Bladder stone

Treatment options in male horses

* **Surgical challenge**

- * **Pelvic** location of the **bladder** (limited access and exposure)
- * **Long** and **narrow urethra**
- * **Risk of recurrence** if **removal of calculi is incomplete**

* **Several surgical techniques** and **variation of surgical approach** have been published in the literature, even recently

- * Reflection of the difficulty in removing large urolith
- * Consistent with axiom: either works well or nothing works well



Bladder stone

Treatment options in male horses

- * **Recumbent surgical techniques**
 - * **Laparocystotomy**
 - * Ventral midline with reflection of the prepuce
 - * Caudal paramedian (parapreputial)
 - * Parainguinal
 - * Modified parainguinal
 - * **Laparoscopic intra-abdominal cystotomy**
 - * **Laparoscopic-assisted cystotomy**
 - * Inguinal
 - * Transinguinal (NOTES)



Bladder stone

Treatment options in male horses

* Standing surgical techniques

* Perineal urethrotomy

- * Small calculi (< 5 cm in diameter)

Can be removed intact

- * Larger calculi (>10 cm in diameter)

in combination with different methods of **fragmentation** and removal under **videoendoscopic guidance** (lithotrite, orthopaedic mallet and osteotome, laser instrument, laparoscopic retrieval device)

* Pararectal cystotomy (Gokel's technique)

* Transurethral cystoscopic lithotripsy (electrohydraulic, shockwave, laser)

* Laparoscopic intra-abdominal cystotomy



Bladder stone

Laparocystotomy in male horses

- **Preferred treatment** for cystic calculi in male horses
- **Complete calculus removal without fragmentation**
- General anaesthesia and abdominal **exposure** of the **urinary bladder**

- Once exteriorised **standard cystotomy** techniques are used to remove the calculus in all procedures
- A **surgeon experienced** able to perform this approach **without complications**

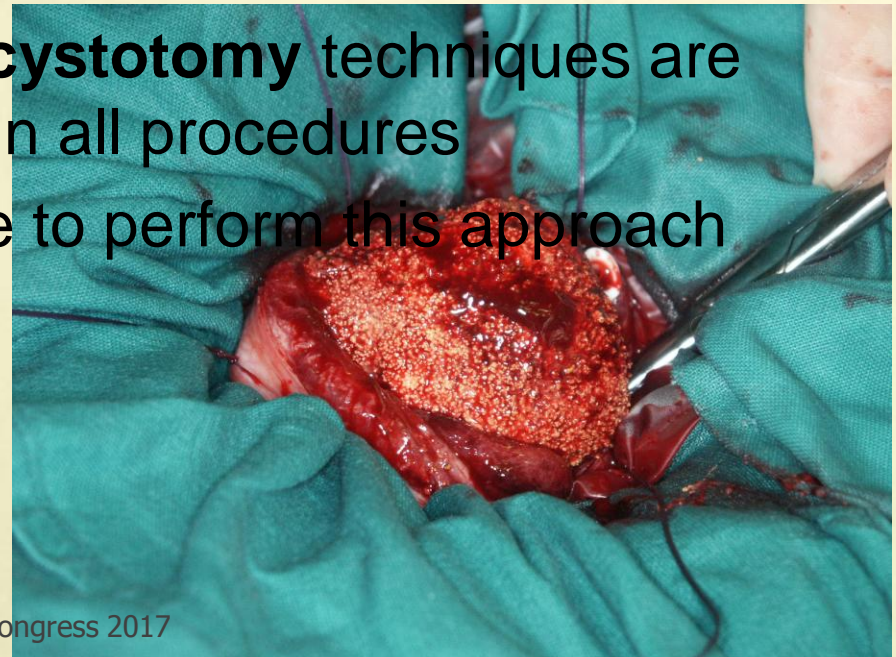
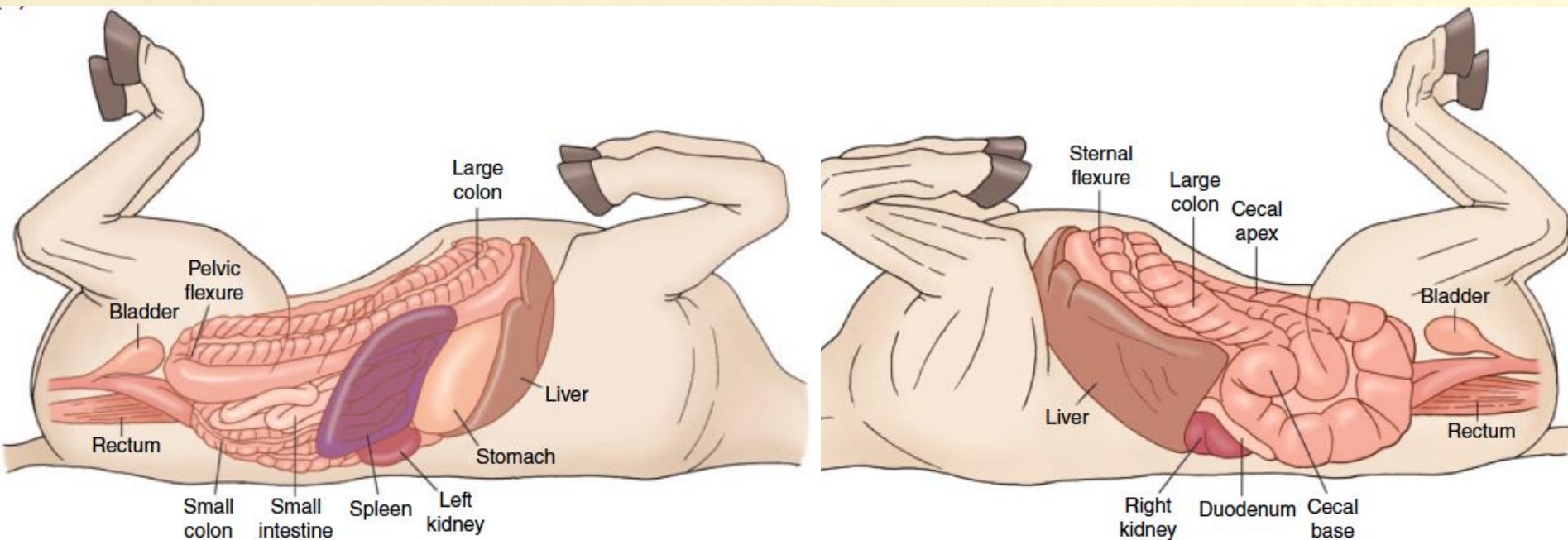




Diagram of the abdominal structures



Structures in the abdomen stay relatively fixed even when the horse is turned on its back

The urinary bladder is often just over the pelvic brim





Bladder stone

Local Anesthesia and Hydro-Distension to Facilitate Cystic Calculus Removal in Horses

Tom Russell¹, BVMS, MACVSc, Diplomate ECVS and Patrick J Pollock², BVMS, CertES(Soft Tissue), Diplomate ECVS

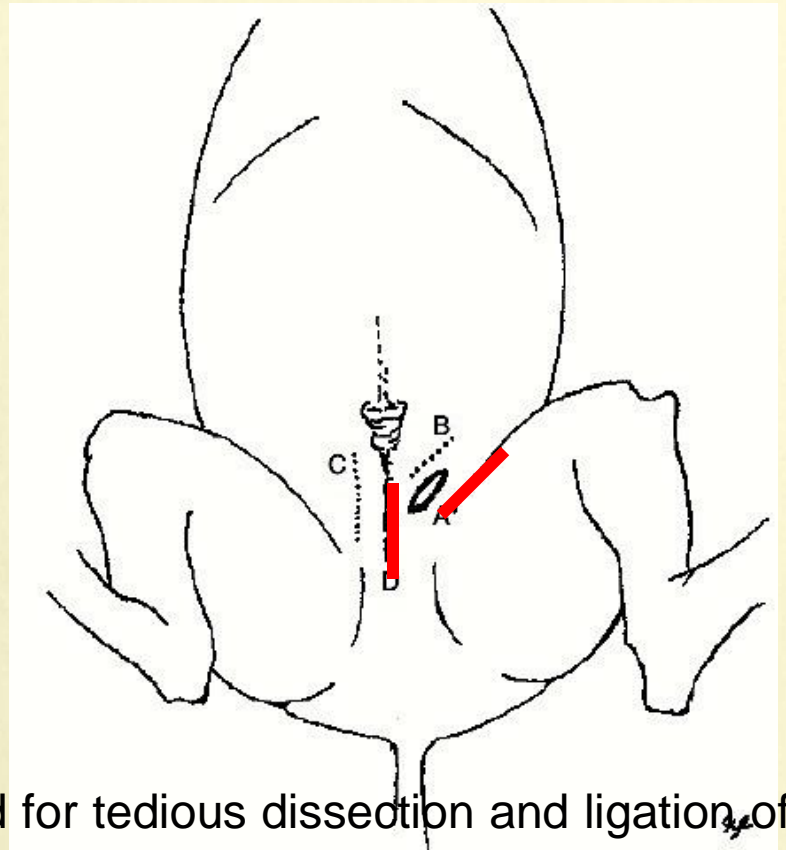
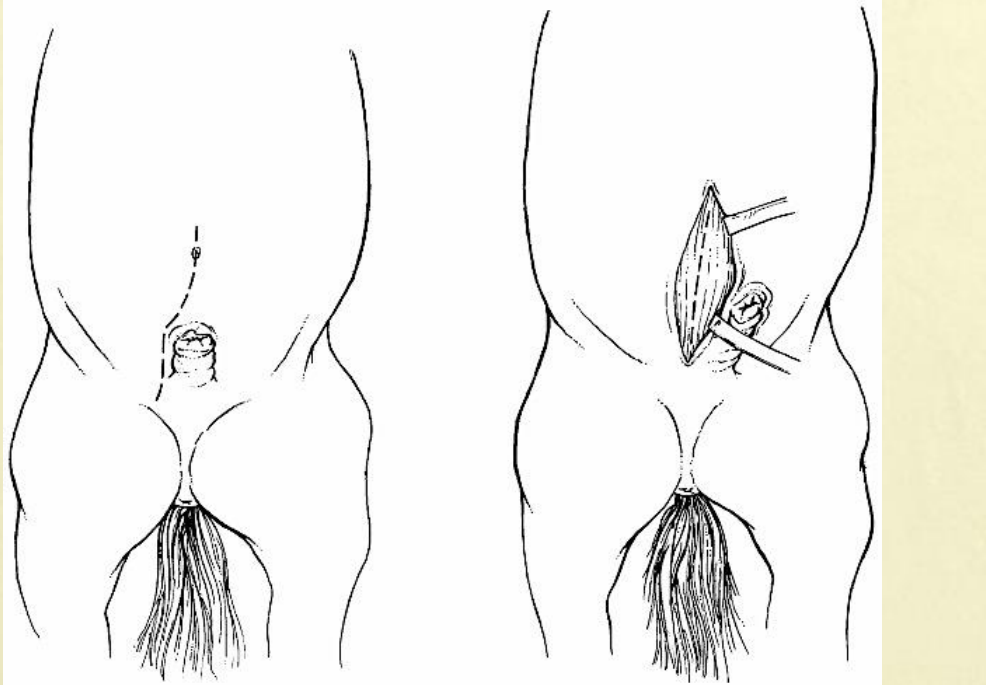
Veterinary Surgery 41 (2012) 638–642 © Copyright 2012 by The American College of Veterinary Surgeons

- Russell and Pollock (2012) and Vitte (2013) described
 - The use of **local anaesthesia** and **hydro-distension** of the bladder prior or just after started the surgery via a urinary catheter to **increase bladder size** prior to paramedian cystotomy or laparoscopic inguinal approach
 - When the bladder was grasped, the fluid was then siphoned off via the catheter to allow bladder exteriorization



Bladder stone

Laparocystotomy in male horses



The parainguinal approach eliminates the need for tedious dissection and ligation of branches of the external pudendal and caudal superficial epigastric vessels and the need to reflect the prepuce in male horses



Bladder stone

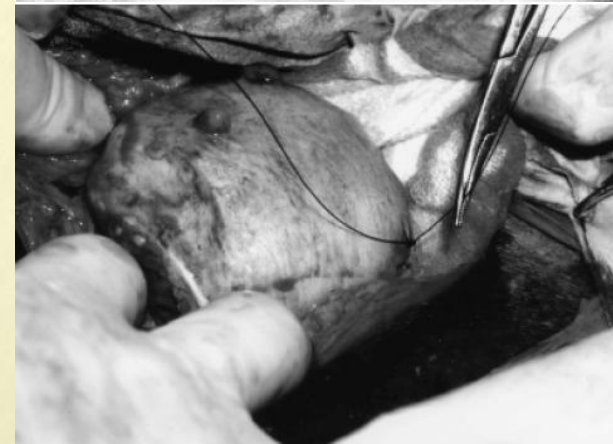
Veterinary Surgery
33:386-390, 2004

Parainguinal Laparocystotomy for Urolith Removal in Geldings



WARREN BEARD, DVM, MS, Diplomate ACVS

- **Parainguinal laparocystotomy offers advantages over median laparocystotomy**
 - easier approach that **avoids major vessels**
 - **smaller incision**
 - **decreased dead space**





Bladder stone

Modified parainguinal approach for cystic calculus removal in five equids

A. E. WATTS* and S. L. FUBINI

2013

Equine Veterinary Journal ISSN 0425-1644
DOI: 10.1111/j.2042-3306.2012.00557.x

- * **Ventral midline laparotomy-guided parainguinal laparocystotomy**
- * With an arm introduced to the abdomen via the ventral midline, the surgeon is able to select the **ideal parainguinal laparotomy incision location** that allows bladder exteriorisation with the minimum amount of tension





Bladder stone

Modified parainguinal approach for cystic calculus removal in five equids

Equine Veterinary Journal ISSN 0425-1644
DOI: 10.1111/j.2042-3306.2012.00557.x

A. E. WATTS* and S. L. FUBINI

- The **parainguinal incision** can be sized to just allow exteriorisation of the urinary bladder and urolith, increasing **extra-abdominal bladder security** during cystotomy while reducing **incision size** in the parainguinal region
- **Bladder stability** within the parainguinal incision during **cystotomy closure**



Torre dell'Orso, SICV 2008





Bladder stone

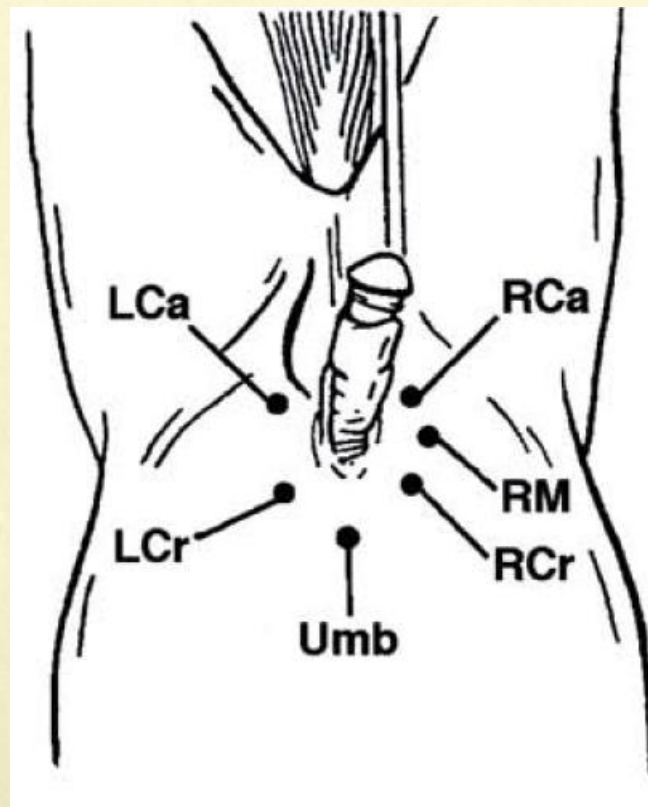
DORSALLY RECUMBENT URINARY ENDOSCOPIC SURGERY

VETERINARY CLINICS OF NORTH AMERICA: EQUINE PRACTICE

VOLUME 16 • NUMBER 2 • AUGUST 2000

Claude A. Ragle, DVM

- * Male horses with bladder urolith 5 cm or greater and **negative results** for **bacteria** on **urine** cytology and culture
- * Positioned in **dorsal recumbency** and tilted in a **head-down posture**
- * **Five instrument portals**





Bladder stone

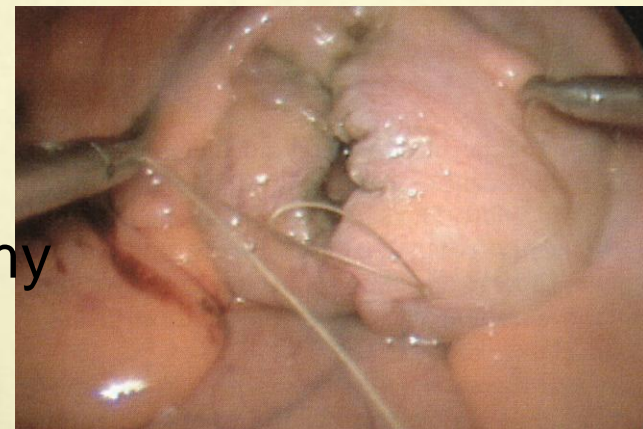
DORSALLY RECUMBENT URINARY ENDOSCOPIC SURGERY

VETERINARY CLINICS OF NORTH AMERICA: EQUINE PRACTICE

VOLUME 16 • NUMBER 2 • AUGUST 2000

Claude A. Ragle, DVM

- **Surgeon skilled in intracorporeal suture techniques and familiarity with advanced laparoscopic procedure**
- **Excellent observation** of the surgical site and **tension free** manipulation of the bladder
- **Small umbilical celiotomy** for removal cistic calculi
- **Complications:** septic peritonitis, cystotomy leakage and prolonged anaesthesia times



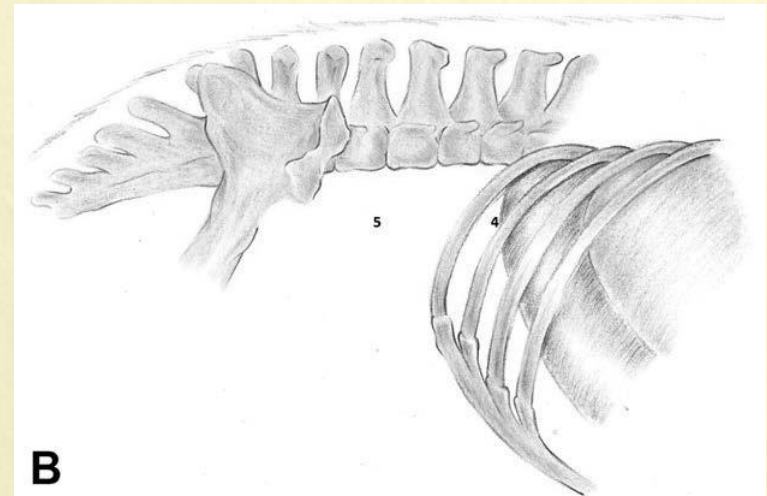
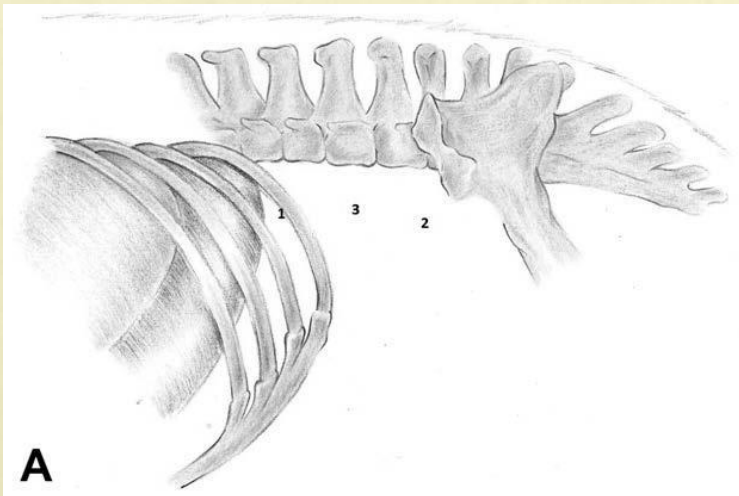


Bladder stone

Laparoscopic removal of a bladder urolith in a standing horse

Caleb M. Lund, DVM; Claude A. Ragle, DVM, DACVS, DABVP; J. Dylan Lutter, DVM

JAVMA, Vol 243, No. 9, November 1, 2013



Multiportal transparalumbar fossa laparoscopic approach



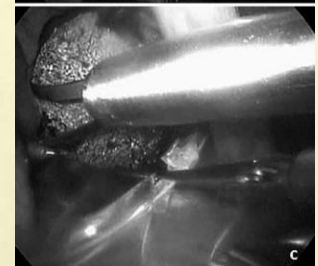
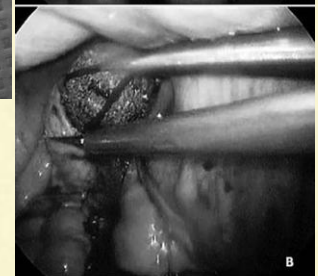
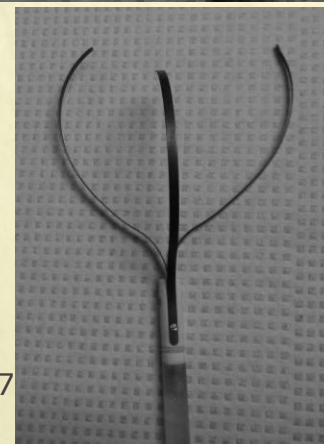
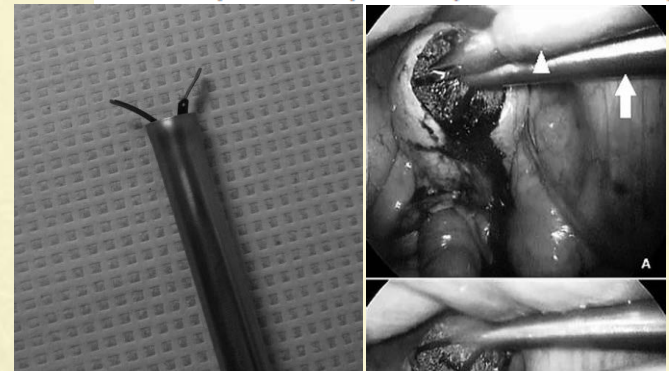
Bladder stone

Laparoscopic removal of a bladder urolith in a standing horse

Caleb M. Lund, DVM; Claude A. Ragle, DVM, DACVS, DABVP; J. Dylan Lutter, DVM

JAVMA, Vol 243, No. 9, November 1, 2013

- Avoids the disadvantages of conventional laparocystotomy for removal of large uroliths and the potential complications of general anesthesia
- Excellent viewing and access to the bladder, permitting extraction of the urolith and secure closure of the cystotomy with minimal tension and tissue trauma to the bladder





Bladder stone

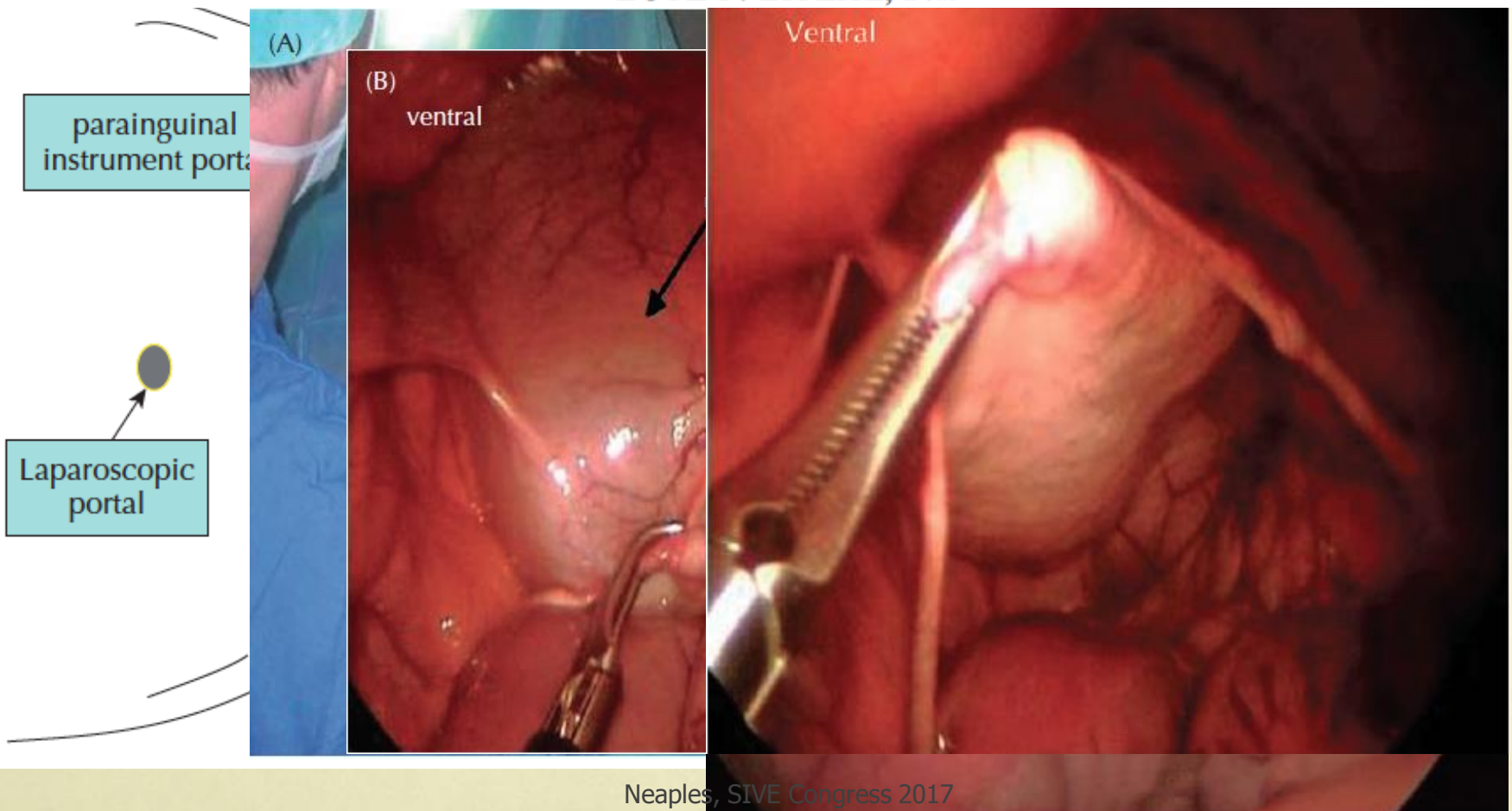
Laparoscopic-assisted cystotomy in male horses

- **Combines the advantages** of the **paringuinal laparocystotomy** with **laparoscopic technique** for removal of cystic calculi
- Laparoscopic technique with **extra-abdominal extraction** of the cystic calculus
- **Simplifies bladder closure**, prior experience in laparoscopic suturing techniques is not required
- **Decrease the risk** for **urine leakage** into the abdomen (peritoneal contamination with septic urine)
- Compared with the paringuinal laparocystotomy, the **size** of the **incision** is generally **smaller**



Laparoscopic-Assisted Cystotomy for Urolith Removal in Geldings

MICHAEL RÖCKEN, DVM, CHRISTIANE STEHLE, DVM, GESINE MOSEL, DVM, JULIA RASS, DVM, and
LUTZ F. LITZKE, DVM





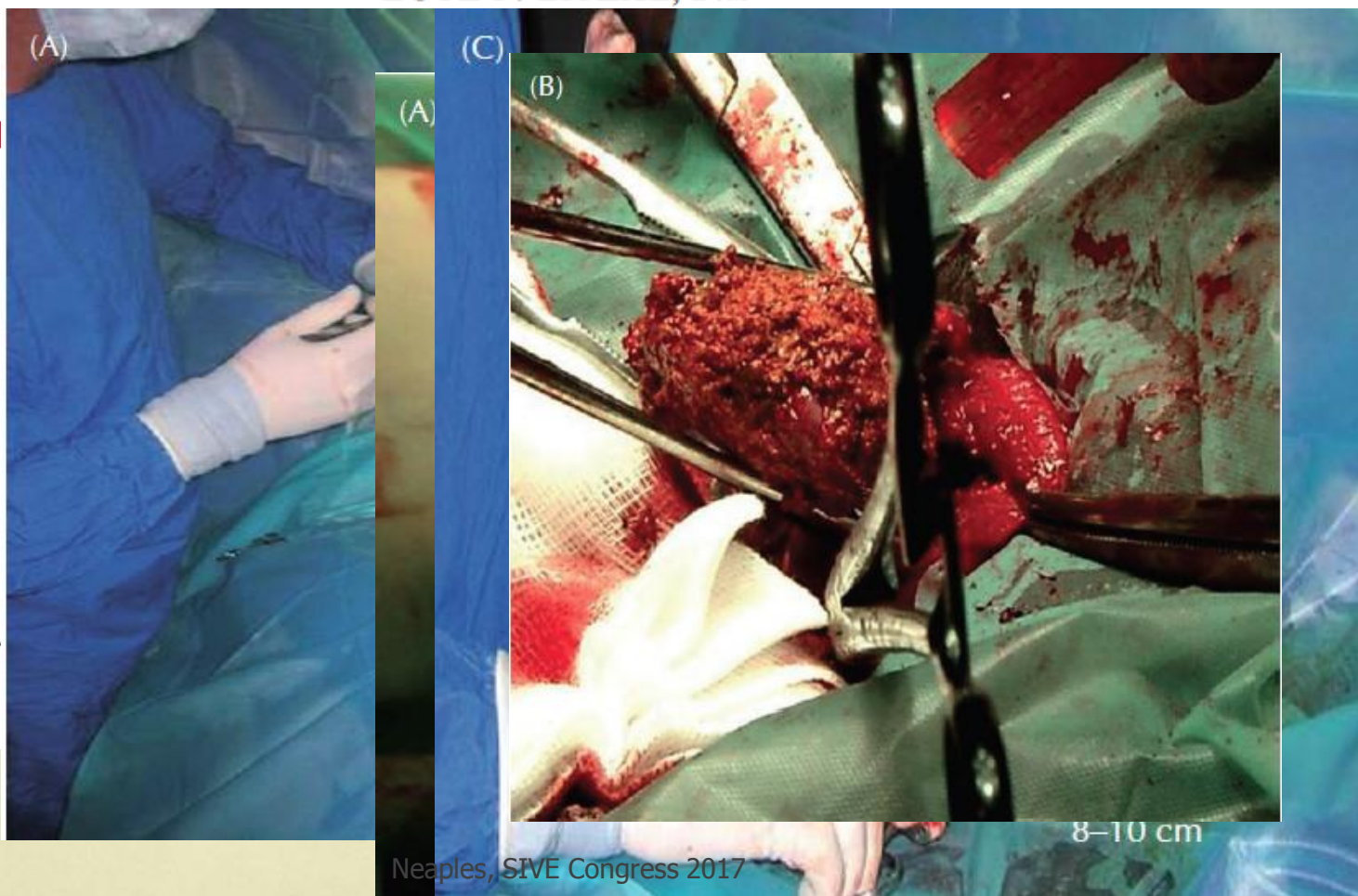
Laparoscopic-Assisted Cystotomy for Urolith Removal in Geldings

MICHAEL RÖCKEN, DVM, CHRISTIANE STEHLE, DVM, GESINE MOSEL, DVM, JULIA RASS, DVM, and LUTZ F. LITZKE, DVM

parainguinal
mini-laparotomy



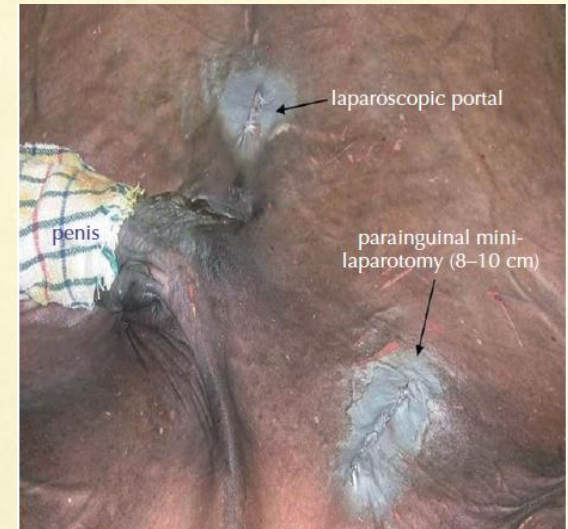
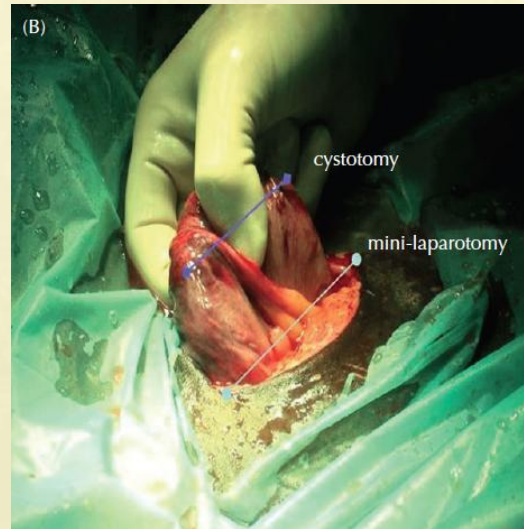
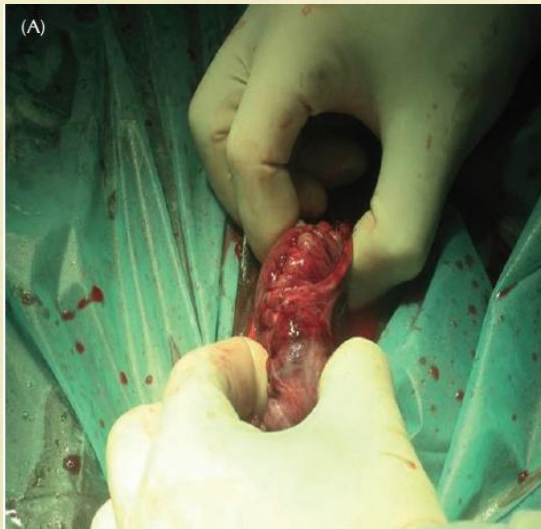
Laparoscopic portal





Laparoscopic-Assisted Cystotomy for Urolith Removal in Geldings

MICHAEL RÖCKEN, DVM, CHRISTIANE STEHLE, DVM, GESINE MOSEL, DVM, JULIA RASS, DVM, and
LUTZ F. LITZKE, DVM





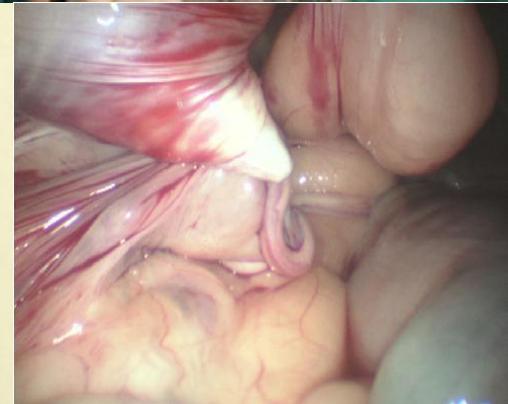
Bladder stone

Removal of cystic calculi using a transinguinal laparoscopic-assisted technique in two stallions

A. Vitte^{*†‡}, C. Mespoulhès-Rivière[‡], A. Lechartier^{†‡} and F. Rossignol[†]

Equine vet. Educ. (2013)
doi: 10.1111/eve.12013

- **Modified laparoscopic-assisted method**, for sexually intact males, involving minimal soft tissue dissection by using the **inguinal canal as a natural orifice** (NOTES)
- Laparoscopic-assisted cystotomy technique to **exteriorise the bladder** and **remove uroliths** via the **inguinal canal after hemicastration**





Bladder stone

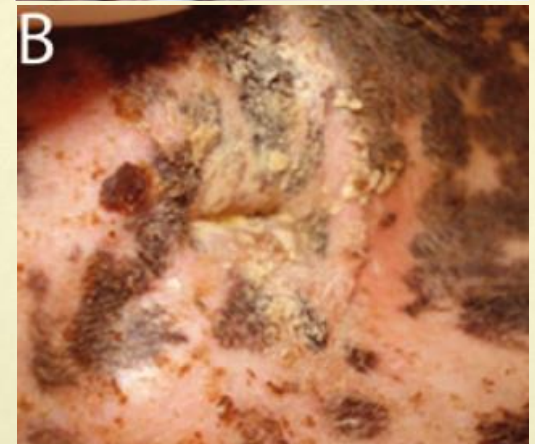
Laparoscopic-Assisted Cystotomy and Cystostomy for Treatment of Cystic Calculus in a Gelding

Paola Straticò¹, DVM, Riccardo Suriano¹, DVM, Chiara Sciarrini¹, DVM, PhD, Vincenzo Varasano¹, DVM, and Lucio Petrizzi¹, DVM, Diplomate ECVS

Veterinary Surgery 41 (2012) 634–637 © Copyright 2012 by The American College of Veterinary Surgeons

If the stone breaks???

- Laparoscopic-assisted **cystotomy** for **calculus removal** and subsequent inguinal **cystostomy** was used to facilitate urolith fragment removal
- **Outcome** was **favorable** with only **minimal urine scalding** of the ventral abdomen

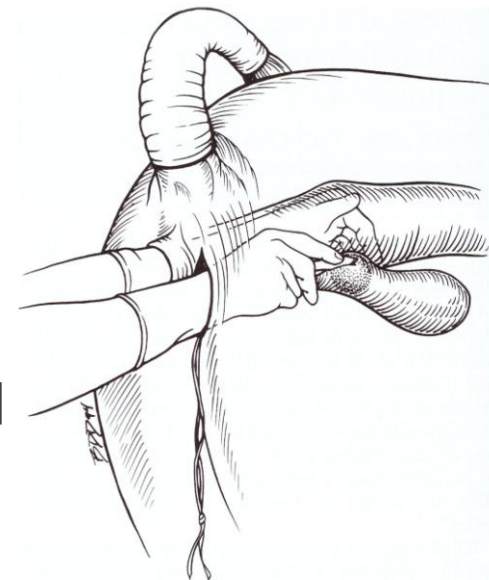
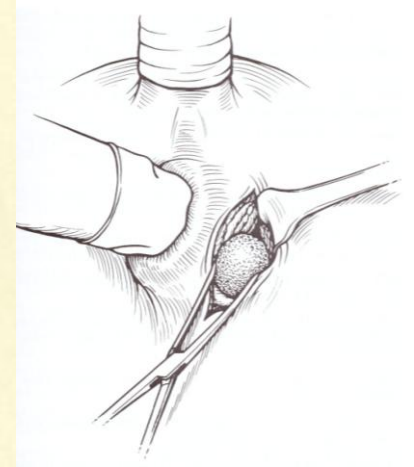




Bladder stone

Pararectal cystotomy in male horses

- * If **laparocystotomy is not an option and complete, intact calculus removal is desired**
- * Intravenous sedation, epidural anaesthesia, and a **perirectal incision** to gain access to the **retroperitoneal aspect of the trigone region of the bladder**
- * A 2 cm **sharp cystotomy** over the calculus **digitally enlarged** to facilitate calculus removal
- * **Lavage** of the bladder
- * Cystotomy **incision closed primarily or second intention healing**





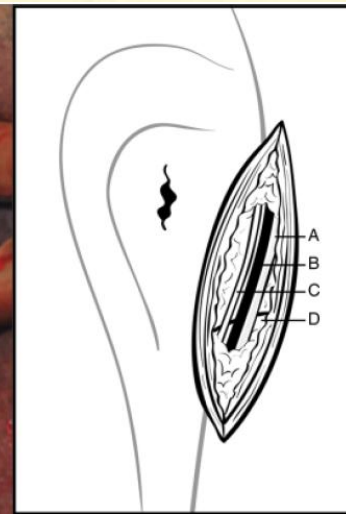
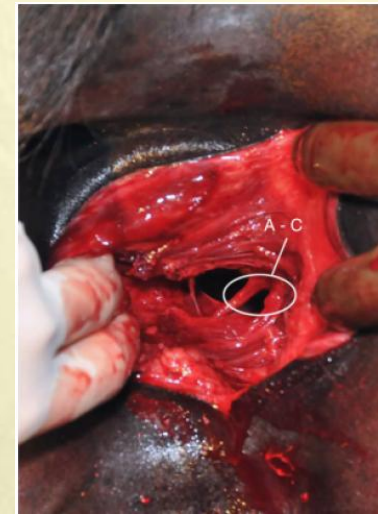
Bladder stone

Vet Surg, 2010

Pararectal Cystotomy for Urolith Removal in Nine Horses

Gustavo A. Abuja¹, LV, José M. García-López¹, VMD, Diplomate ACVS, Richard Doran², DVM, MS, Diplomate ACVS, and Carl A. Kirker-Head¹, MA, Vet MB, MRCVS, Diplomate ACVS & ECVS

- * **Eight returned to previous use** with no recurrence of clinical signs and **one horse had prolonged incisional healing**, which ultimately resolved, but the horse could **not return to previous use**
- * Reported **complications** associated with Gokel's cystotomy (septic peritonitis, perirectal abscessation and persistent drainage) **were not observed**
- * The internal pudendal artery, vein and nerve are identified and **avoided**

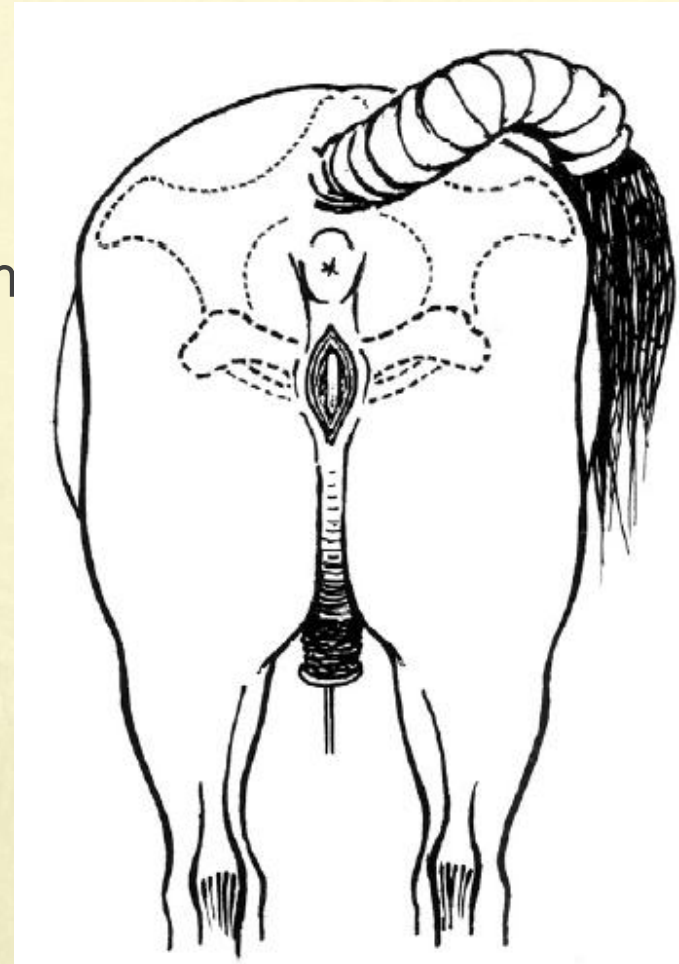




Bladder stone

Perineal urethrotomy in male horses

- * For **economic reason** or high **risk** for **general anesthesia**
- * Small calculi (**<5 cm in diameter**) and fragments of calculi can be removed from the bladder by lavage or with sponge forceps, canine whelping forceps or lithotrites
- * Larger calculi (**>10 cm in diameter**) require crushing with lithotrites or with a mallet and osteotome.
- * Laser lithotripsy or shock-wave therapy can be used to fragment the calculus





Bladder stone

Complications Associated With Perineal Urethrotomy in 27 Equids

Isabelle Kilcoyne¹, MVB, and Julie E. Dechant^{1,2}, DVM, MS, Diplomate ACVS & ACVECC
Veterinary Surgery 43 (2014) 691–696 © Copyright 2014 by The American College of Veterinary Surgeons

- * Perineal urethrotomy was performed for **urolithiasis (n= 22)**
- * **52% complications**
- * 6 equids managed with **indwelling urinary catheters**, 2 had early minor complications (detrusor atony, stranguria), 2 developed delayed major complications (urethral stricture, urine scalding), and 2 had no complications
- * Perineal urethrotomy can be an **effective for treatment of urolithiasis**
- * **Postoperative cystoscopy** and **bladder lavage** significantly **reduced** the incidence of postoperative **recurrence** of urolithiasis



Bladder stone

Use of a Laparoscopic Retrieval Device for Urolith Removal through a Perineal Urethrotomy

Inés Martín Menéndez, LVM and Gareth Fitch, BVetMed, Diplomate ACVS

Veterinary Surgery 41 (2012) 629–633 © Copyright 2012 by The American College of Veterinary Surgeons

- * Uroliths were removed successfully with **no** short- or longterm **complications**
- * The larger of the 2 uroliths measured **6 cm** in **length** and **4.6 cm** in **width**
- * Was an **expedient** and **minimally traumatic** method that **obviated** the need for **fragmentation** before removal





Bladder stone

Use of a laparoscopic specimen retrieval pouch to facilitate removal of intact or fragmented cystic calculi from standing sedated horses: 8 cases (2012–2015)

Scott A. Katzman DVM

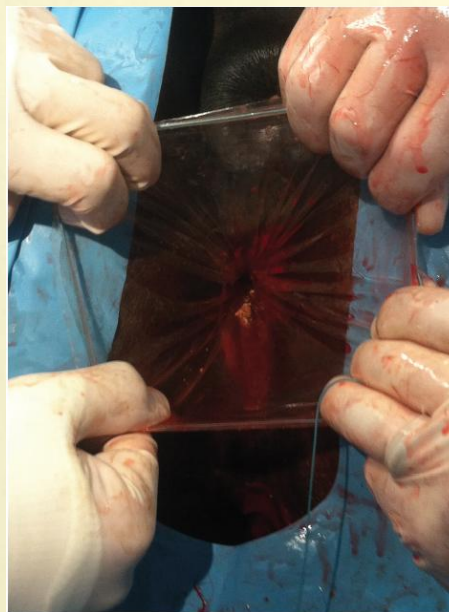
Betsy Vaughan DVM

Jorge E. Nieto DVM, PhD

Larry D. Galuppo DVM

JAVMA • Vol 249 • No. 3 • August 1, 2016

- Direct access to the urinary bladder was gained in **geldings** via **perineal urethrotomy** or in **mares** by a **transurethral approach**
- The pouch **protected** the urinary bladder and urethra from trauma during calculus removal (**intact or fragmented**)





Bladder stone

Transurethral cystoscopic lithotripsy in male horses

- * **Fragmentation** of the calculus can be performed using electrohydraulic, ballistic shockwave and laser lithotripsy
- * **Electrohydraulic** and laser **lithotripsy** (usually a *holmium:yttrium-aluminum-garnet laser* ; Ho:YAG)
 - * **Flexible endoscope** inserted via the urethra
 - * In the standing sedated patient
- * **Disadvantages**
 - * **Cost of the equipment**
 - * **Duration** and/or **repetition** of the procedure
 - * **Experience**
 - * **Risk for urethral obstruction**



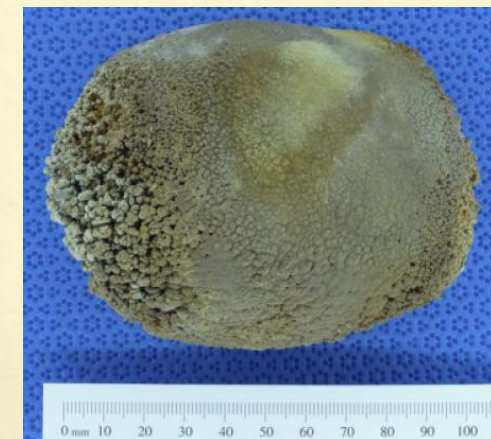
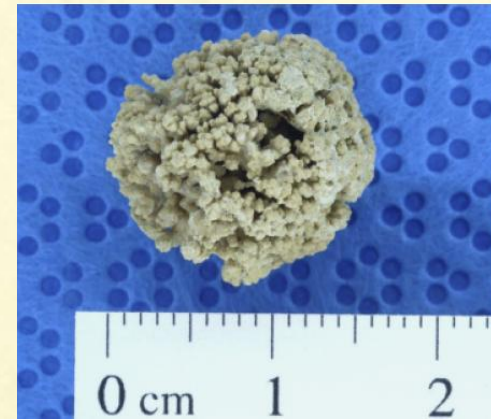
Bladder stone

J Vet Intern Med 2009;23:1079–1085

Holmium:YAG Laser Lithotripsy for Urolithiasis in Horses

D.C. Grant, J.L. Westropp, R. Shiraki, and A.L. Ruby

- **Success in 5 of 7** laser lithotripsy procedures
- **No complications** during laser lithotripsy
- One horse developed **uroabdomen** after failure of laser lithotripsy
- **Differences in microstructure**
 - urolith type 1 successfully **fragmented**
 - urolith type 2 **resistant** to laser fragmentation





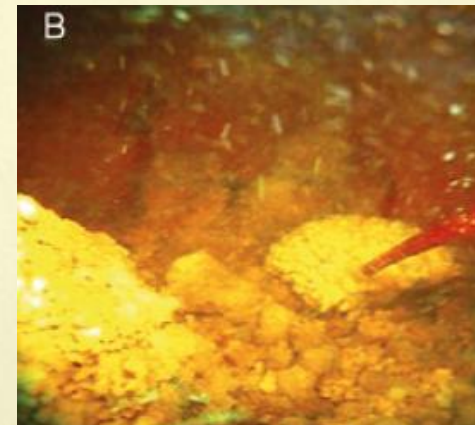
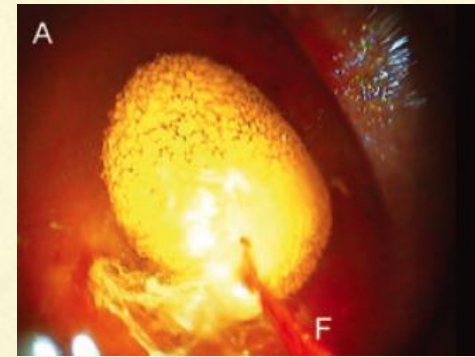
Bladder stone

Endoscopic-Assisted Electrohydraulic Shockwave Lithotripsy in Standing Sedated Horses

Michael Röcken^{1,2}, DVM, Priv-Doz, Anton Fürst³, DVM, Diplomate ECVS, Martin Kummer³, DVM, Diplomate ECVS, Gesine Mosel¹, DVM, Theo Tschanz⁴, DVM, and Christoph J. Lischer⁵, DVM, Diplomate ECVS

Veterinary Surgery 41 (2012) 620–624 © Copyright 2012 by The American College of Veterinary Surgeons

- Complete calculus removal was achieved in 20 horses (95%)
- **1 horse** perineal urethrotomy performed for complete fragment removal **via the urethra**
- **Postoperative complications:**
 - Hematuria because of severe mucosal erosion (n = 2)
 - Dysuria because of a trapped urethral fragment (2) small amount of urinary debris (1)
 - One horse was euthanatized because of bladder rupture





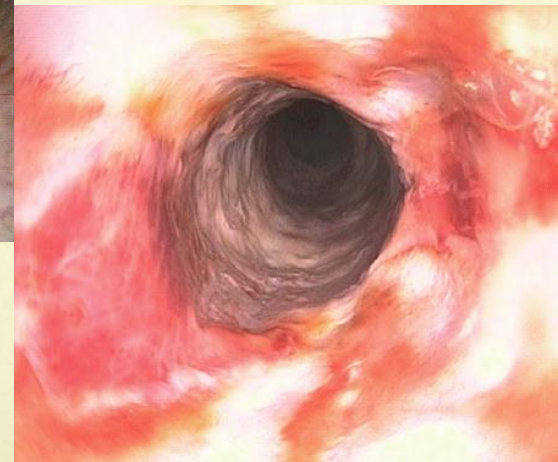
Bladder stone

Complications associated with transurethral endoscopic-assisted electrohydraulic lithotripsy for treatment of a bladder calculus in a gelding

U. Reichelt and C. Lischer*

Equine vet. Educ. (2013) **25** (2) 55-59
doi: 10.1111/j.2042-3292.2011.00369.x

- **After the third lithotripsy**, the horse suffered a recurrence of dysuria and pollakiuria due to **partial obstruction of the urethra** by the calculus fragments
- The **treatment was repeated** within the urethra until clearance of the fragments was achieved





Bladder stone

Treatment options in female horses

- Female has a **wide, short and accessible urethra** (easily distensible)
- **Calculi < 10 cm** in diameter can be **extracted manually**
 - The calculus manipulated into the trigone of the bladder by manual transrectal positioning
 - A few finger or grasping forceps introduced into the urethra and the calculus is extracted from the bladder
- If this is **unsuccessful**
 - the calculus physically disrupted and the fragments removed manually or flushed from the bladder
- **Sphincterotomy** in the dorsal part of the urethra may help access and remove **larger stone**
- **Laparocystotomy** is rarely necessary



Bladder stone

Postoperative care

- * Should include
 - * adequate **water intake** for proper hydration
 - * **antimicrobial therapy** to control bacterial cystitis when is present
 - * antimicrobial selection should be based on culture and sensitivity results
 - * **NSAID** administration to reduce abdominal discomfort
 - * Checked regularly for proper **urination**



Bladder stone

Prognosis

- Early report excellent long-term results and no recurrence after removal of cystic calculi by **laparocystotomy** in four horses (Lowe, 1981)
- Similar low rates of recurrence in several reviews of equine urolithiasis (Debowes 1984, 1988; Holt 1984)
- In contrast to these favorable reports
 - Laverty *et al.* (1992) reported that clinical signs of **urolithiasis recurred** in **12** of **29** horses (41%) for which follow-up data were available
 - The interval between episodes of recurrence was **1** to **32 months** (mean: 13 months)



Bladder stone

Prognosis

- As Lowe initially described in 1965, Laverty *et al.* (1992) **greater recurrence of cystic calculi** after treatment by **perineal urethrotomy**
 - **7 of 15** horses with follow-up compared with **laparocystotomy**
- Meticulous **removal of debris and fragments** of calculus following surgical removal and/or lithotripsy is the single most **important factor** in **preventing recurrence** of uroliths formation



Bladder stone

Long-term management

- **Preventing recurrence**
 - **Acidify urine** - reducing urinary pH to <6.0
 - Instigate **dietary changes**: reduce absorption of calcium from the gastrointestinal tract and alter the dietary cation–anion balance
 - Promote **diuresis**
 - Control UTI if **recurrent cystitis** occurs
 - **Recheck** examination **6 months** after the procedure and then **annually** thereafter



Bladder stone

Conclusion

- * **Indications and contraindications** for each of the described techniques should be discussed with the **owner**
- * **Traditional laparocystotomy, ventral midline-guided parainguinal laparocystotomy and the laparoscopic assisted cystostomy**
 - * allow **complete calculus removal**
 - * **negates** the need for **fragmentation**
 - * thus can **minimize surgical time** and **decrease** the **risk** for **urethral obstruction** and **postoperative inflammation** of the bladder and urethra



Bladder stone

Conclusion

- * **Gokel's cystotomy** and **perineal urethrostomy** good alternative to **avoid general anesthesia**
- * Physical disruption of the calculus **via perineal urethrotomy** may be an **economic option** or may be use in small and/or multiple calculi
- * **Laser** or **electrohydraulic lithotripsy** both require expensive equipment and carry the risk of **unsuccessful fragmentation of hard, dense calculi** for some horses
- * Surgeons should fully understand the **pros** and **cons** of each of these procedures, according to their own **skill, equipment, and owners' expectation**



OSPEDALE VETERINARIO
UNIVERSITARIO DIDATTICO FACOLTÀ MEDICINA VETERINARIA



**Grazie per
l'attenzione!**

**Servizio di medicina e
chirurgia del cavallo UNITE**