



# Urolithiasis in beef cattle: *from diagnosis to prevention*

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ECBHM
European College of Bovine Health Management

# FROM LIEGE TO CREMONA

# LIEGE


MER DU NORD
PAYS-BAS
ANVERS
Bruges
Anvers
RÉGION FLAMANDE
FLANDRE OCCIDENTALE
Gand
Escaut
LIMBOURG
ALLEMAGNE
FLANDRE ORIENTALE
Ypres
Lys
Courtrai
Bruxelles
Louvain
Hasselt
BRABANT
LIÈGE université
Médecine Vétérinaire
Tournai
HAINAUT
RÉGION WALLONNE
Meuse
Liège
LIÈGE
Mons
Namur
FRANCE
Charleroi
Sambre
NAMUR
Bastogne
LUXEMBOURG
LUXEMBOURG
Arlon
Meuse
COMMUNAUTÉS DE LANGUE :
flamande
française
allemande
Limite de régions
Limite de province
0
50 km

# UNIVERSITY OF LIEGE

# Faculty of Veterinary Medecine

# Faculty of Veterinary Medecine

# CLINIC FOR RUMINANTS

# SURGERY

# HOSPITALIZATION

# BELGIAN SPECIALITIES…


# AND BELGIAN BLUE...

# Belgian blue cattle breed

- 50 % belgian cattle & 95 % beef cattle
  - 1.300.000
- 17.000 BBCB herds / 25.000 herds
- Carcass yield = 70 % with 80 % meat
- 99 % calvings by C-section
- Extensive use of AI (50 %)

# UROLITHIASIS IN CATTLE

- **INTRODUCTION**
- DIAGNOSIS
- PROGNOSIS
- TREATMENT
- PREVENTION

# INTRODUCTION

- **DEFINITION**
- EPIDEMIOLOGY
- ETHIOPATHOGENY
- CALCULI

# DEFINITION

- Urolithiasis = urinary calculi
- Metabolic disorder
  - Nutritional disease
- Uroliths = concretions of solid mineral and organic compounds in the urinary tract.
- Sublinical > partially obstruct. > obstruct.

# INTRODUCTION

- DEFINITION
- **EPIDEMIOLOGY**
- ETHIOPATHOGENY
- CALCULI

# EPIDEMIOLOGY

- 1st URINARY DISEASE in Small ruminants (SR)
- CATTLE = ONE stone vs SR = multiple
- SPORADIC BUT if 1 case
  - SURVEILLANCE OF THE UNIT/BATCH
- EFFECT of DIET
  - HIGH PROPORTION GRAIN/CONCENTRATE

# EPIDEMIOLOGY

- Susceptibility: MALE = FEMALE
- URINARY OBSTRUCTION: MALE >>> FEMALE
  - Fattening
  - Urinary tract anatomy
- NO EFFECT OF AGE
- CASTRATION = NEGATIVE EFFECT

# INTRODUCTION

- DEFINITION
- EPIDEMIOLOGY
- **ETHIOPATHOGENY**
- CALCULI

# ETIOPATHOGENY

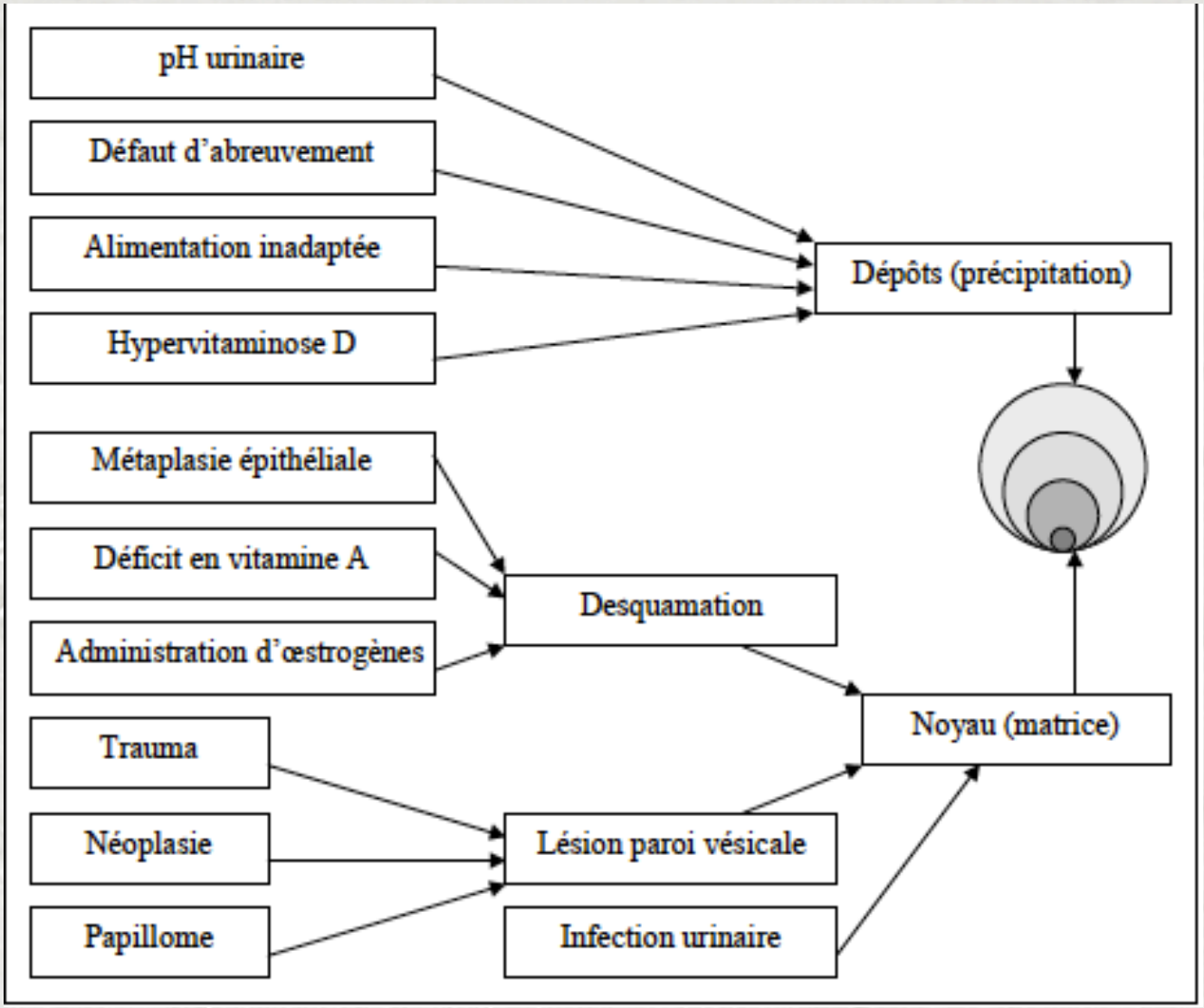
- CALCULI = ORGANIC x INORGANIC INTERECTION
  - ORGANIC = EPITHALIAL CELLS, PEPTIDES, MUCOPROTEINS
  - INORGANIC = MINERALS

- CALCULI FORMATION

1) ORGANIC NUCLEUS FORMATION
2) PRECIPATION MINERALS AROUND NUCLEUS
3) CONCRETION BY CEMENTING PRECIPITATED SALT

- FACTORS AFFECTING
  - NUCLEUS FORMATION ?
  - MINERALS PRECIPATION ?
  - CONCRETION?

# ETIOPATHOGENY



# ETIOPATHOGENY

## 1) ORGANIC NUCLEUS FORMATION

- EXCESSIVE EPITHELIAL DESQUAMATION
  - URINARY TRACT INFECTION
  - VITAMINE A DEFICIENCY
  - ADMINISTATION OF ESTROGEN

# ETIOPATHOGENY

## 2) INORGANIC PRECIPITATION

- INCREASED MINERALS INTAKE
  - Diet with HIGH % GRAIN (Ca, P, Mg)
  - Highly minarelized water
- INCREASED URINARY EXCRETION
  - PELLETS: ↘ saliva P excretion & ↗ P urinary excretion
- DECREASED WATER INTAKE
  - Urine concentration
- URINARY Ph
  - Alkaline = risk for phosphate & carbonate

# ETIOPATHOGENY

## 3) CONCRETION BY CEMENTING PRECIPITATED SALT

- HIGH CONCENTRATE DIET
  - MUCOPROTEINS AND PEPTIDES

# INTRODUCTION

- DEFINITION
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# CALCULI

- **STRUVITE**
  - **magnesium ammonium phosphate**
  - ✓ **more frequent in cattle**
  - ✓ **diet with HIGH grain proportion = LOW Ca:P**
  - ✓ **Pelleting = ↘ P salivary excretion**

- SILICA
  - grazing silica-rich soil
  - Cu & Zn deficiency
  - HIGH Ca:P
  - Western north-america

# CALCULI

- CALCIUM CARBONATE
  - Calcium rich diet
    - Subterranean clover


- CALCIUM OXALATE
  - Oxalate plant rich diet
    - Halogeton
    - Tops of common sugar beet

# UROLITHIASIS IN CATTLE

- INTRODUCTION
- **DIAGNOSIS**
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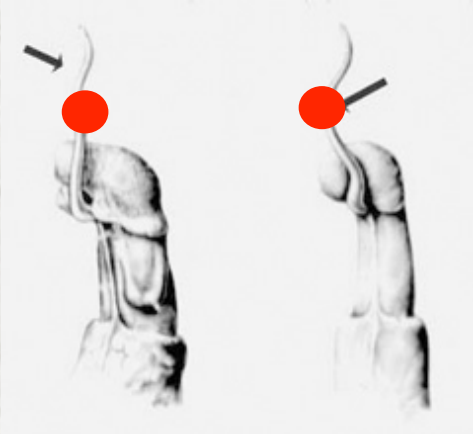
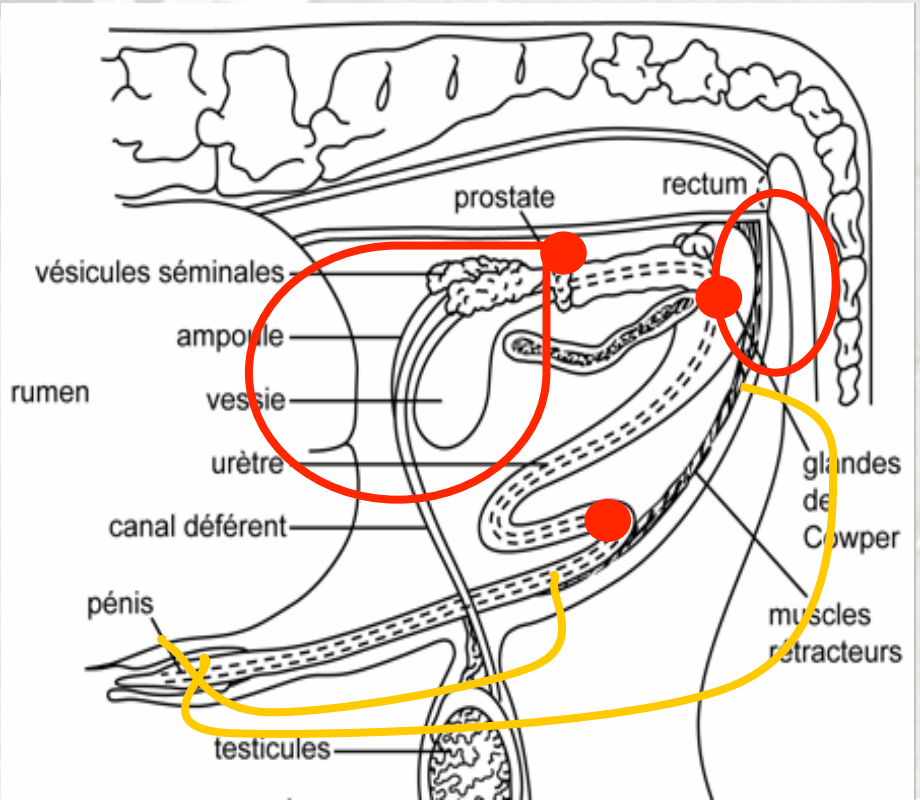
# CLINICAL EXAMINATION

- DEPENDING ON
  - Degree of obstruction
  - Location: ureter & kidney = UNCOMMON
  - Duration





# CLINICAL EXAMINATION

- ACUTE OBSTRUCTION = Unspecific
  - Anorexia
  - Abdominal pain: colic
  - Tenesmus
  - Dysuria, stranguria
  - Vocalization (goats)
  - Distended bladder
  - Dry penile air and uroliths

# CLINICAL EXAMINATION

- AFTER 2-3 DAYS of obstruction
  - Weakness, depression = UREMIA
  - Urethral rupture = Ventral abdominal swelling
    - ✓ HOT > COLD = NECROSIS
    - ✓ PAINFULL

# CLINICAL EXAMINATION

- AFTER 2-3 DAYS of obstruction
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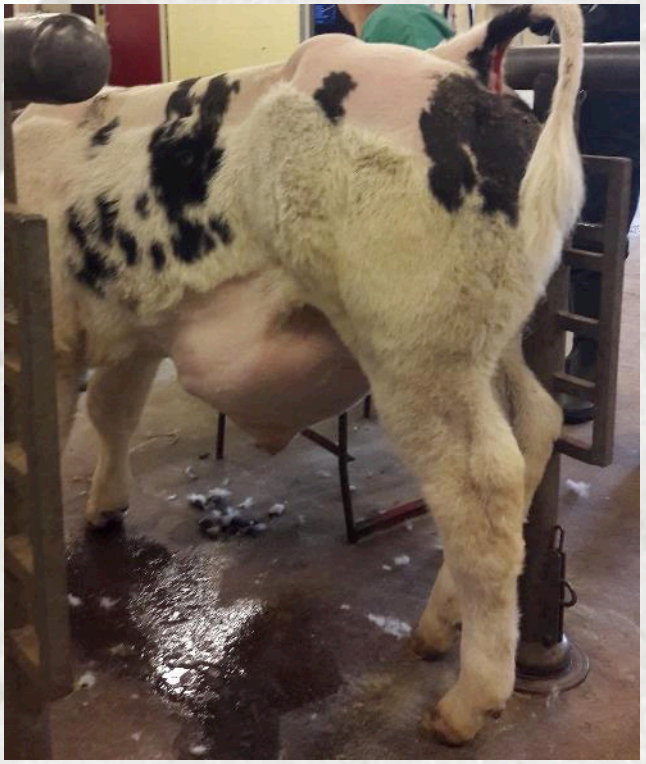


# CLINICAL EXAMINATION

- AFTER 2-3 DAYS of obstruction
  - Urethral rupture = Ventral abdominal swelling
    - ✓ HOT > COLD = NECROSIS
    - ✓ PAINFULL

# CLINICAL EXAMINATION

- AFTER 2-3 DAYS of obstruction
  - Perineal urethral distension
    - ✓Edema
    - ✓Tenesmus

# CLINICAL EXAMINATION

- AFTER 2-3 DAYS of obstruction
  - Bladder rupture (BULLS >>>> CALVES)
    - ✓ Abdominal distension
    - ✓ Liquid succussion

# ANCILLARY EXAMS

- HEMATOLOGY = unspecific

| PARAMETERS | VALUES ($10^9$/L) |
|---|---|
| WBC | 4,0 – 10,0 |
| Neutrophiles | 0,6 – 4,5 |
| Monocytes | 0,08 – 0,7 |
| Lymphocytes | 1,8 – 7,5 |
| Eosinophiles | 0,0 – 2,4 |
| Basophiles | 0,0 – 0,2 |

# ANCILLARY EXAMS

- BIOCHEMISTRY: INFLAMMATION
  - Total proteins:
    - ✓ serum > 81 d/l (No = 57 – 81)
    - ✓ E-fibrinogen: plasmatic – serum > 6 g/l

# ANCILLARY EXAMS

- BIOCHEMISTRY: INFLAMMATION
  - Glutal test (Glutaraldehyde)
    - ✓ ≤ 3 min: chronic inflammation
    - ✓ 3 – 6 min: inflammation
    - ✓ 6 – 15 min: suspected inflammation
    - ✓ ≥ 15 min: negative

# ANCILLARY EXAMS

- BIOCHEMISTRY: ELECTROLYTES
  - $Na^+$: 130 – 150 mmol/l
    - ↘ INTESTINE OR KIDNEY
  - $K^+$: 3,9 – 5,8 mmol/l
    - ↗ si ARI or UROPERITONEUM (acidosis, hemolysis)
    - ↘ DIET OR intestinal obstruction
  - $Cl^-$: 97 – 111 mmol/l
    - ↘ abomasum, acidosis
  - $Ca^{2+}$: 1,17 – 1,25 mmol/l
  - BE: +2 - +5 mmol/l
    - ↗ alkalosis
    - ↘ acidosis

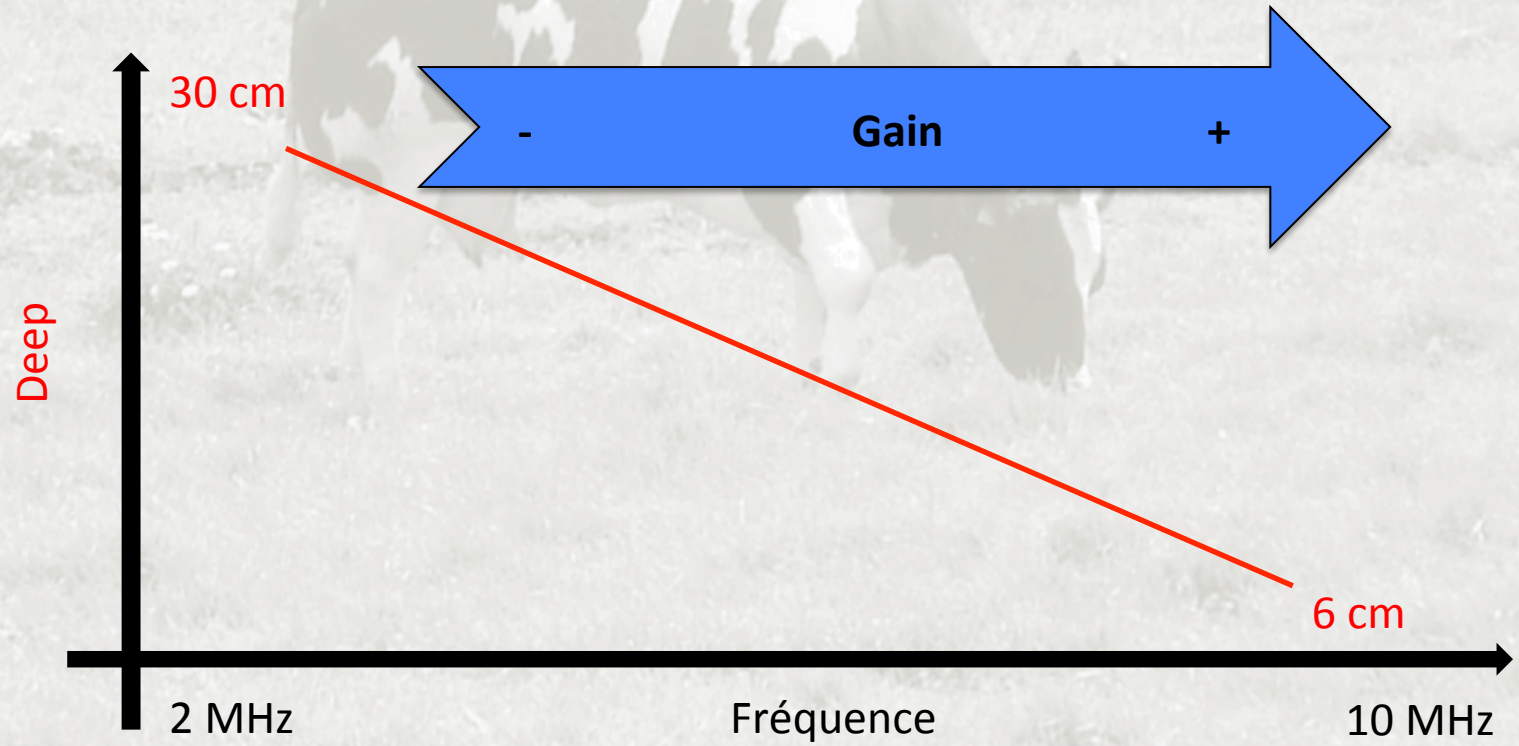
# ANCILLARY EXAMS

- BIOCHEMISTRY: RENAL FUNCTION
  - UREA
    - Normal range: 1,7 – 10,7 mmol/l (20-30 mg/dl)
    - ↗ si Dehydration, RI, UROLITHIAIS
  - CREATININE
    - Normal range: 88 – 176 µmol/l (1-2 mg/dl)
    - ↗ RI & UROLITHIASIS

**UREE x CREATININE > 9500 = POOR PROGNOSIS**

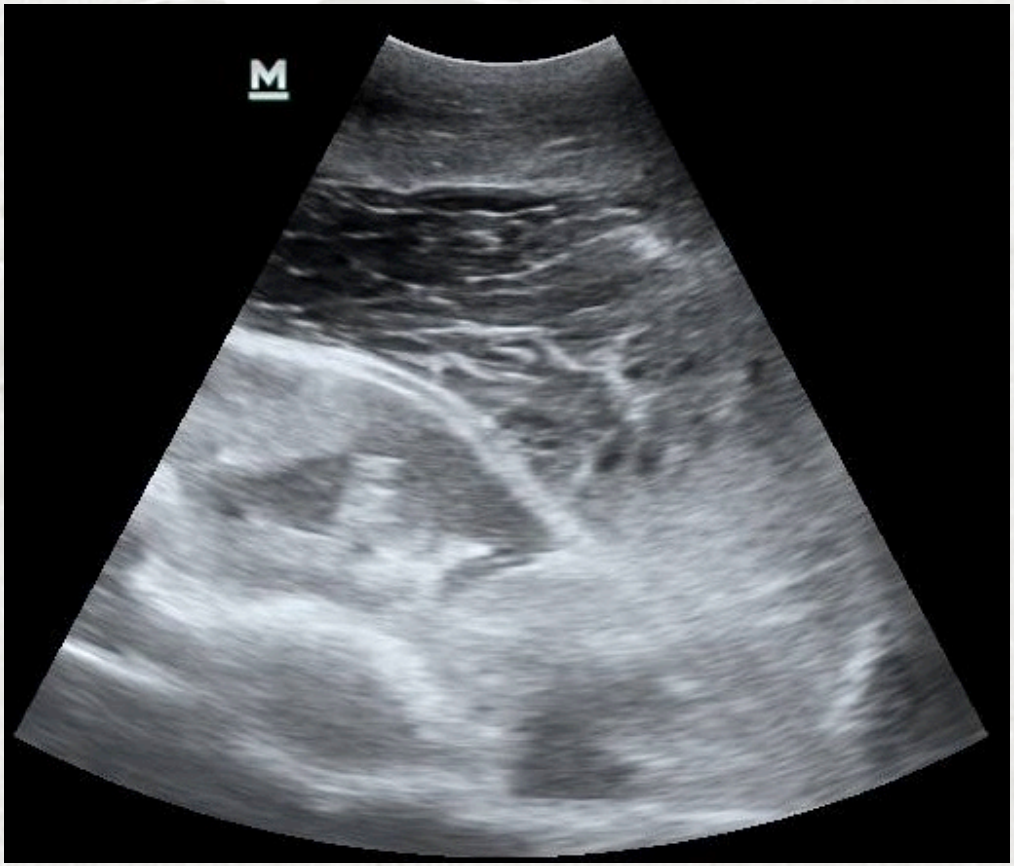
# ANCILLARY EXAMS

- DIAGNOSTIC IMAGING
  - Ultrasonography



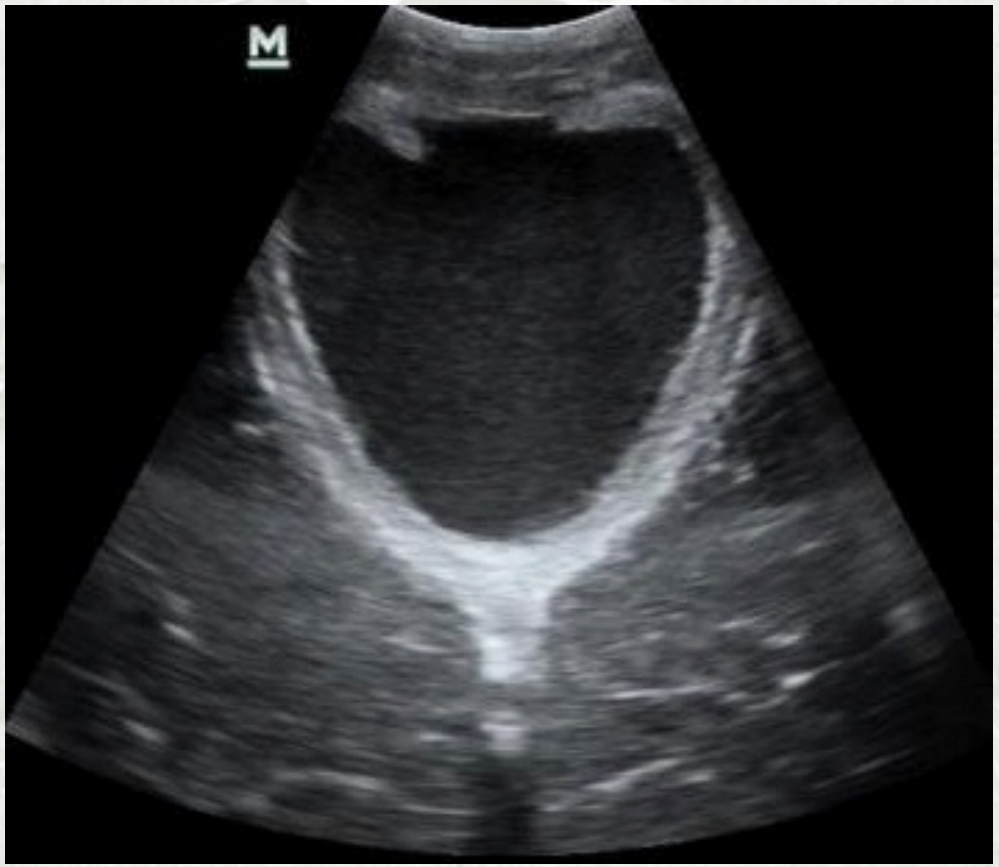
# ANCILLARY EXAMS

- ULTRASONOGRAPHY
  - Urethral rupture



# ANCILLARY EXAMS

- ULTRASONOGRAPHY
  - Perineal urethral distension



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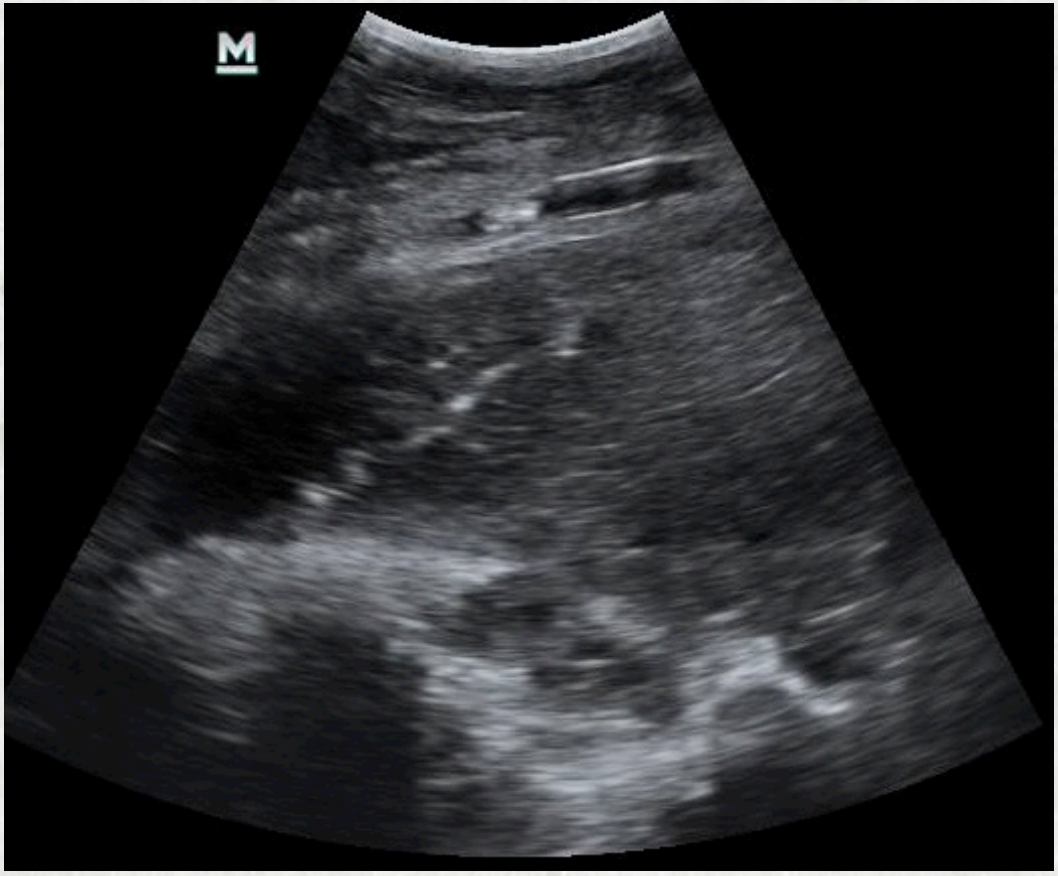
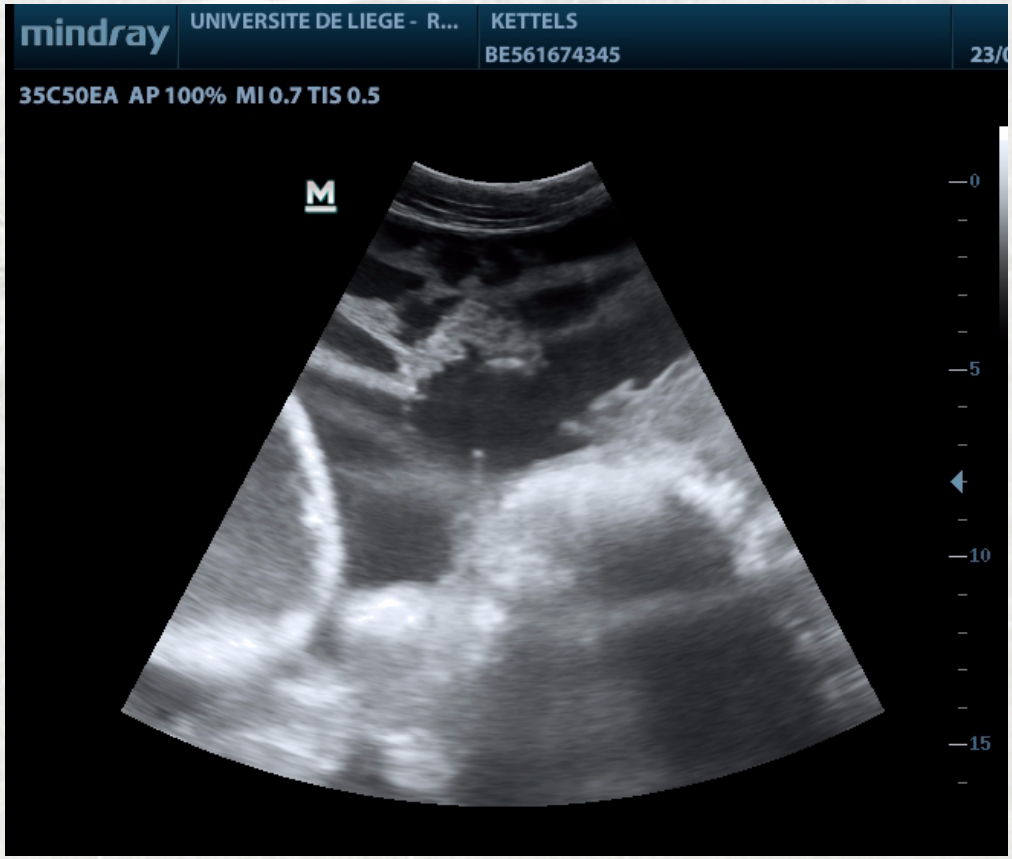


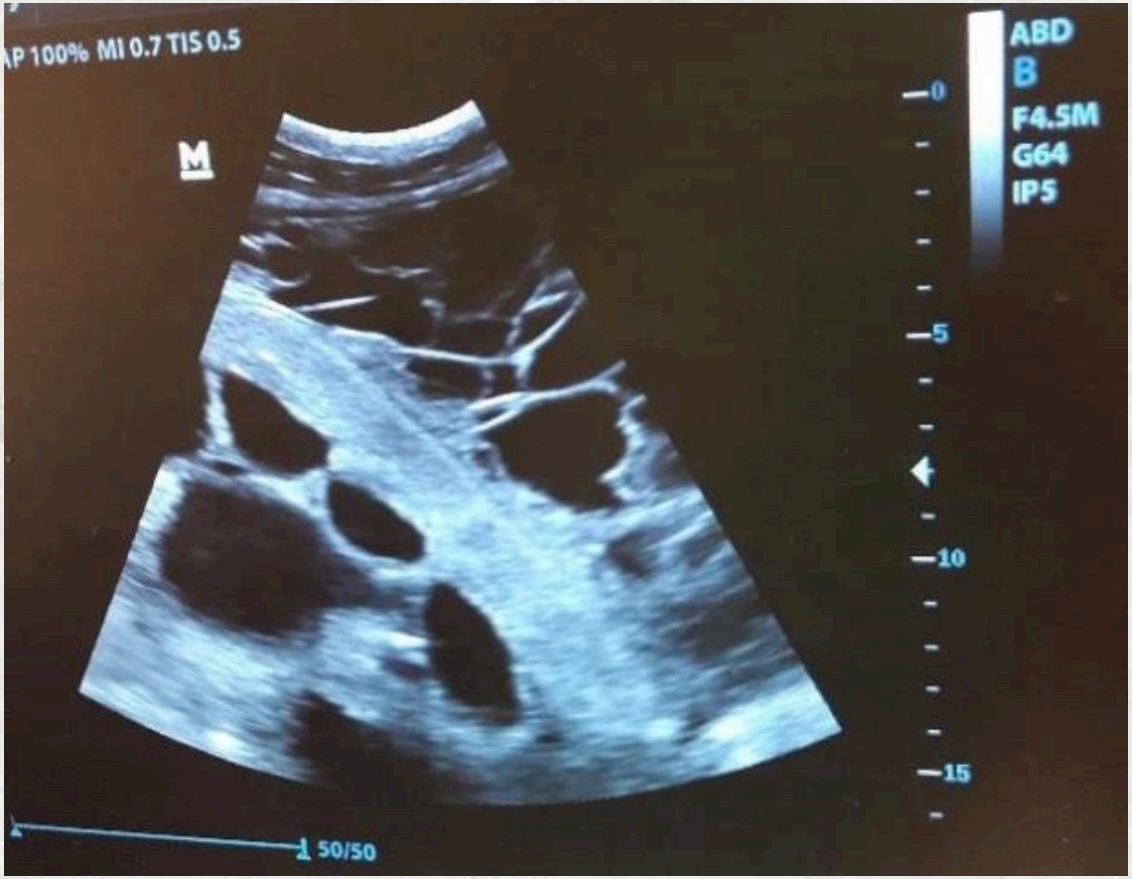
# ANCILLARY EXAMS

- ULTRASONOGRAPHY
  - Bladder rupture



# ANCILLARY EXAMS

- ULTRASONOGRAPHY
  - Hydronephrosis



# ANCILLARY EXAMS

- Paracentesis

# ANCILLARY EXAMS

- Paracentesis
  - Volume = 1 ml/kg
  - Glucose = 42 – 133 mg/dl
    - ✓↘ = septic peritonitis ( ≠ > 20 mg/dl)
  - Total proteins = 5 – 21 g/l
    - ✓↗ = peritonitis
  - Lactate = 0,19 – 1,31 mmol/l
    - ✓↗ ischemia
  - Creatinine
    - ✓si 2 x > blood creatinine = uroperitoneum
  - Inflammatory cells
    - ✓CMT

# UROLITHIASIS IN CATTLE

- INTRODUCTION
- DIAGNOSIS
- **PROGNOSIS**
- TREATMENT
- PREVENTION

Master Thesis,
Hélène Casalta

# Prognosis

To establish a **cut-off value** to orient medical and surgical care

*Which parameters could be analyzed?*

- Blood renal markers: Blood urea nitrogen (BUN), creatinine (CREAT)
- Abdominal ultrasound: renal modifications, uroperitoneum
- Non-specific markers of inflammation
  - ✓ Lactate
  - ✓ Fibrinogen
  - ✓ CR-P
  - ✓ …

# MATERIAL & METHODS

- Cattle referred for colic and anuria from 2005 to 2009 and from 2013 to 2017
- Signalment
- Clinical exam
- Biochemistry analysis: **BUN/CREA**
- Surgical treatment

OUTCOME: **DEAD** or **ALIVE**

SLAUGHTERHOUSE

CARCASS DISPOSAL

# MATERIAL & METHODS

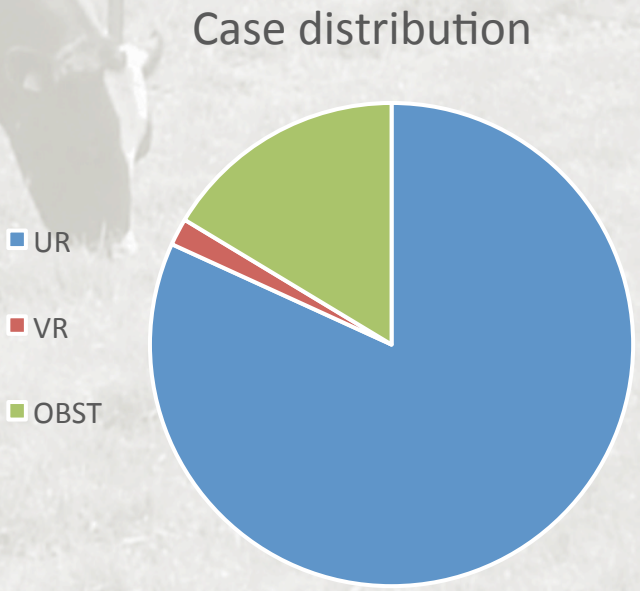
TREATMENTS:

- ✓ Surgical drainage
- ✓ Perineal urethrostomy
- ✓ Fluidotherapy (NaCl 0.9 %)
- ✓ NSAIDs, antimicrobials and vitamin C

# RESULTS

- SIGNALMENT
  - ✓ **54** Blue Belgian **males**
  - ✓ Mean age: **7 months** (1 to 36 months)
  - ✓ Mean body weight: **196kg** (88 to 844kg)

- CLINICAL SIGNSDepression
  - ✓ Colic
  - ✓ Abdominal swelling
  - ✓ Abdominal distension
  - ✓ Tenesmus



# RESULTS

- BUN/CREAT values:
  - ✓ Normal range BBCB:

BUN: 1,66 - 10,73 mmol/L

CREAT: 151 - 232 µmol/L

  - ✓ Results in the study:

| | | BUN (mmol/L) | CREAT (µmol/L) | BUN*CREAT |
|---|---|---|---|---|
| DEAD | median | 19.95 | 690.00 | 12800.85 |
| | average | 71.21 | 1030.85 | 80059.20 |
| ALIVE | median | 10.09 | 485.00 | 3992.06 |
| | average | 11.10 | 478.04 | 6232.37 |

- ✓ **82 %** of cattle **below** the BUN threshold are **alive** (18/22)
- ✓ Only **52 %** of cattle **above** the BUN threshold are **dead** (16/31)
- ✓ Results are worst using only CREA

# RESULTS

- SURGICAL MANAGEMENT:
  - ✓ 53 urethrostomies performed
  - ✓ 63 % OF SHORT-TIME SUCCESS
  - ✓ 37 % of death :
    - ➢ euthanized or died during hospitalization or surgery

# RESULTS

## ❑ LONG-TERM OUTCOME

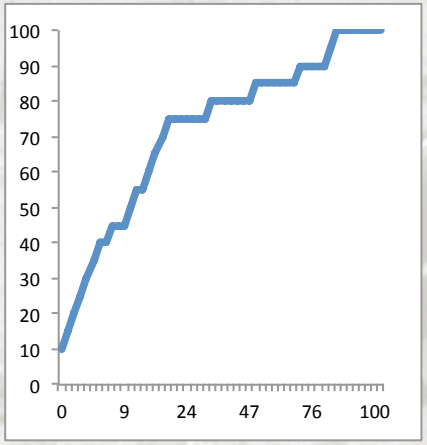
- ➢ 34 DISCHARGED FROM HOSPITAL

| | | < 1 MONTH | 1MONTH < x < 1 YEAR | > 1 YEAR | NO DATA |
|---|---|---|---|---|---|
| DEAD | SLAUGHTERED | 3 | 10 | 4 | 3 |
| | EUTHANATIZED | 2 | 2 | 0 | |

- ➢
- ➢ ALIVE (03.10.17): 5 > 4 months (1 recidive)

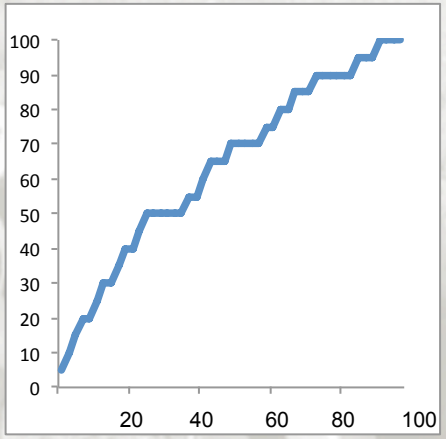
# RESULTS

## BUN



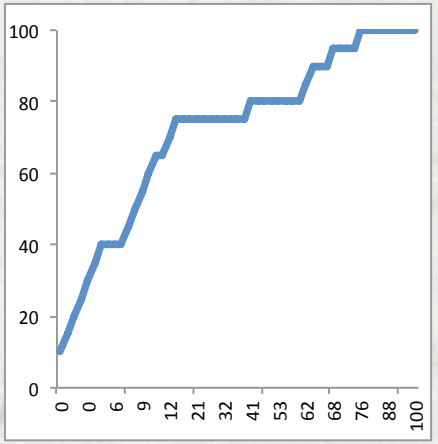

AUC = 80.2
CUT-OFF = 15.96
Se = 71 %
Sp = 84.3 %
Youden index = 0.63

## CREAT




AUC = 72.6
CUT-OFF = 747
Se = 50 %
Sp = 91.18 %
Youden index = 0.41

## BUN x CREAT




AUC = 81.2
CUT-OFF = 9637.28
Se = 75 %
Sp = 88.24 %
Youden index = 0.63

# RESULTS

PRELIMINARY RESULTS: TRANSABDOMINAL RENAL US

- ✓ Hydronephrosis (HN) could be a predictive factor
  - ➢ 58 % of bad outcome had HN

# DISCUSSION & CONCLUSION

- Surgical intervention must be ECONOMICALLY VALUABLE
- Need a prognosis factors to PREDICT OUTCOME
- The data BUN X CREA seems to be useful and can be easily set up at low cost
- It may be associated with OTHER PARAMETERS to improve sensitivity

# UROLITHIASIS IN CATTLE

- INTRODUCTION
- DIAGNOSIS
- PROGNOSIS
- **TREATMENT**
- PREVENTION

# MEDICAL TREATMENT

- ASSOCIATED WITH SURGICAL TREATMENT
  - IV FLUIDOTHERAPY:
    - ↘ BUN & K (bradycardia)
    - NaCl 0.9 %
    - Without OBSTRUCTION
  - ↘ URINARY pH:
    - Salt: 10-20 g/day/animal
    - Ammonium chloride: 200 mg/kg PO
  - BROAD SPECTRUM ANTIMICROBIALS
    - Beta lactamine
  - NSAIDs

# SURGICAL TREATMENT

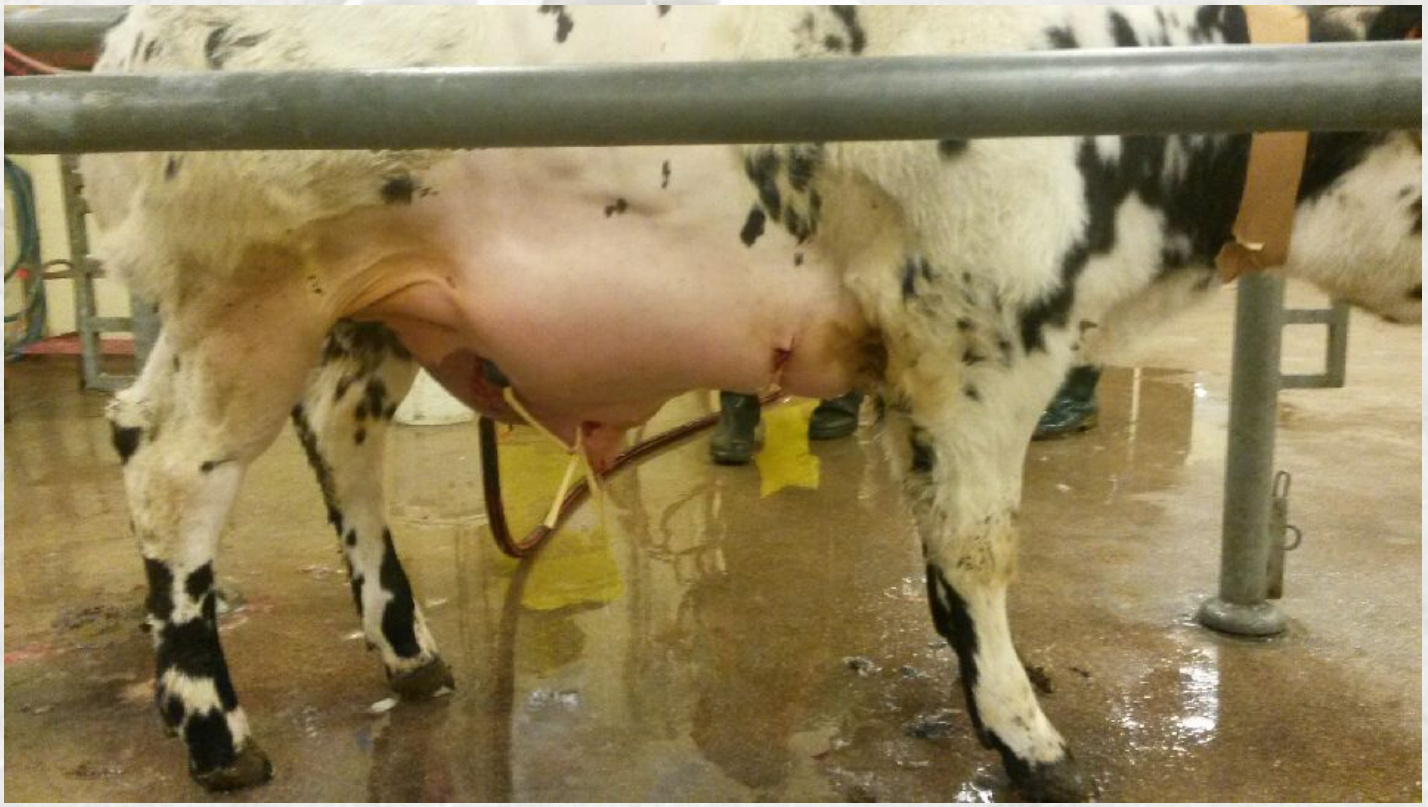
- URETHRAL RUPTURE
  - SURGICAL DRAINAGE
    - ✓ CLIPPING or SHAVING
    - ✓ SURGICAL CLEANING
    - ✓ LOCAL ANESTHESIA
    - ✓ CROSS INCISION
    - ✓ SOFT SUBCUTANEOUS DEBRIDMENT
    - ✓ PENROSE DRAINS PLACEMENT

# SURGICAL TREATMENT

- URETHRAL RUPTURE
  - SURGICAL DRAINAGE

# SURGICAL TREATMENT

- URETHRAL RUPTURE
  - SURGICAL DRAINAGE

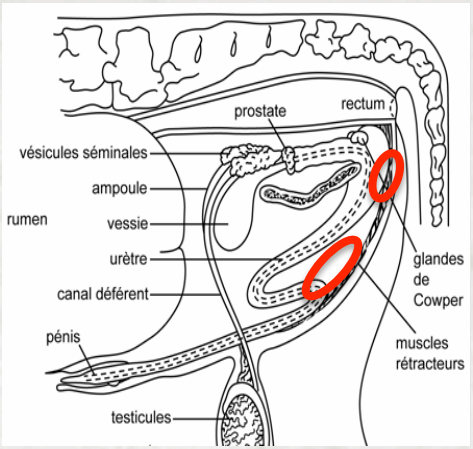


# SURGICAL TREATMENT

- URETHRAL RUPTURE
  - SURGICAL DRAINAGE

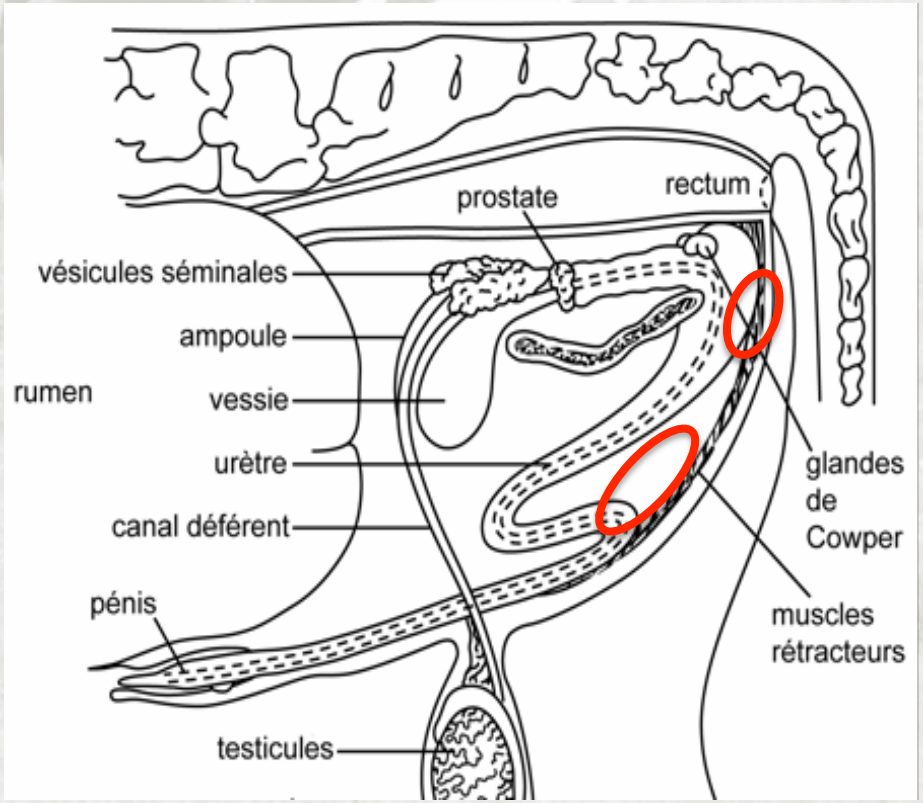
# SURGICAL TREATMENT

- URETROSTOMY
  - LOWER = ANTE-SCROTAL
    - ✓ urethral rupture
    - ✓ lateral or dorsal recumbency
    - ✓ sedation or general anesthesia
    - ✓ Double-muscled cattle
  - HIGHER = PERINEAL = urethral dilatation
    - ✓ urethral dilatation
    - ✓ standing cattle
    - ✓ epidural



# SURGICAL TREATMENT

- URETROSTOMY
  - LOWER = ANTE-SCROTAL
  - HIGHER = PERINEAL = urethral dilatation



# SURGICAL TREATMENT

- GENERAL ANESTHESIA
  - **Xylazine: 0,2 mg/kg, IM**

  ou Valium: 0,4 mg/kg, IM
  - Ketamine : > 15 min, 8 mg/kg, IM
  - Zolazepam-tilétamine: 3 - 6 mg/kg, IM
  - 40 – 45 min
- LOCOREGIONAL
  - **Epidural : procaïne 1 ml/100kg**

# SURGICAL TREATMENT

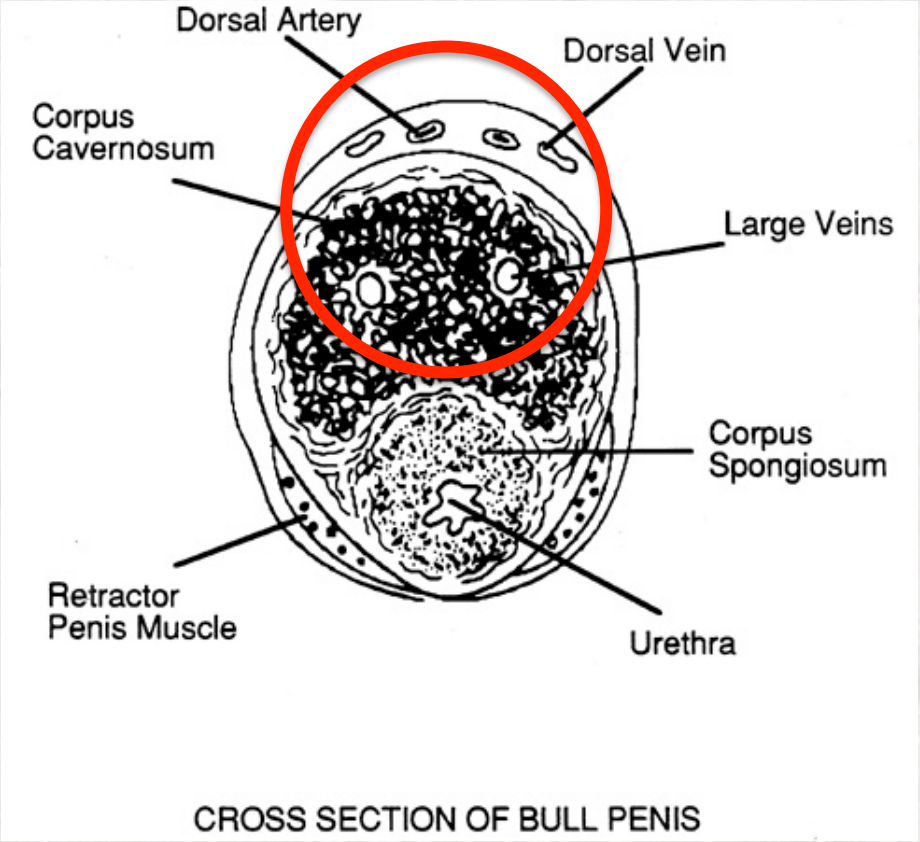
- ANTESCROTAL URETROSTOMY
  - with or without penil amputation
  - ✓ LATERAL OR DORSAL RECUMBENCY
  - ✓ CLIPPING & SURGICAL PREPRATION
  - ✓ SKIN INCISION (10 cm)
  - ✓ SOFT DISSECTION
  - ✓ PENILE LOCALIZATION
  - ✓ PENILE TRANSFICTION
  - ✓ PENILE SECTION

  } PENILE AMPUTATION

  - ✓ OPEN URETHRA (5 cm)
  - ✓ MARSUPIALIZATION = urethrostomy
    - non absorbable simple/continuous suture

# SURGICAL TREATMENT

- ANTESCROTAL URETROSTOMY



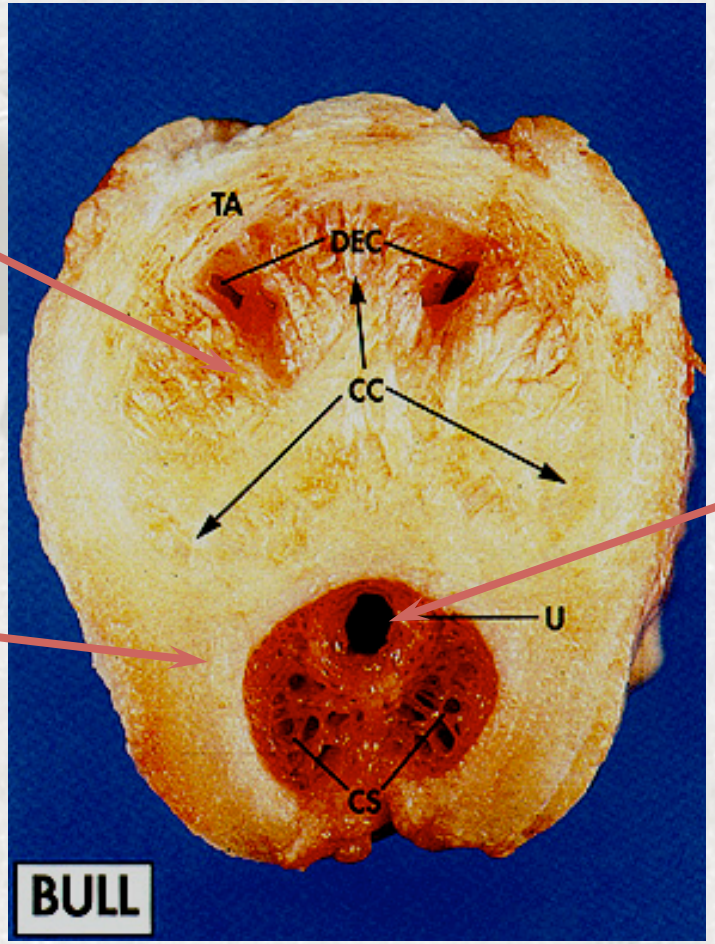

CROSS SECTION OF BULL PENIS

# SURGICAL TREATMENT

- ANTESCROTAL URETROSTOMY

Corpus Cavernosum

Corpus Spongiosum




Urethra

# SURGICAL TREATMENT

- ANTESCROTAL URETROSTOMY

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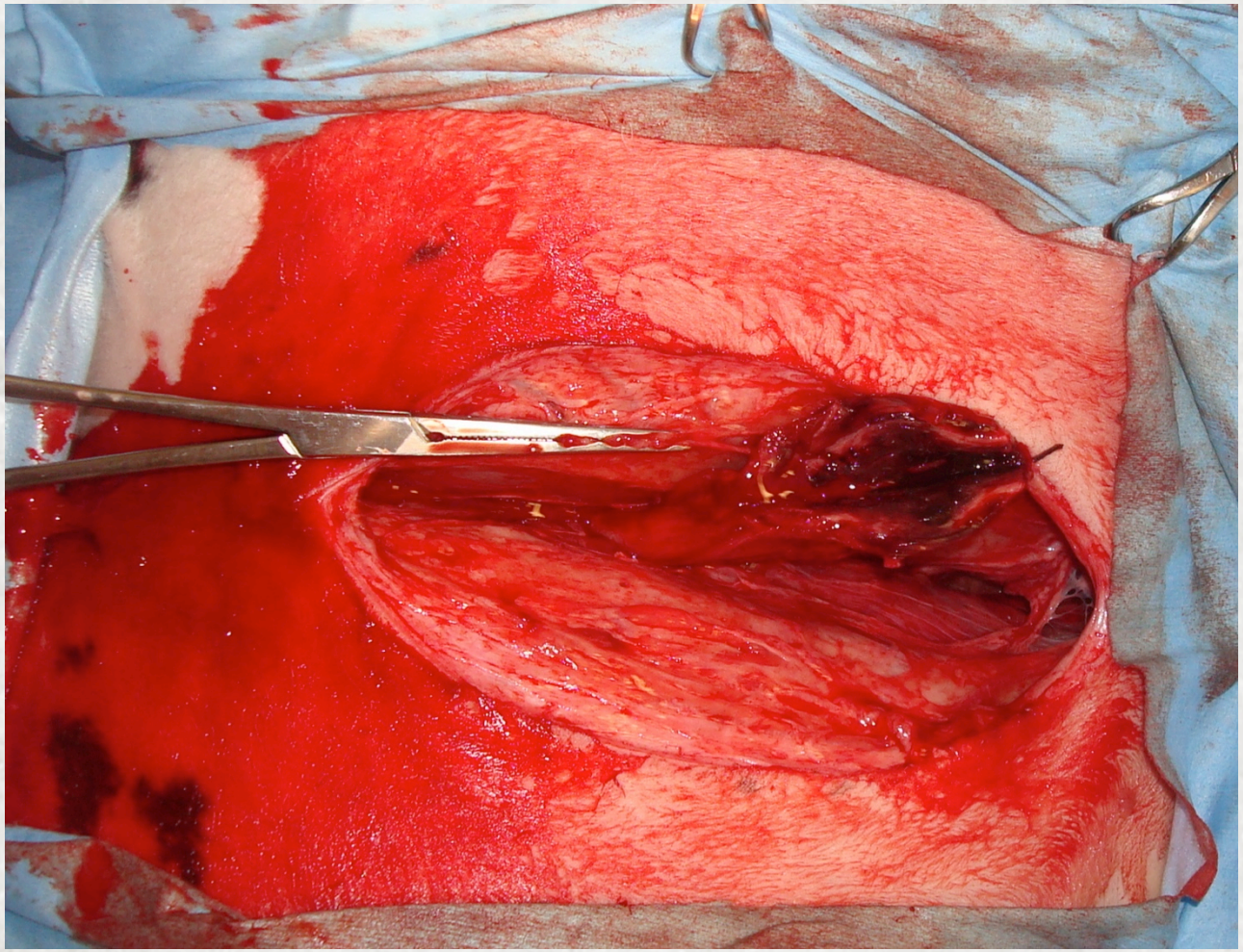
- ANTESCROTAL URETROSTOMY



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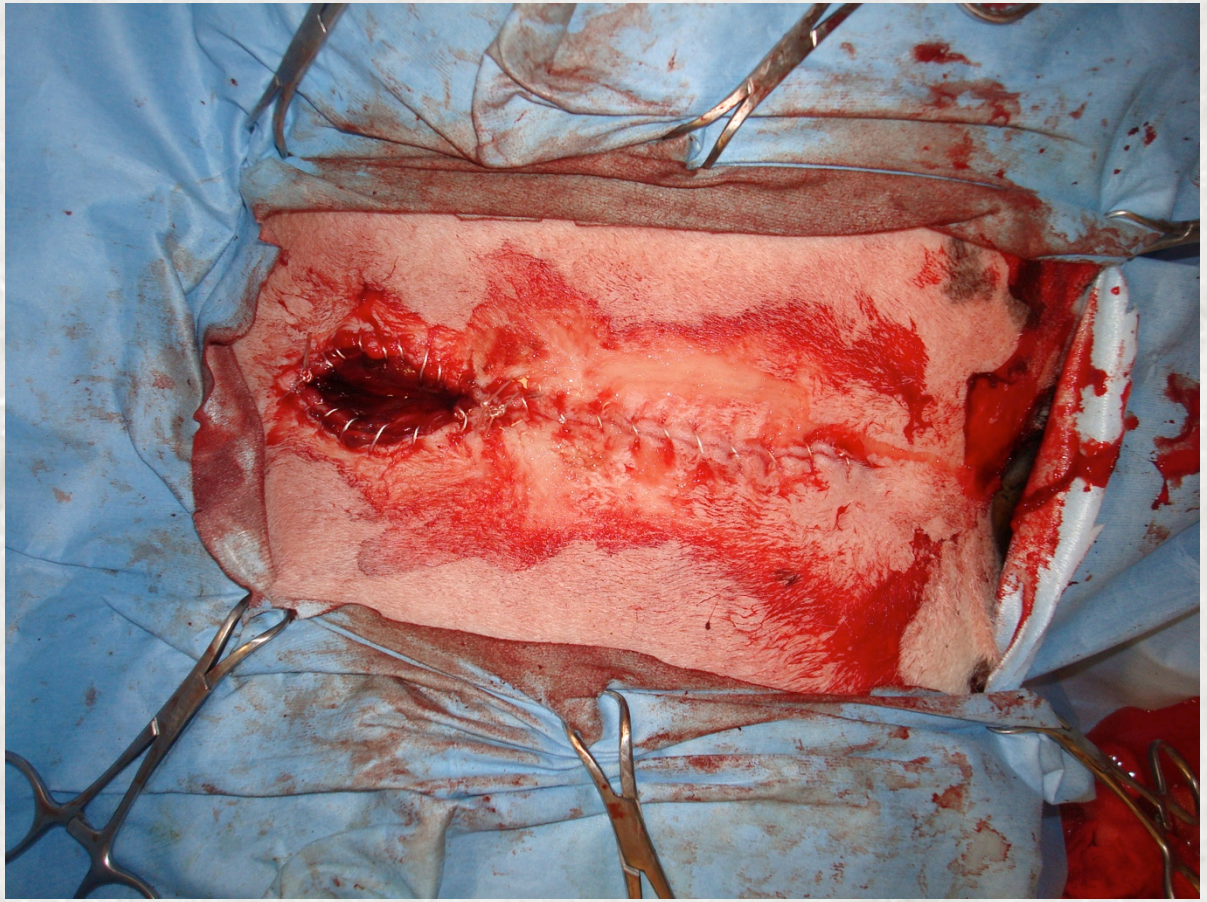


# SURGICAL TREATMENT

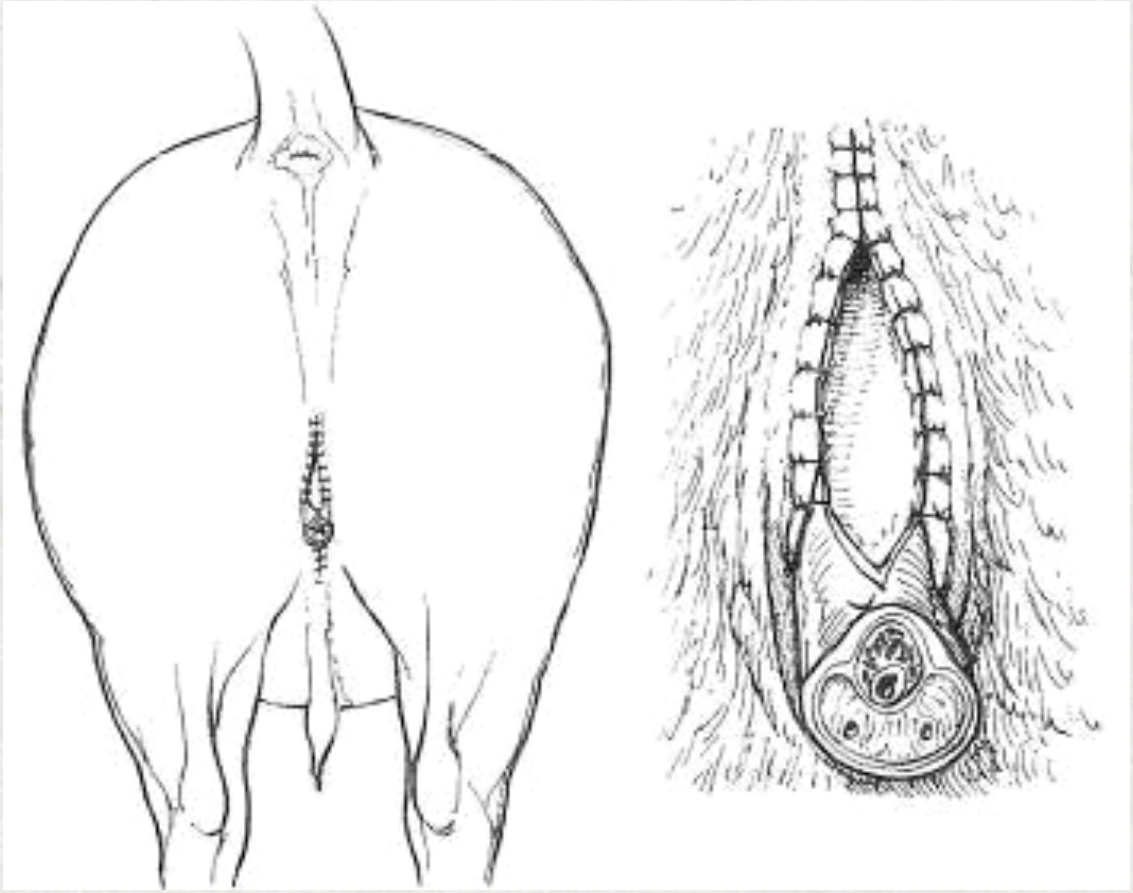
- ANTESCROTAL URETROSTOMY

# SURGICAL TREATMENT

- PERINEAL URETROSTOMY
  - ✓ CLIPPING & SURGICAL PREPARATION
  - ✓ SKIN INCISION (10 cm)
  - ✓ SUBCUTANEOUS DISSECTION
  - ✓ URETHROTOMY
  - ✓ MARSUPILAZATION

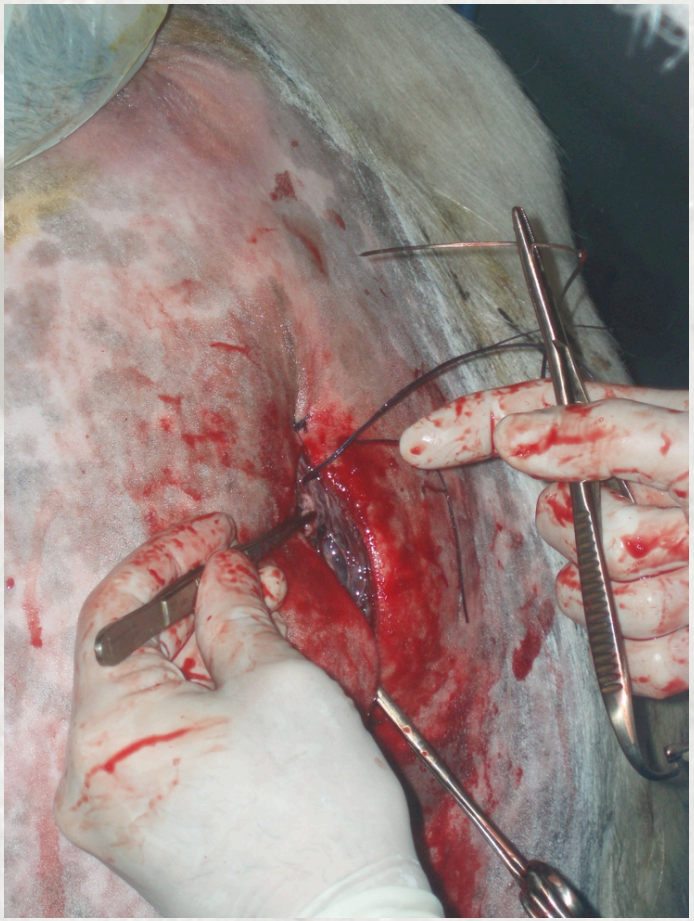
# SURGICAL TREATMENT

- PERINEAL URETROSTOMY
  - with penile amputation



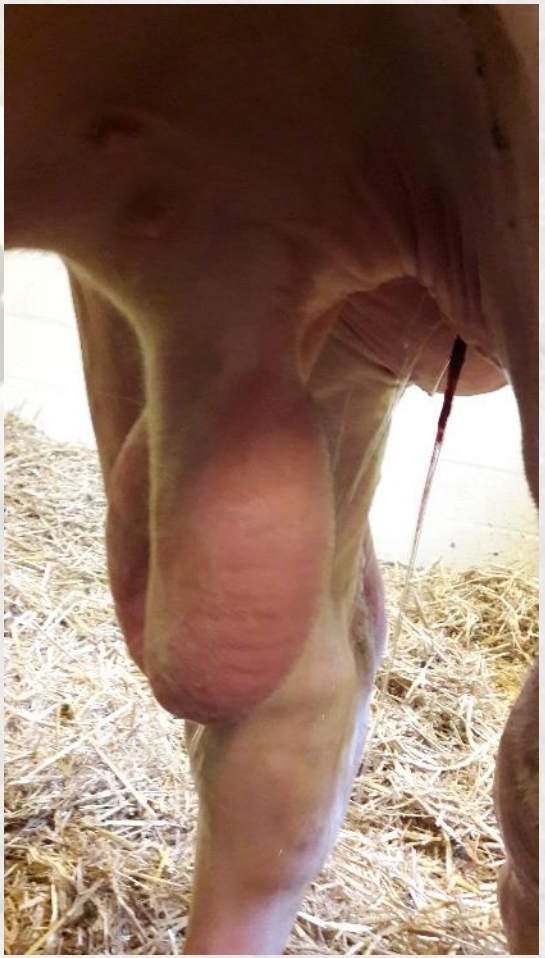
# SURGICAL TREATMENT

- PERINEAL URETROSTOMY



# SURGICAL TREATMENT

- POSTOPERATIVE CARE
  - CONTROL MICTION



# SURGICAL TREATMENT

- POSTOPERATIVE CARE
  - HYDROTHERAPY, CLAY & vaseline on urethrostomy

# SURGICAL TREATMENT

- POSTOPERATIVE CARE
  - DEBRIDMENT OF NECROSIS (hyperthermia)

# SURGICAL TREATMENT

- POSTOPERATIVE CARE
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# SURGICAL TREATMENT

- POSTOPERATIVE CARE
  - DEBRIDMENT OF NECROSIS

# SURGICAL TREATMENT

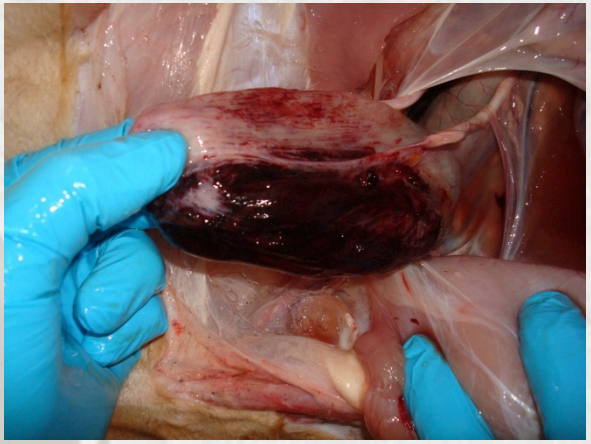
- POSTOPERATIVE CARE
  - Healing by 2nd intention

# SURGICAL TREATMENT

- URETHRAL PROCESS AMPUTATION: buck
- URETROTOMY
  - Calculi localization
  - Risk of stenosis
- ANTEPUBIC URETHROSTOMY
  - Poor prognosis
- CYSTOSTOMY TUBE
  - 2 or 3 weeks
  - Small ruminants
  - without urethral rupture
- CYSTOSTOMY
  - cystitis

# SURGICAL TREATMENT

- BLADDER RUPTURE / UROPERITONEUM
  - NO EFFICIENT TREATMENT
  - NECROTIC CYSTITIS
  - PERITONITIS
  - EXCEPT IF TRAUMATIC



# SURGICAL TREATMENT

| Technique | Avantages | Inconvénients |
|---|---|---|
| Pénectomie | - Simplicité de réalisation | - Strictions fréquentes et rapides<br>- Procédure de sauvetage uniquement |
| Urétrotomie | - Procédé simple<br>- Intéressant chez les reproducteurs car le pénis reste intact | - Résultats décevants à long terme car striction urétrale au niveau du site d'intervention |
| Urétrostomie périnéale | -Pas de sténose cicatricielle | - Résultats décevants à long terme car striction urétrale au niveau du site d'intervention<br>- Inadapté pour les animaux destinés à la reproduction à cause de la perte de perméabilité urétrale |
| Urétrostomie anté-pubienne | - Bons résultats à court terme<br>- Solution suite à un échec de la technique périnéale | - Résultats décevants à long terme car striction urétrale au niveau du site d'intervention<br>- Inadapté pour les animaux reproducteurs à cause de la perte de perméabilité urétrale<br>- Cystites récurrentes<br>- Infections urinaires ascendantes<br>- Hernies |
| Sonde de cystostomie | - La meilleure technique décrite<br>- Bons résultats<br>- Simplicité de réalisation<br>- Anesthésie de courte durée<br>- Restauration des capacités de reproducteur par conservation de la perméabilité urétrale<br>- Récurrences plus tardives<br>- Possibilité d'enlever les calculs | - Coût élevé car hospitalisation nécessaire<br>- Obstruction récurrente<br>- Irritation de l'urètre par les rinçages<br>- Cystite récurrente |
| Marsupialisation de la vessie | - Coûts moins élevés car hospitalisation moins longue que lors de pose de sonde de cystostomie<br>- Soins postopératoires réduits<br>- Peu de complications observées | - Succès modéré<br>- Perte de continence urinaire<br>- Brûlures par l'urine, odeur<br>- Striction au site d'abouchement<br>- Prolapsus vésical à travers le site de fistule<br>- Infections urinaires rétrogrades par le site de marsupialisation |
| Lithotripsie au laser par endoscopie | - Coût réduit<br>- Hospitalisation courte | - Peu décrite chez les ruminants |
| Greffe de muqueuse buccale | - Bonne cicatrisation<br>- Bonne survie à long terme | |

# UROLITHIASIS IN CATTLE

- INTRODUCTION
- DIAGNOSIS
- PROGNOSIS
- TREATMENT
- **PREVENTION**

# PREVENTION

" IN EMERGENCY = DIRECTLY"

- Control penile hairs
- Control water suppliers
- Table salt
  - 20 to 30 g/cattle/day salt
- Ammonium chloride
  - 30 to 40 g/day/cattle
  - PALATABILITY
- INCREASE roughage

# PREVENTION

"Economic & vital POOR PROGNOSIS "

"Sporadic BUT if ONE CASE CONTROL the others"

- RISK FACTORS
  - ✓ DIET
    - LOW Ca:P ratio or Excess P in diet
    - HIGH Mg intake
    - LOW fiber content
  - ✓ WATER INTAKE
  - ✓ URINE pH
  - ✓ CASTRATION

# CONTROL DIET

- Ca:P ratio
  - ✓ MAX 2.5:1 to 2:1
  - ✓ P: MAX 4g/kg DM(GRAINS HIGH LEVEL of P)
  - ✓ Ca: 4 and 7.5 g/kg DM
  - ✓ ↗ ROUGHAGE & ↘ PELLETS = ↗ P salivary excr.
- Mg
  - ✓ MAX 0.6 % TOTAL DIET
- Vitamines A & D

➢ FEED ANALYSIS: concentrates, roughage

# CONTROL WATER

- WATER FLOW
  - ✓ adult cattle: 10 l /min
  - ✓ Calves: ad libitum fresh water
  - ✓ FROZEN WATER
  - ✓ TEMPERATURE
  - ✓ ELECTROLYTES

# URINE pH

- URINE ACIDIFICATION
  - ✓ Ammonium chloride: 0.5-2 %
  - ✓ Calcium chloride: 1-2 %
  - ✓ Sodium chloride: 1-4 %
  - ✓ Monitoring of urine pH

# CASTRATION

- Castration
  - ✓ DECREASE URETHRAL DIAMETER
  - ✓ DELAYED CASTRATION

# TAKE HOME MESSAGE

- SPORADIC BUT 1ST URINARY DISEASE
- Economic, vital & reproductive POOR PROGNOSIS
- Sporadic BUT if ONE CASE CONTROL the others
- Surgical treatment is efficient BUT NO for long term
- NUTRITIONNAL/METABOLIC DISEASE
  - PREVENT IS BETTER TO CURE

**THANK YOU FOR YOUR ATTENTION...**

**ANY QUESTIONS...?**