

Common Surgical Procedures in Ferrets

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Preparation

- **Data base**
 - Depends on disease process
- **Short fast**
 - Rapid transit time
- **2.5% dextrose fluids**
 - Prone to hypoglycemia

Surgical Preparation

- Standard aseptic technique
- Clip fur
- Chlorhexidine alternating with sterile saline
- Prone to hypothermia



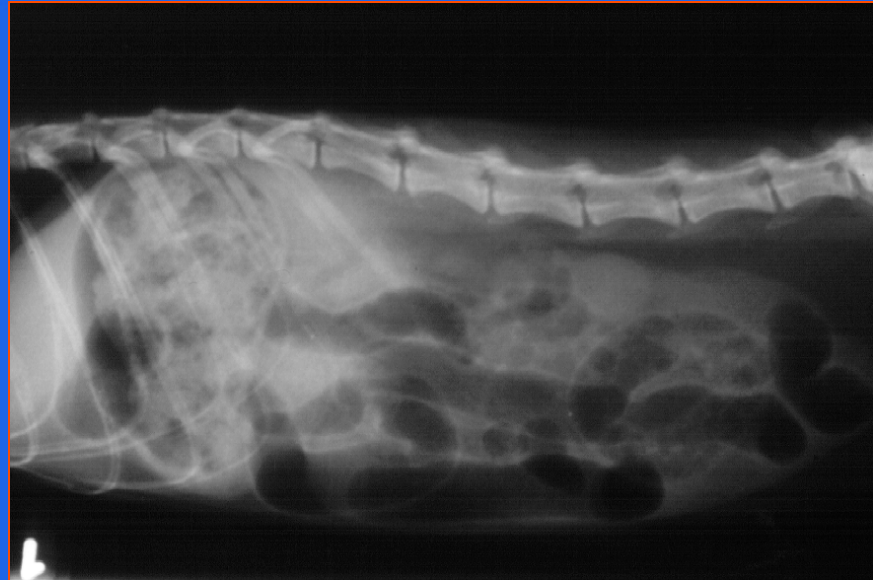
Postoperative Management

- Analgesia
- Rebound hyperthermia
 - Temperature gets very high
 - Not known to cause problems
- Peri-incisional bruising
 - Unknown cause



Gastrointestinal Foreign Bodies

- **Ingested foreign body**
 - < 1 yr age
 - Soft rubber
- **Trichobezoars**
 - Older ferrets



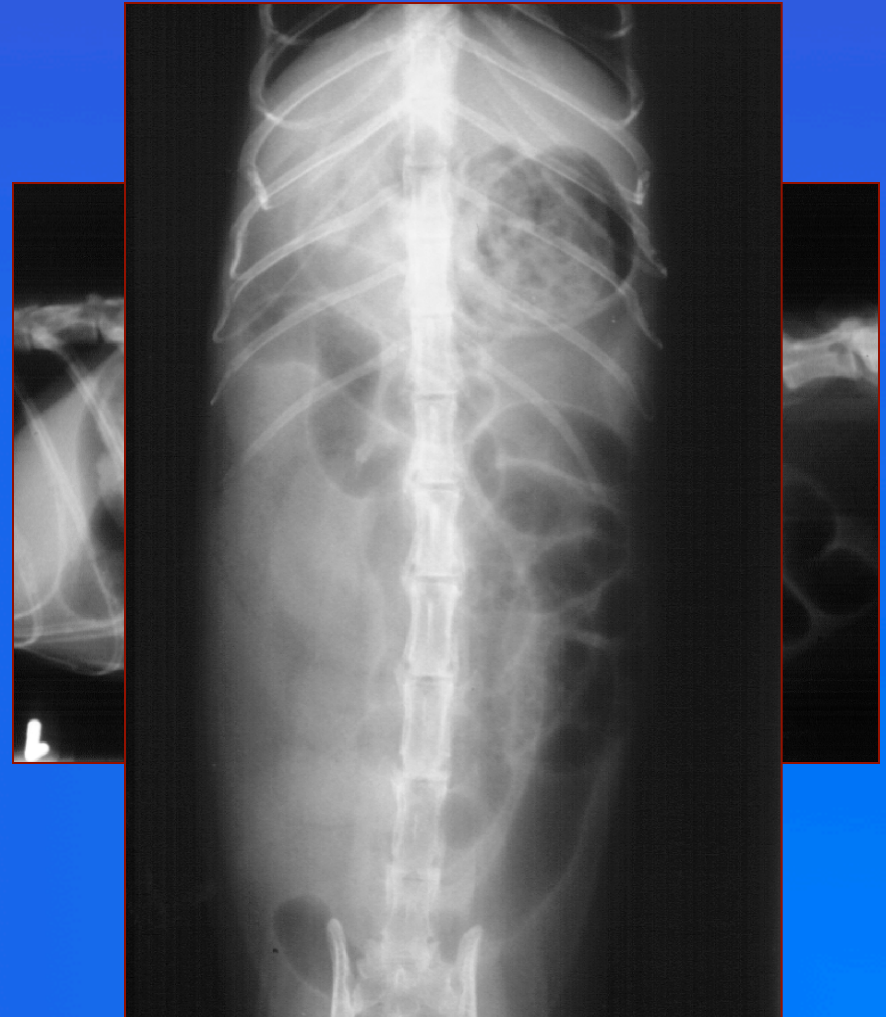
Gastrointestinal Foreign Bodies

- **Clinical signs**
 - Complete vs. partial
 - Anorexia
 - Depression
 - Melena
 - Vomiting (?)



Gastrointestinal Foreign Bodies

- **Diagnosis**
 - Palpation
 - Radiographs
 - Ultrasound
 - Very good
 - Contrast radiography
 - Barium swallow

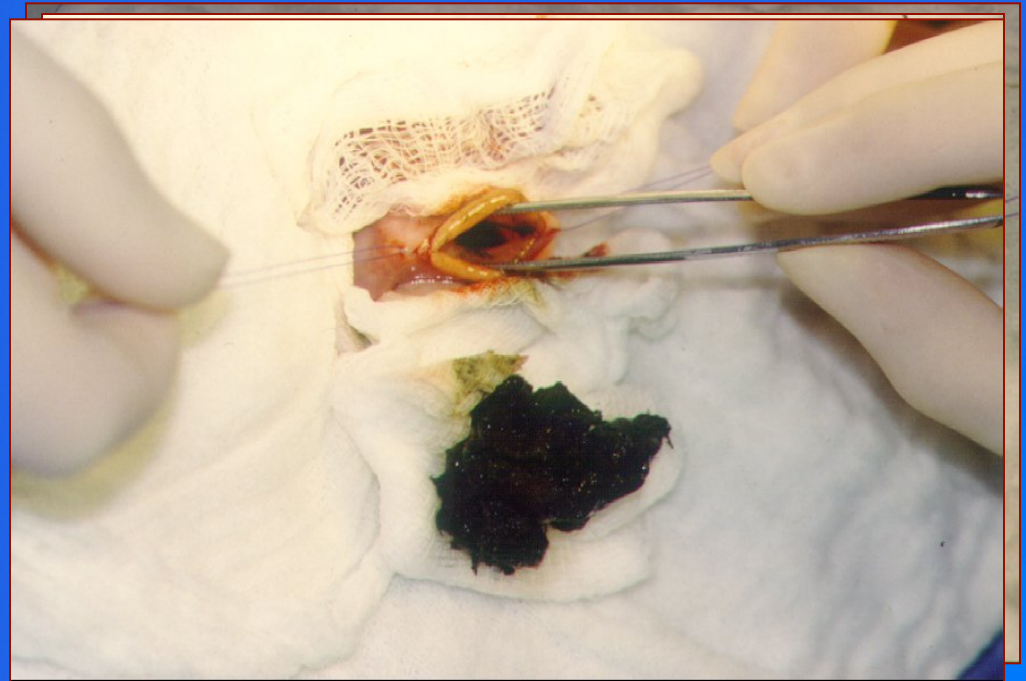


Gastrointestinal Foreign Bodies - Treatment

- **Laxatives?**
 - Not effective in most cases
- **Consider emergency?**
 - Not as urgent in ferrets as other species
- **Stabilize and rehydrate prior to surgery**
- **Complete exploratory**
 - May be concurrent problems

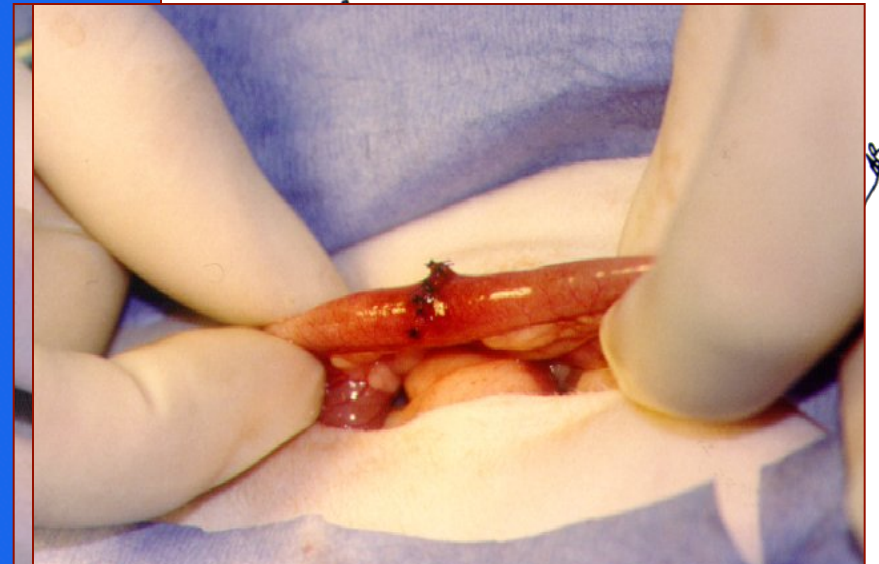
Gastric Foreign Bodies - Gastrotomy

- **Standard technique**
 - Lap pads
 - Evaluate mucosa
 - Biopsy
- **Two layer closure**
 - Simple continuous
 - Inverting



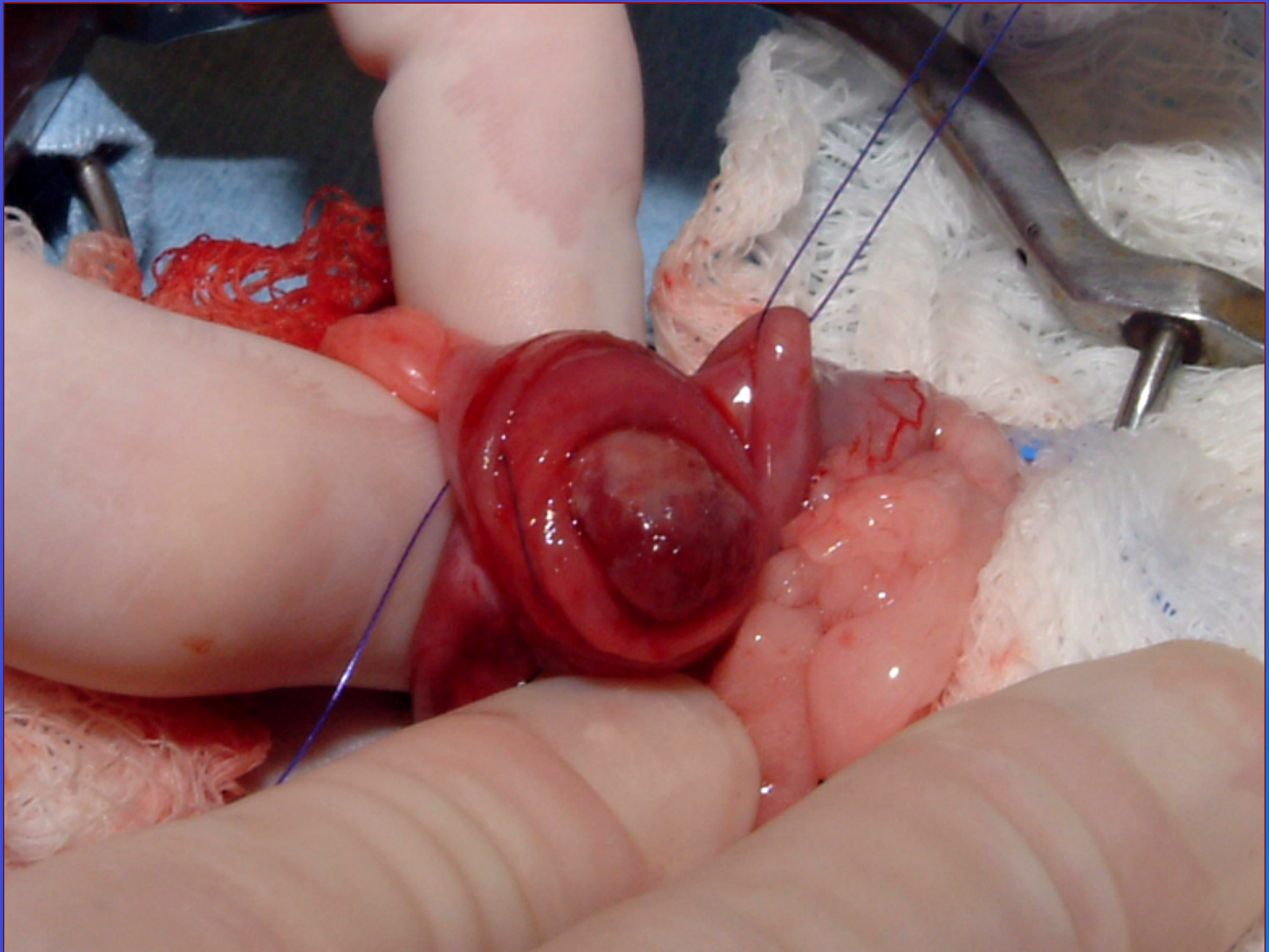
Intestinal Foreign Bodies

- **Enterotomy**
 - **Narrow diameter**
 - **Incision in healthy segment**
 - **Longitudinal antimesenteric incision**
 - **Transverse closure**



Gastric Adenocarcinoma

- **Probably most common GI neoplasm**
- **Consider partial gastrectomy**
 - **Billroth I**
 - **Can be difficult surgery**
 - **Must preserve duodenal papilla**
 - **Also difficult recovery**



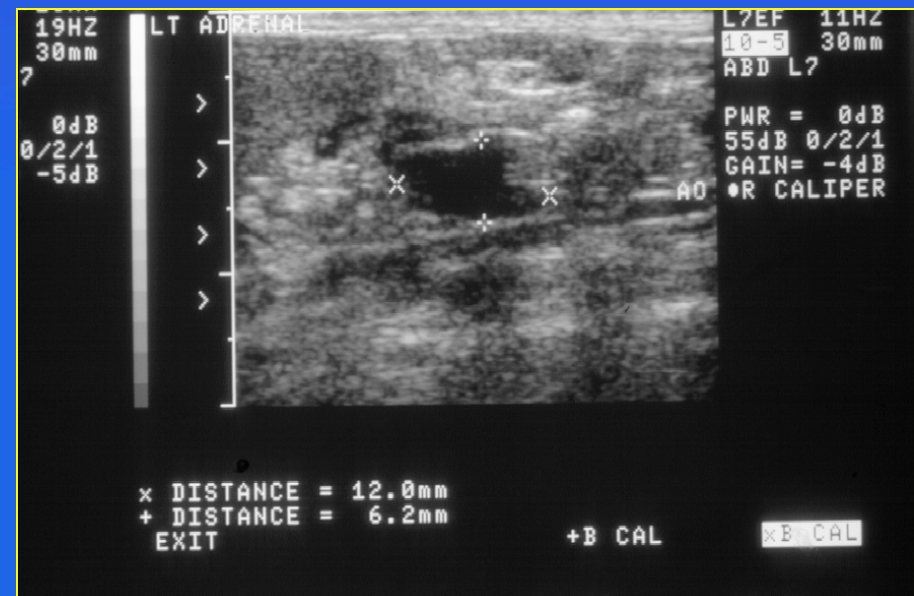
Adrenal Disease

- **Hyperplasia**
- **Adenoma**
- **Adenocarcinoma**
- **Does not involve
pituitary**
- **Metastasis
uncommon**



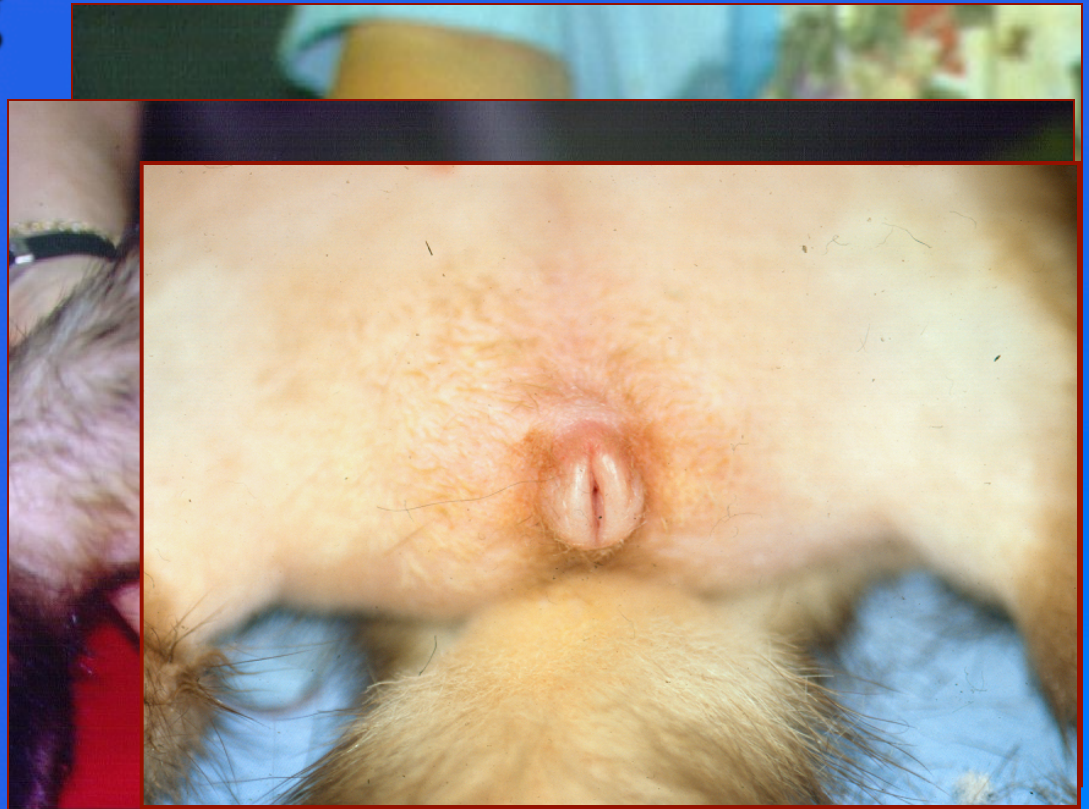
Adrenal Disease - Diagnosis

- History and physical
- Ultrasound
- Adrenal steroid panel
- Exploratory laparotomy



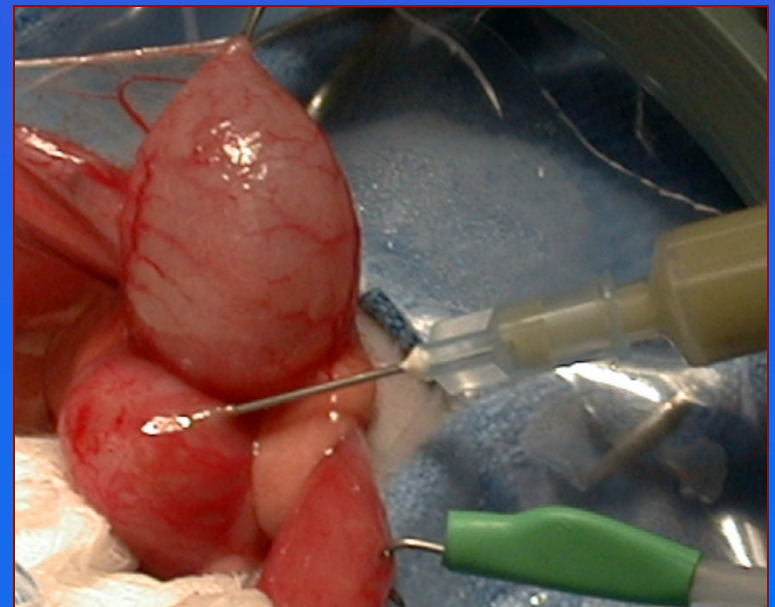
Adrenal Disease – Clinical Signs

- Alopecia
- Vulvar swelling
- Pruritus



Clinical Signs

- **Prostatic disease**
 - Unable to urinate
- **Behavior change**
 - Sexual behaviors
- **Concurrent insulinoma & splenomegaly**



Adrenal Disease - Treatment

- **Medical**
 - Mitotane
 - Flutamide
 - Luprolide acetate
 - Melatonin
 - Deslorelin
 - Others

 - Not shown to cure or reverse tumor growth
- **Surgical**
 - Excision
 - Potential to cure
 - Freezing
 - More complications
 - Debulking
 - Recurrence

Adrenals

Normal

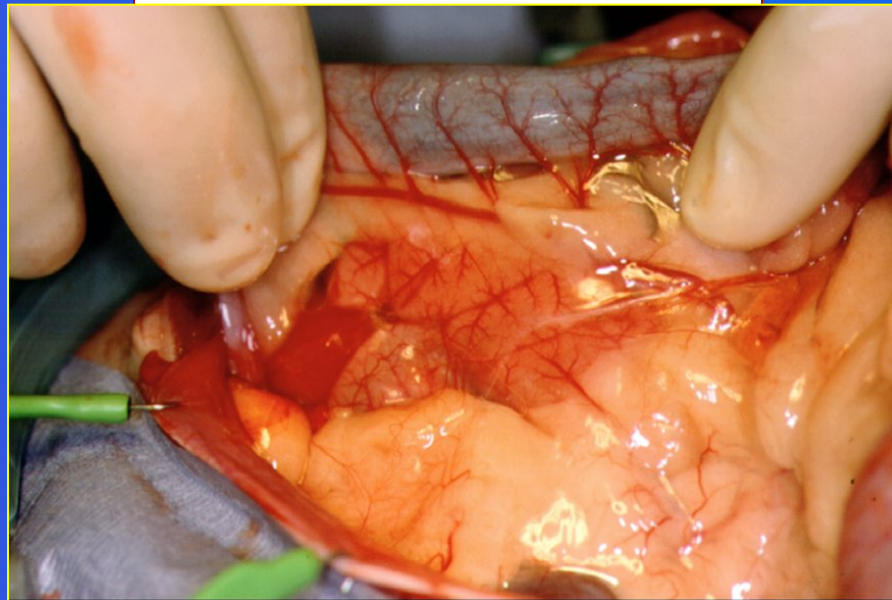
- 2-4 mm x 6-8 mm
- Light pink
- Homogenous

Abnormal

- Lumps
- Firm areas
- Cysts
- Discolored areas
- Gross enlargement

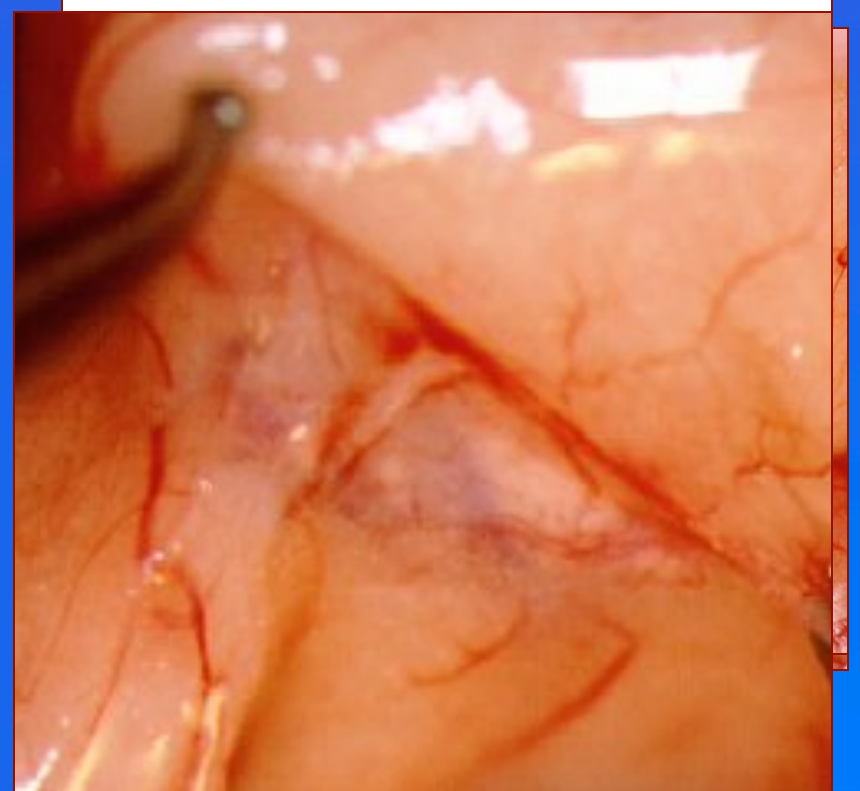
Adrenal Surgery

- Complete exploratory
- Residual / ectopic ovarian tissue
- Left easier to remove
- Right adhered to caudal vena cava



Left Adrenalectomy

- **Craniomedial to kidney**
- **In lumbar fat**
- **Incise peritoneum to inspect**
- **Dissect fat**
- **Evaluate entire gland**



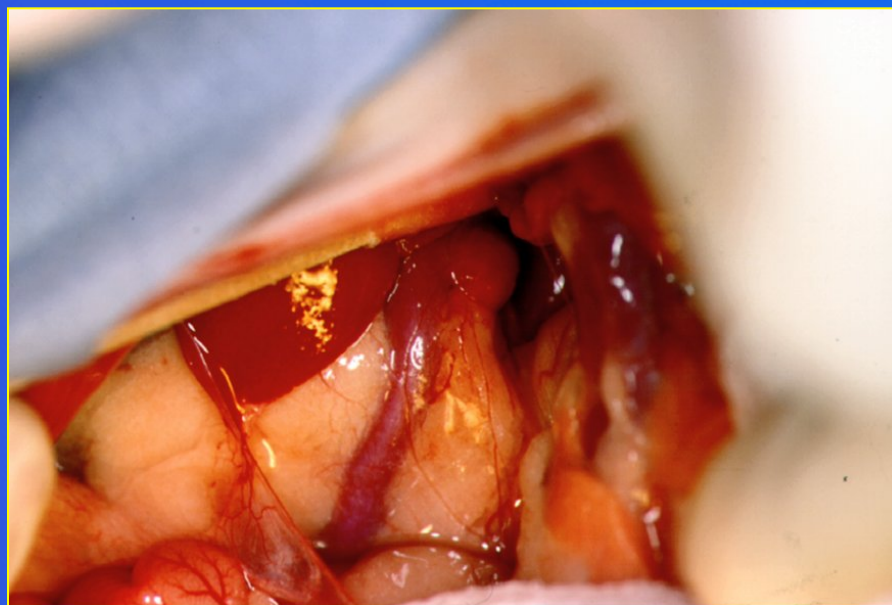
Left Adrenalectomy

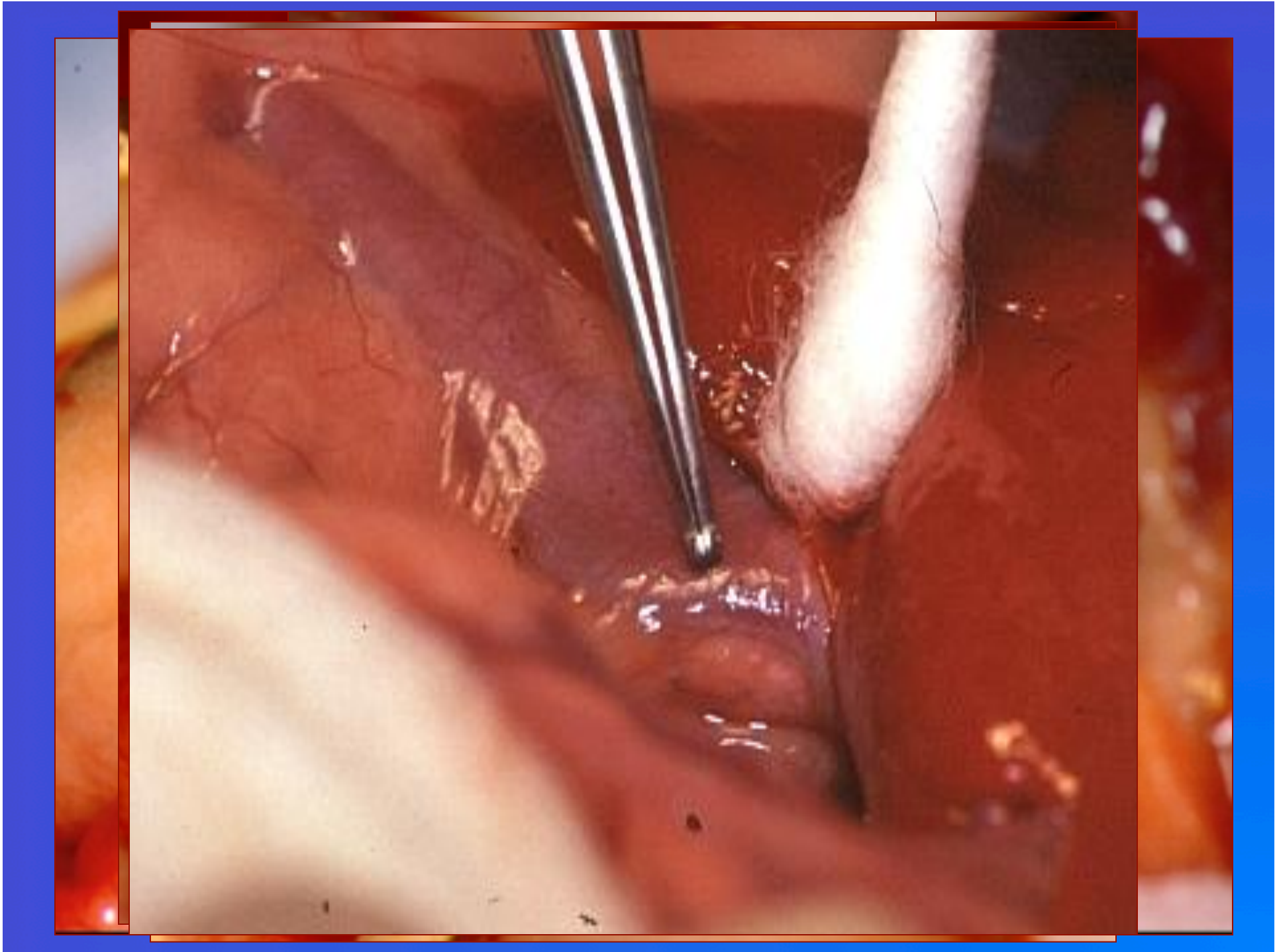
- Adrenolumbar (Phrenicoabdominal) vein
- Ligate or clip on each side
- Transect vein on each side
- Renal artery and vein
- Caudal vena cava



Right Adrenalectomy

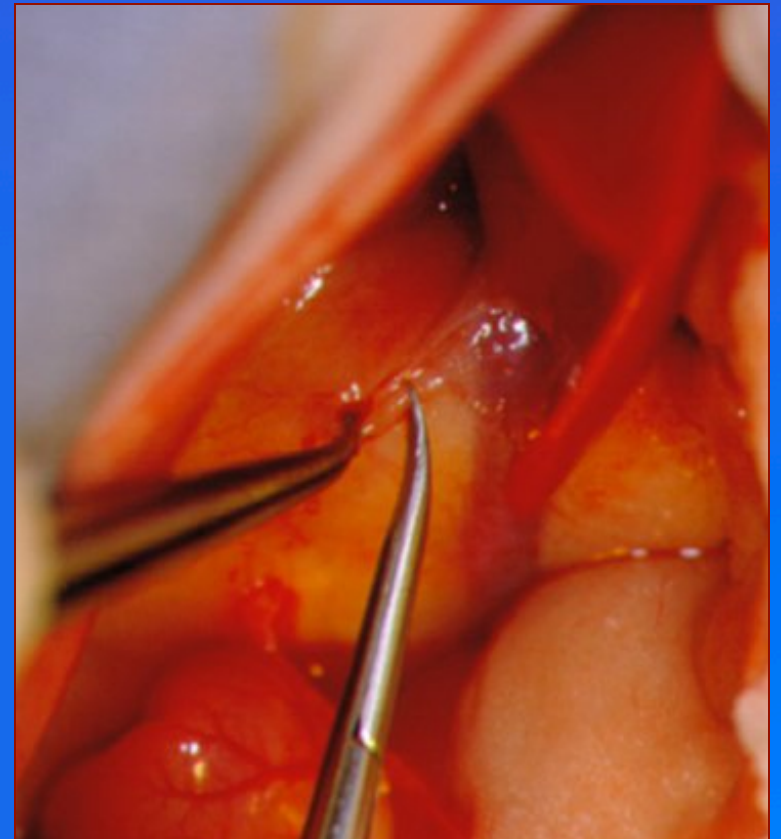
- Under caudate lobe of liver
- Hepatorenal ligament
- Right and dorsal to caudal vena cava
- Can visualize on left of caudal vena cava

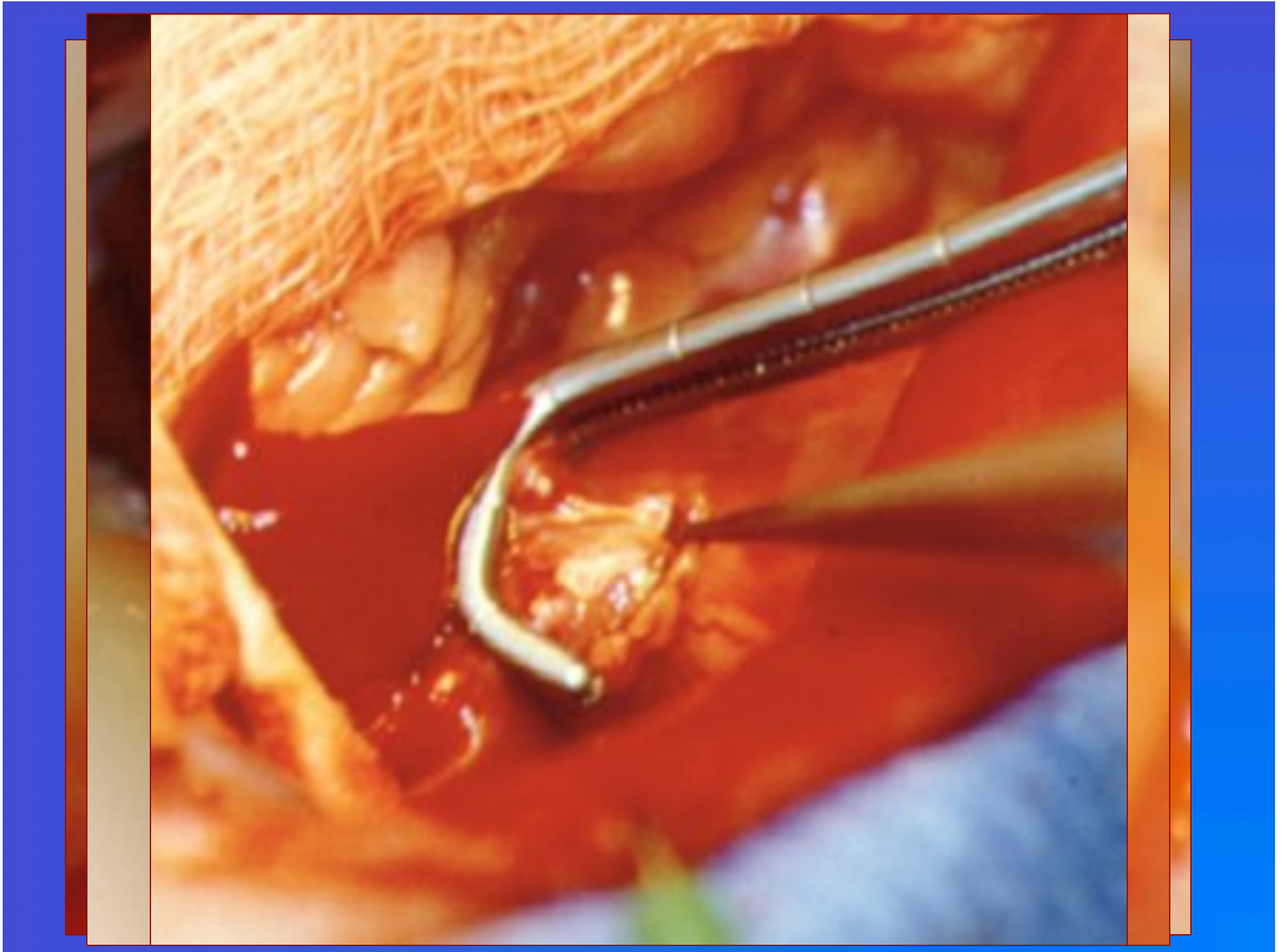




Right Adrenalectomy

- **Open peritoneum**
- **Dissect free from attachments**
- **Vascular clamps**
- **Magnifying loupes**

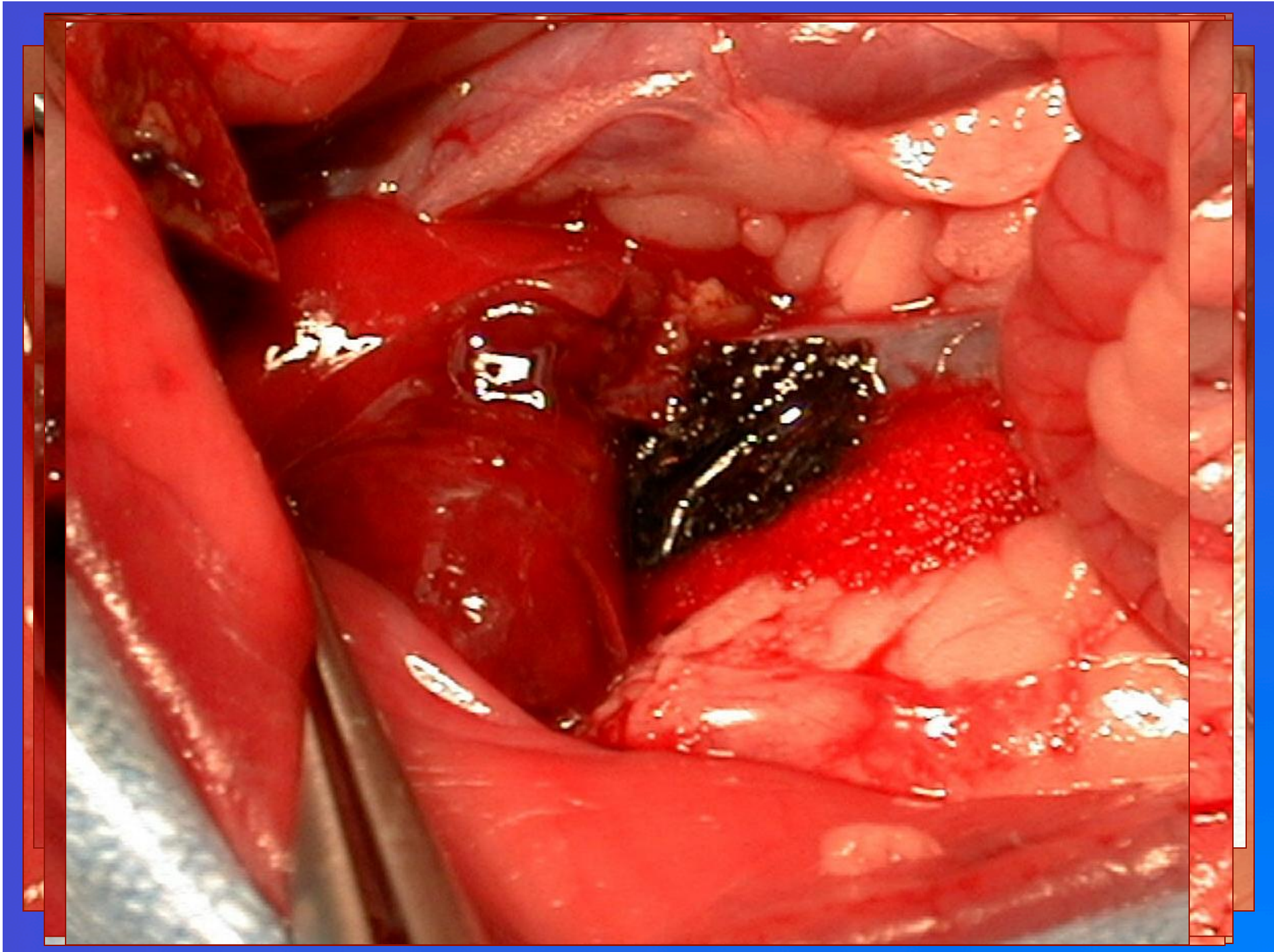




Right Adrenalectomy

- Identify dissection plane
- Dissect off the caudal vena cava
- Inspect for defects in the caudal vena cava
- Suture any holes
- Hemostatic aid
 - Surgicel
 - Gelfoam





Temporary Caval Occlusion

- **Vascular clamps do not damage vessel wall**
- **90 minutes without complications**
- **As short of a time as possible**
- **Do not rush!**

CVC Ligation

- **Reported complications in dogs and humans**
 - **Hind limb edema**
 - **Varicose veins of the abdominal vasculature**
 - **Nephrotic syndrome**
 - **GI dysfunction**
 - **Lumbar pain**

Caval Ligation

- **Anecdotal reports**
 - 75% survive
 - Clinical signs
 - Renal failure
 - Ascites
 - Hind limb edema
- **Similar to dogs and humans**

My Research - Caval Occlusion

- **8 ferrets – 4 males and 4 females**
- **Balloon tip catheter cranial to renal veins**
- **Contrast medium bolus to assess location**
- **Inflated balloon to stop blood through vena cava**
- **Left inflated 30 min.**

Angiography and CVCP Measurements

- **Venogram at 5 and 15 minutes post balloon inflation**
- **CVCP measurements at 0, 1, 2, 3, 4, 5, 10, 15 and 20 minutes post balloon inflation**

Caval Occlusion

- **All diverted blood through vertebral sinuses**
- **1 male and 1 female severe caval hypertension**
- **All survived 30 min without complications**
- **All adopted**

Collateral Circulation

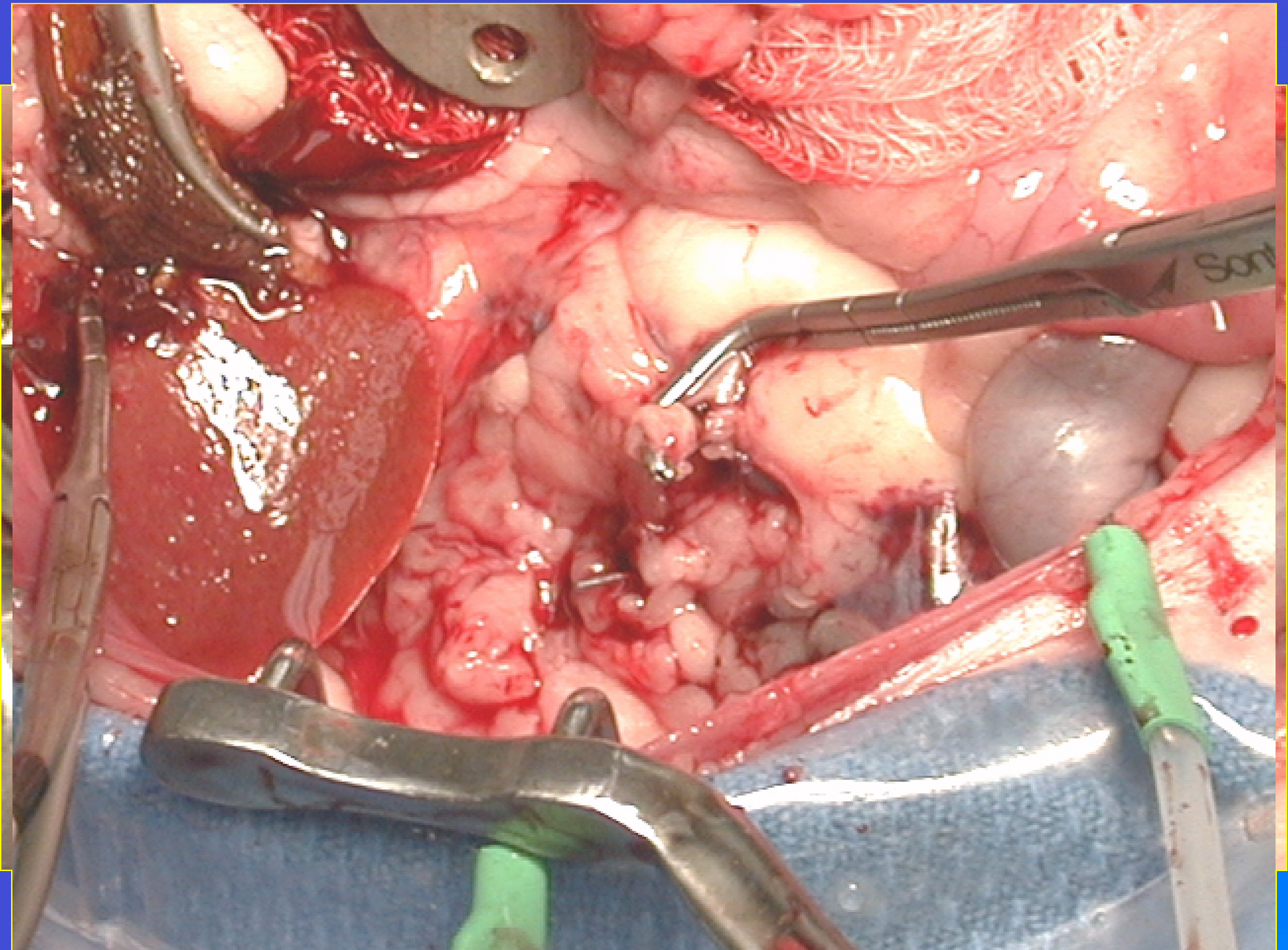
- **All ferrets had collateral circulation**
 - **Lumbar veins**
 - **Vertebral sinus**
 - **Azygous vein**
 - **Cranial vena cava**
 - **Heart**

Male Ferret

Balloon
Catheter

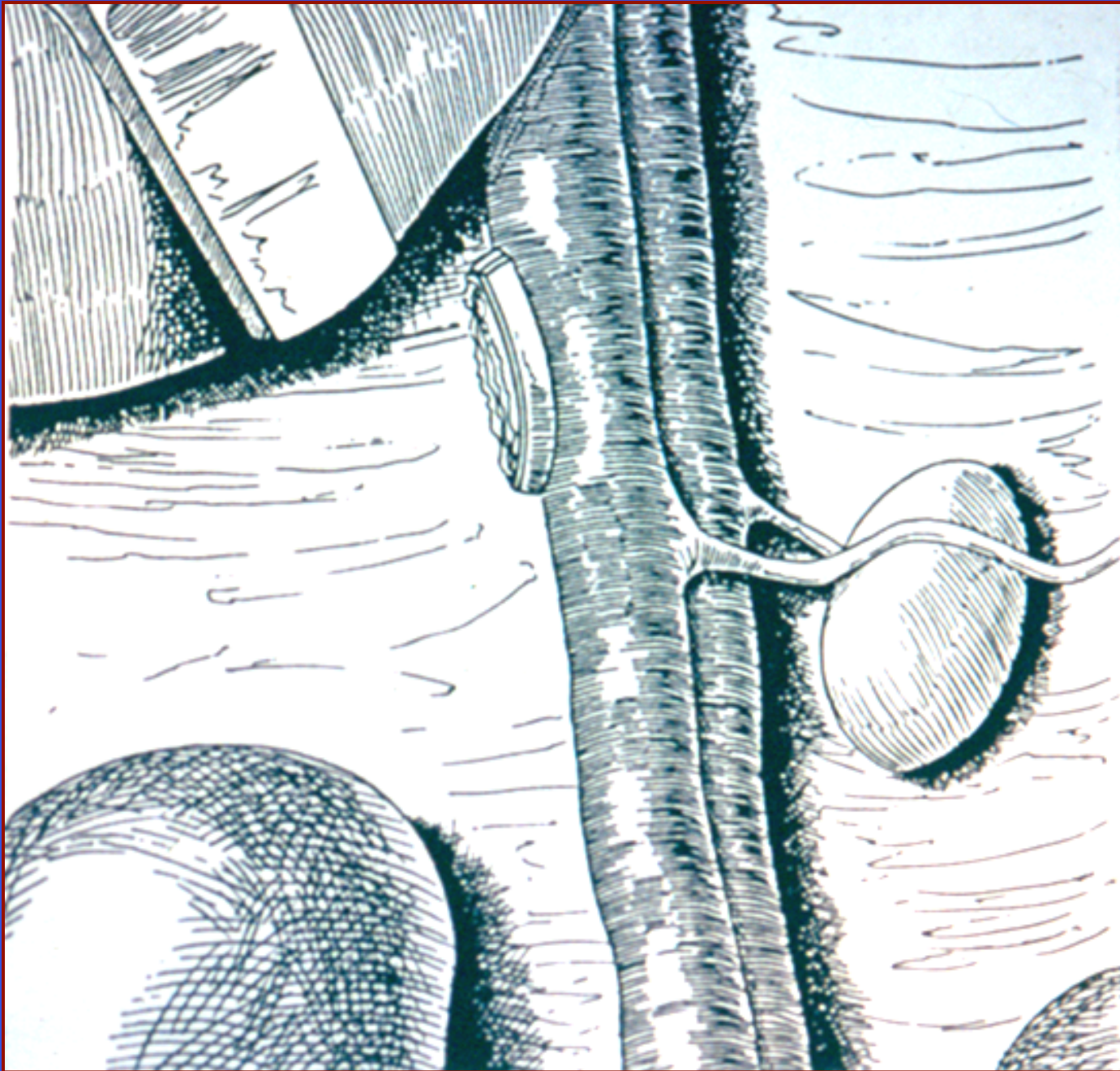
Vertebral
venous plexus Lumbar veins





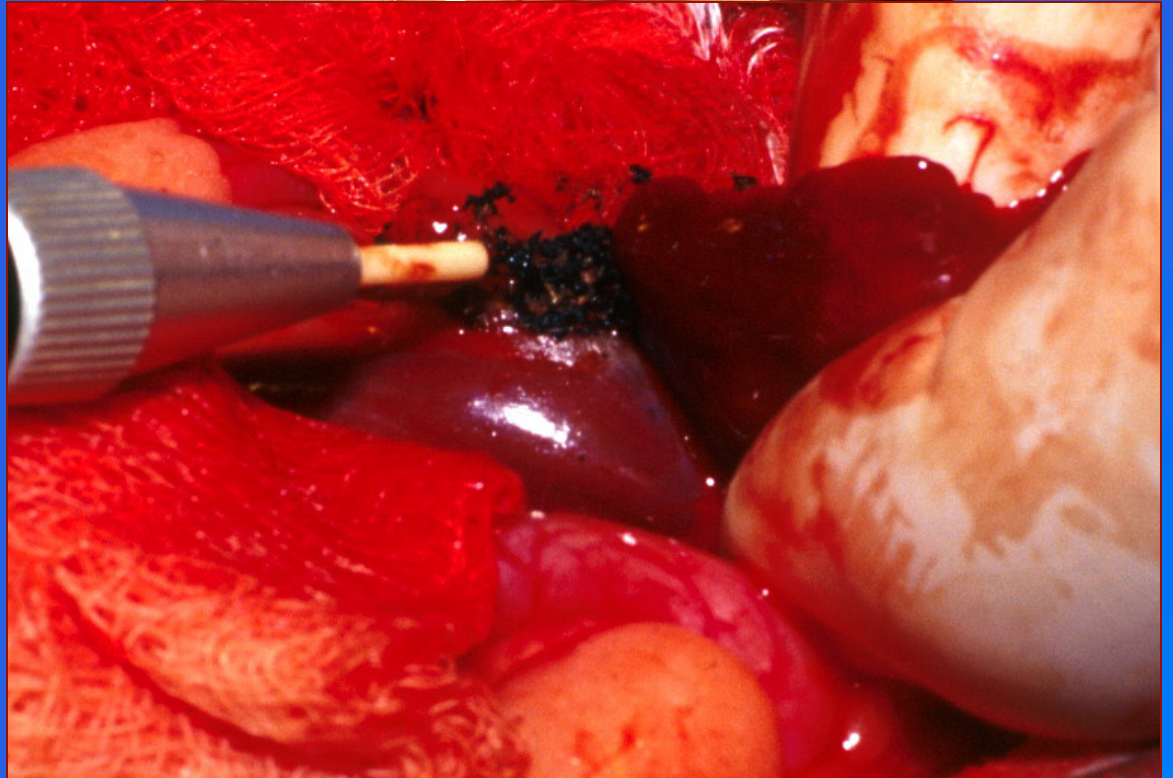
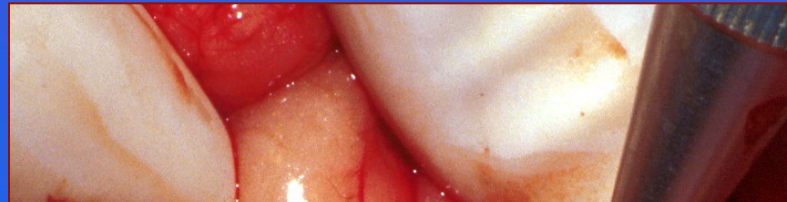
Right Adrenalectomy

- **Clip technique**
 - Hemostatic clips – debulk
 - Place between adrenal and caudal vena cava
 - Transect tissue along clips
 - Generally leaves some tumor behind



Other Techniques Tried

- Lazer
- Cryosurgery



Risk Factors

- CSU study published in Vet Surg 2007
- Only cryotherapy altered prognosis
 - Significantly more problems

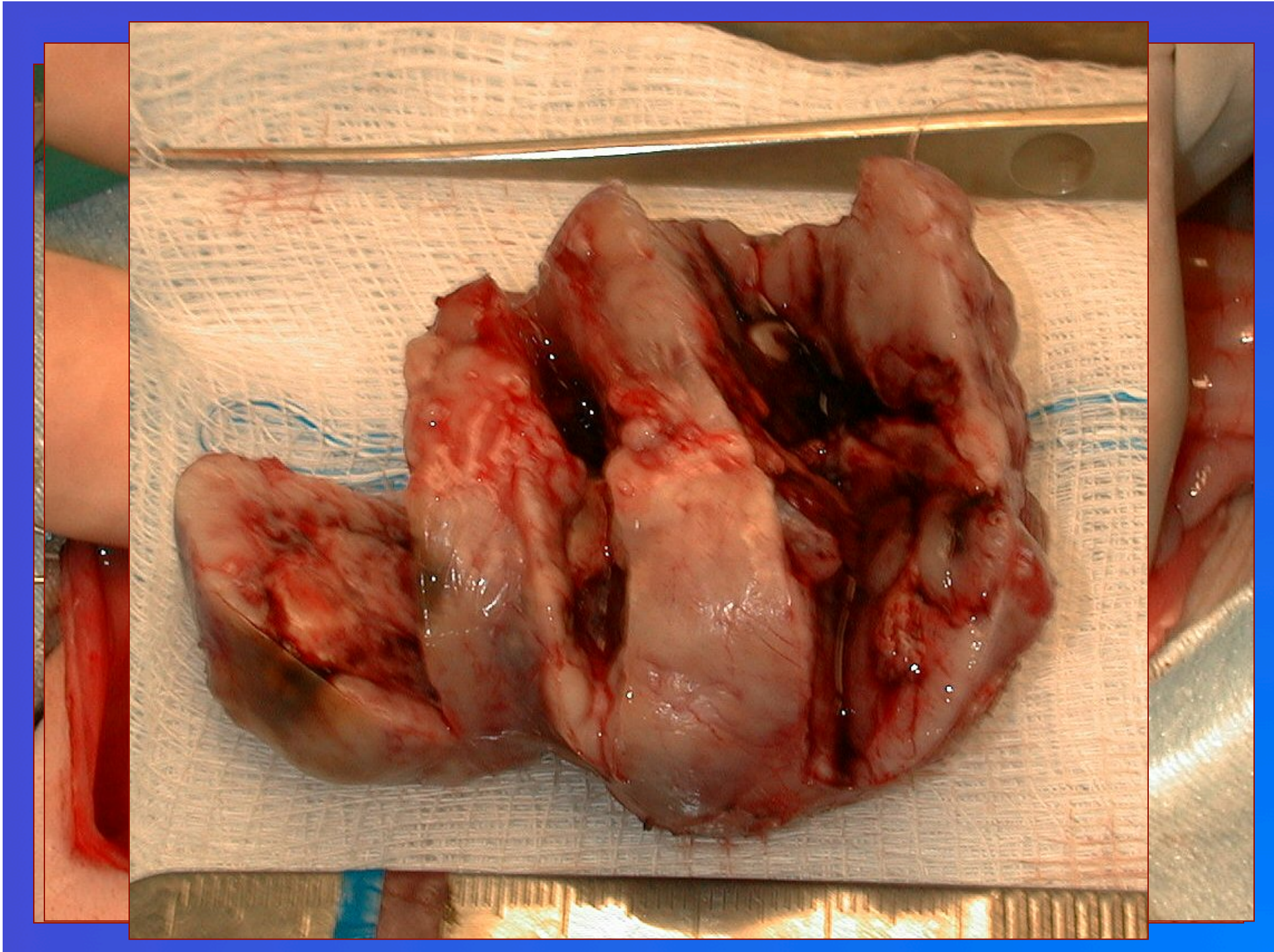
Gradual Caval Occlusion

- **Ameroid constrictor**
 - Casein ring within metal ring
 - Tissue fluid causes casein to swell
 - Cannot swell out
 - Eventually occludes vessel within
 - Two months later remove adrenal mass along with section of vena cava
- **Dr. Driggers -2 of 8 did not survive**



Why Do Surgery At All???

- **Clinical signs**
 - Can you live with a naked, itchy ferret?
- **Prostate disease may be life-threatening**
- **Do not come back when it is huge and ask for surgery**



Post Operative Adrenalectomy

- **Glucocorticoids (?)**
- **Mineralocorticoids (?)**

Bilateral Adrenalectomy

- **Old study in Laboratory Animal**
- **Not very scientific**
- **Did not describe technique**
- **Gave 0.9% saline to drink**
- **No problems reported**
- **Need more research in this area!!!**

Insulinoma

- **Pancreatic beta cell tumor**
- **Often with adrenal disease**
- **High insulin levels**
- **Low blood sugar**

Insulinoma – Clinical Signs

- **Can be transient and intermittent**
- **Weakness and depression**
- **Salivation**
- **Pawing at mouth**
- **Seizures**
- **Coma**

Insulinoma - Diagnosis

- **Fasting glucose < 60 mg/dl**
- **Insulin : Glucose ratio not helpful**
- **Lesions usually too small for ultrasound**

Insulinoma - Treatment

Medical

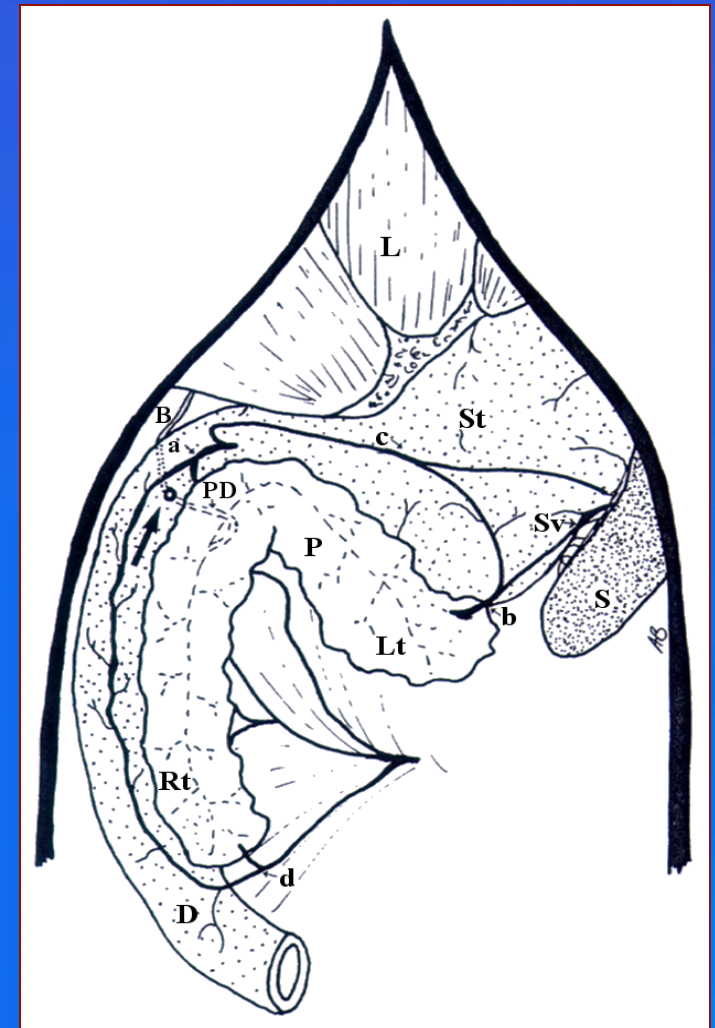
- Diet
- Glucocorticoids
- Diazoxide

Surgical

- May not resolve the hypoglycemia
- Biopsy liver and spleen
 - Metastasis

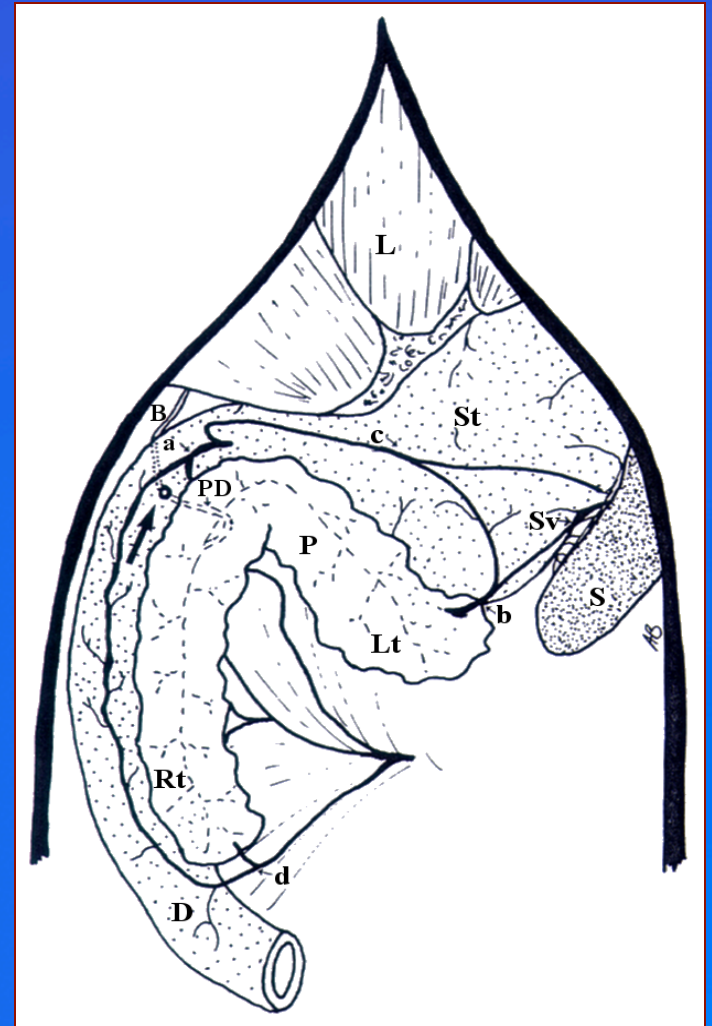
Insulinoma - Anatomy

- Right limb in mesoduodenum
- Left limb in deep leaf of greater omentum
- Body at pyloroduodenal junction



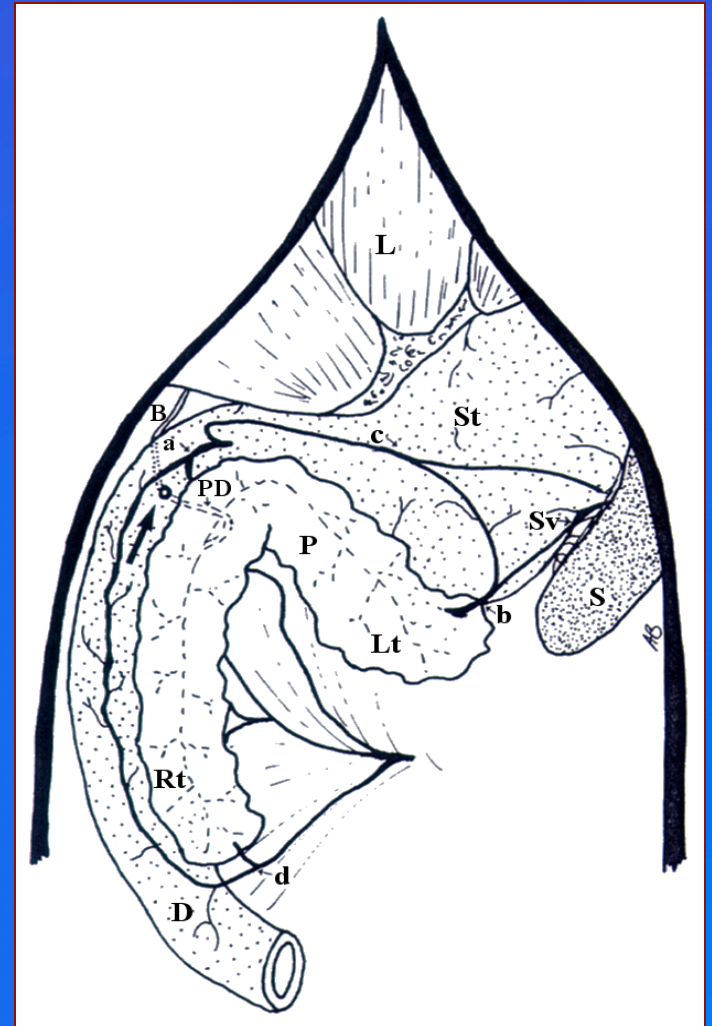
Insulinoma - Anatomy

- One duct in each limb
- Form common pancreatic duct
- To duodenum 2.8 cm caudal to cranial flexure (major papilla)



Insulinoma – Vascular Anatomy

- Cranial and caudal pancreaticoduodenal artery and vein supply right limb
- Splenic artery and vein supply left limb



Insulinoma – Preop Support

- Short fast (1 hr)
- Dextrose fluids (5%)
- Antibiotics (perioperative)
- Analgesics

Insulinoma – Pancreas Exam

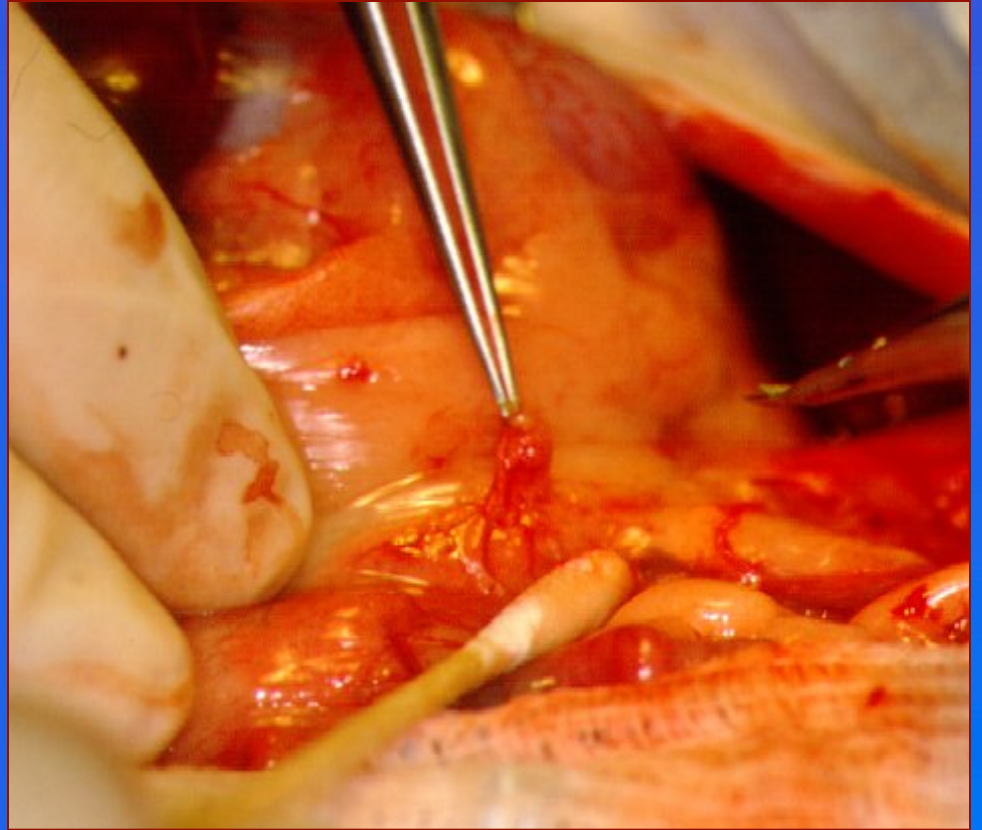
- **Exteriorize omentum**
 - Evaluate left limb
- **Exteriorize duodenum**
 - Evaluate right limb
- **Evaluate both surfaces**
- **Evaluate color & consistency**



Partial Pancreatectomy

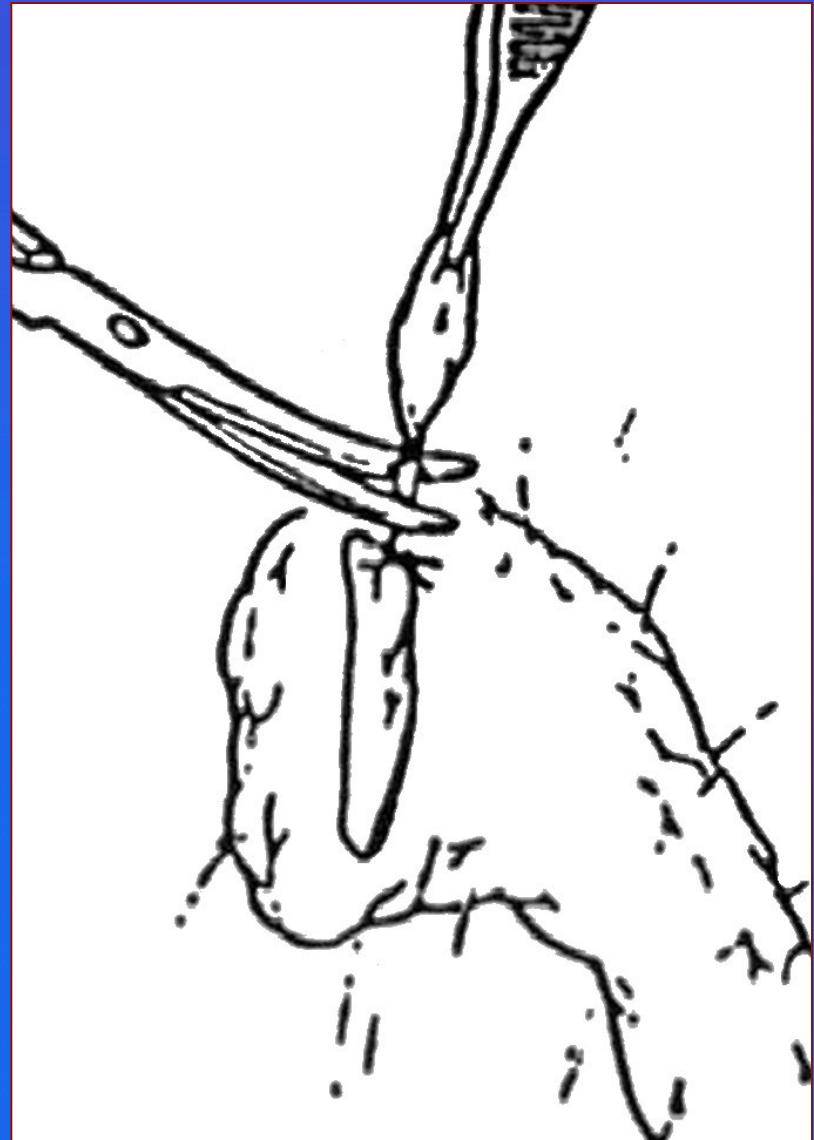
- **Small single mass**
 - **Bluntly dissect around mass between lobules**
 - **Excise without ligatures**
 - **Minor hemorrhage and enzyme leakage (?)**

 - **Clip or ligate vessels and ducts**
 - **Transect distal to clip**



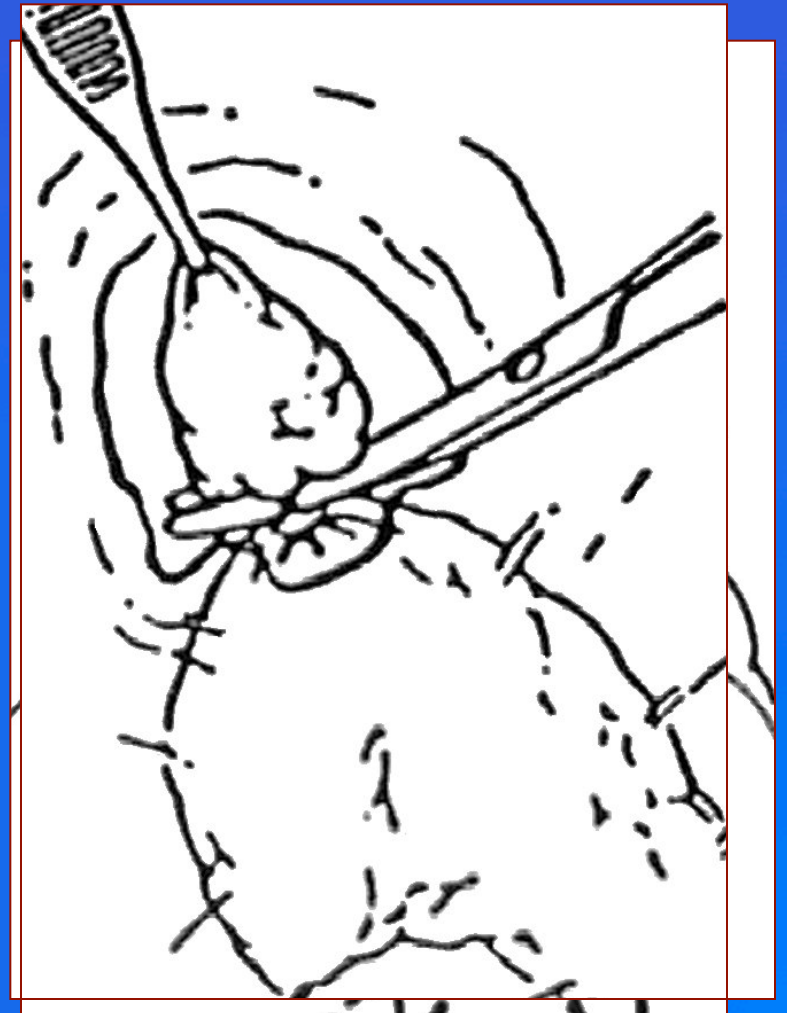
Dissection & Ligation

- **Multiple masses in one area or large masses**
- **Separate lobules until vessels and ducts are exposed**
- **Clip or ligate vessels and ducts**
- **Suture defect in mesentery or omentum**



Partial Pancreatectomy Suture Fracture

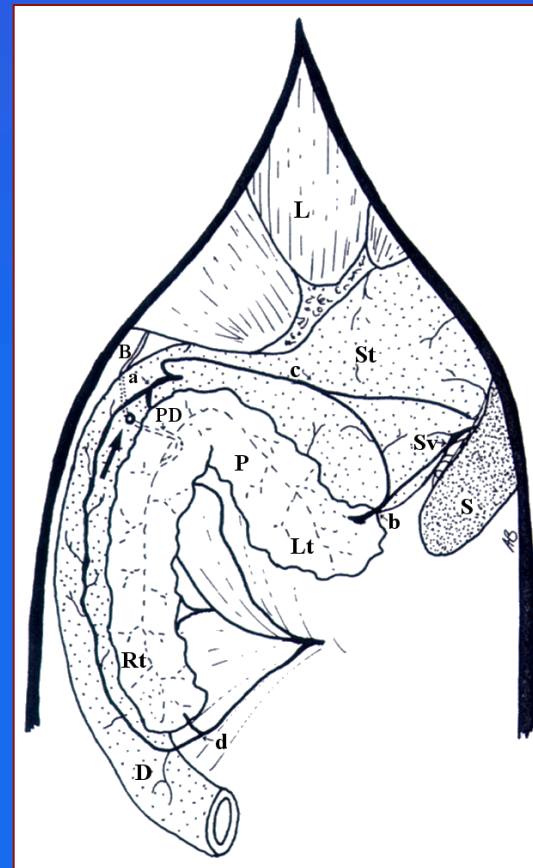
- Isolate segment to be removed
- Pass suture around the segment
- Tighten the suture to cut through parenchyma
- Suture defect closed



Partial Pancreatectomy

No Masses Found

- Remove left limb
- From pylorus left
- Dissect off greater curvature of stomach
- Dissect from omentum
- Debulking procedure



Insulinoma

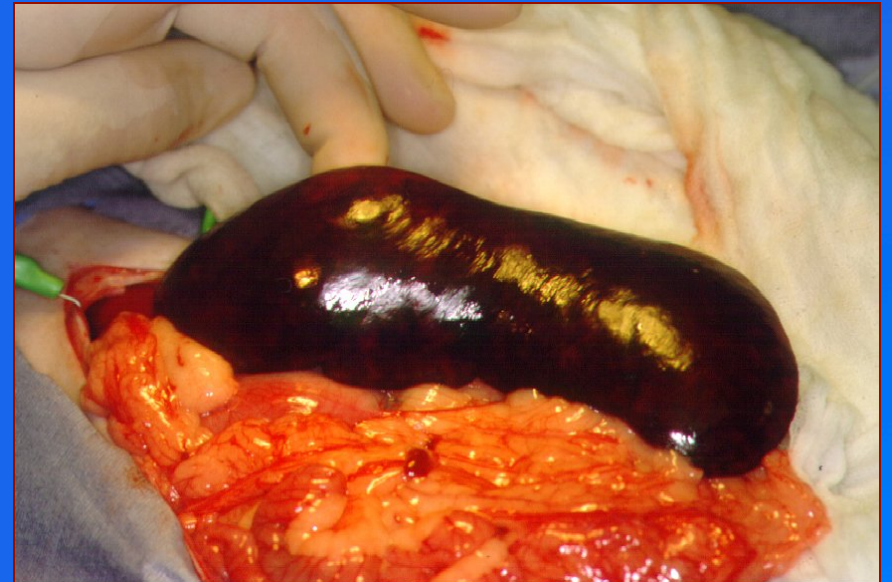
- **Partial pancreatectomy - Caution**
 - **Pancreaticoduodenal artery and vein**
 - Duodenal infarction
 - **Splenic artery and vein**
 - Splenic infarction
- **In dogs, can remove up to 90%**
 - Retain endocrine and exocrine function
 - Unknown in ferrets

Insulinoma

- **Post-operative care**
 - **Maintain on dextrose fluids 24-48 hours**
 - **Small frequent meals**
 - **Monitor blood glucose**
 - **Medical management**

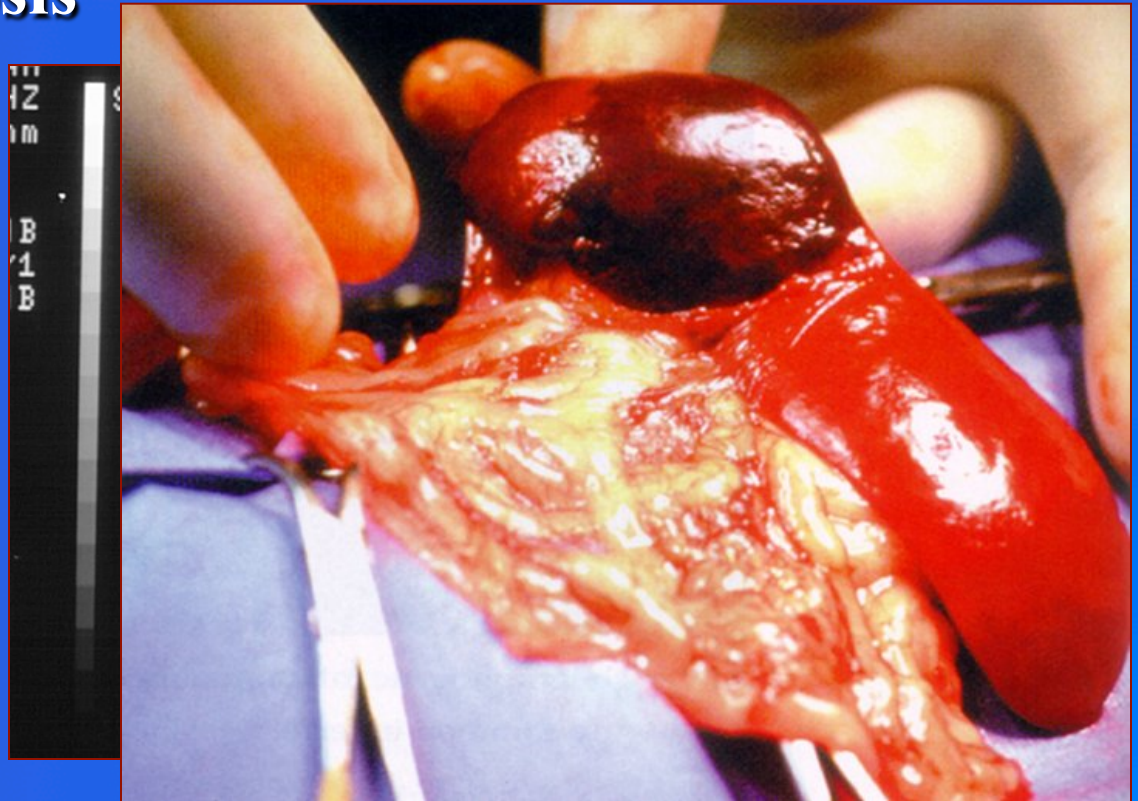
Splenomegaly

- Easy to palpate
- Primary disease uncommon
- Routine removal not recommended
- Remove if:
 - Irregular shape
 - Rapid increase in size
 - Painful
 - Extremely large



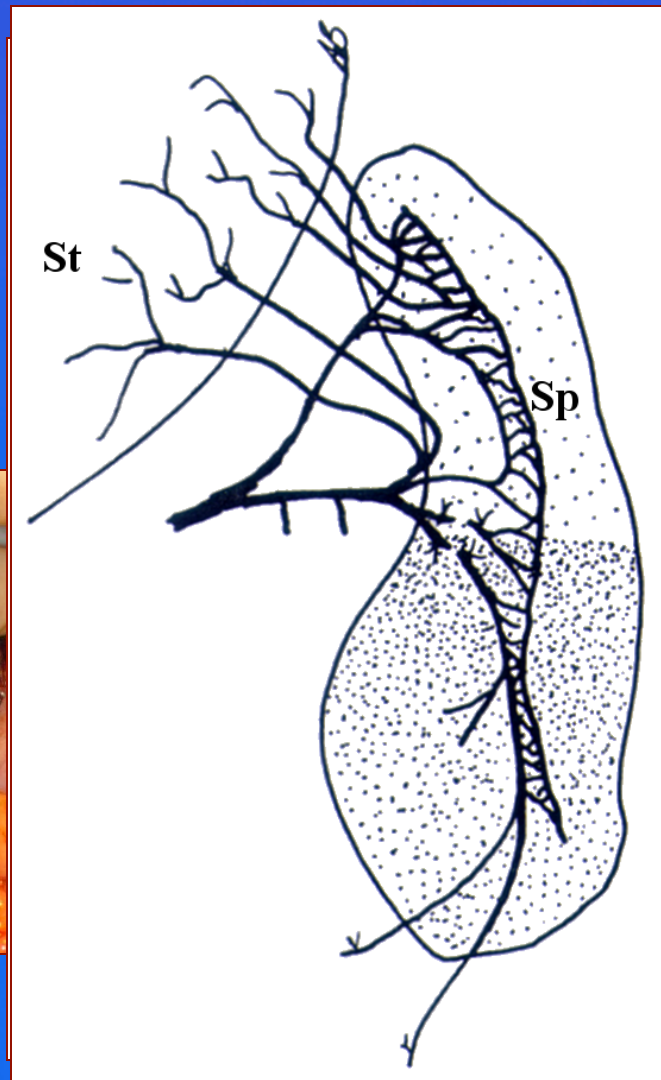
Splenomegaly

- Splenectomy – Preoperative
 - Tissue diagnosis
 - Aspirate
 - Biopsy
 - Ultrasound



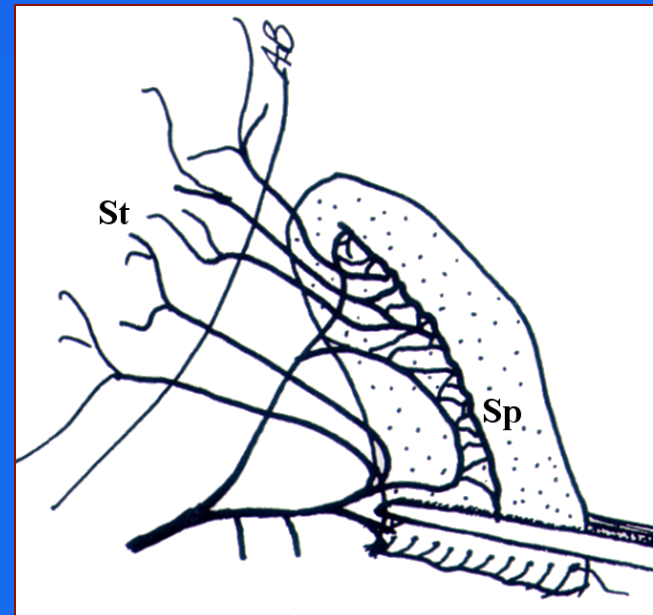
Splenomegaly

- **Partial splenectomy**
 - Benign splenomegaly
 - Caudal portion
 - Double ligate hilar vessels
 - Transect between
 - Line of demarcation



Splenomegaly

- **Partial splenectomy**
 - Pinch parenchyma
 - Milk pulp towards ischemic sections
 - Clamp
 - Cut 2 mm distal to clamp
 - Oversew edge

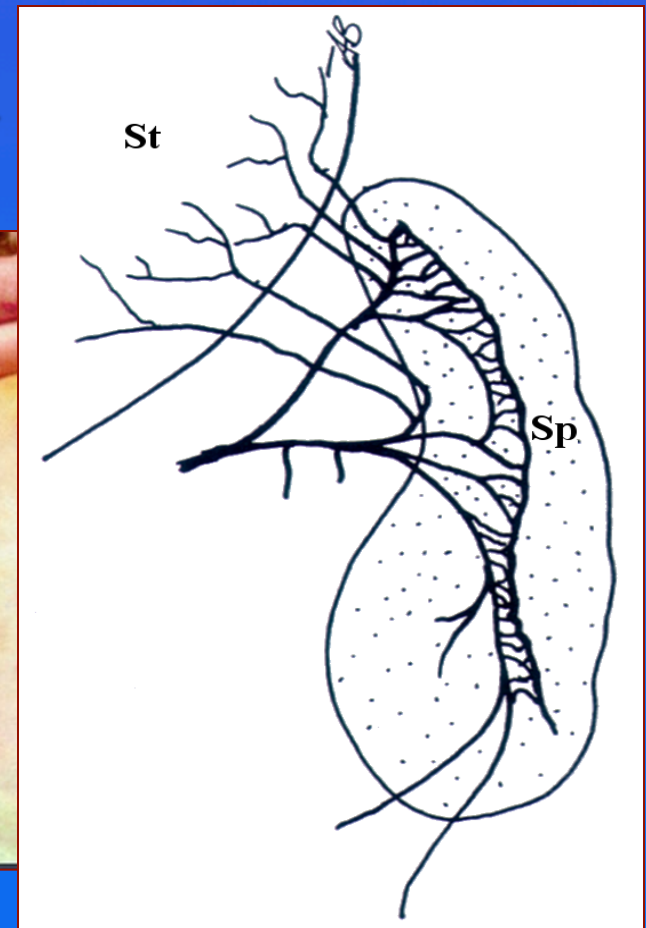


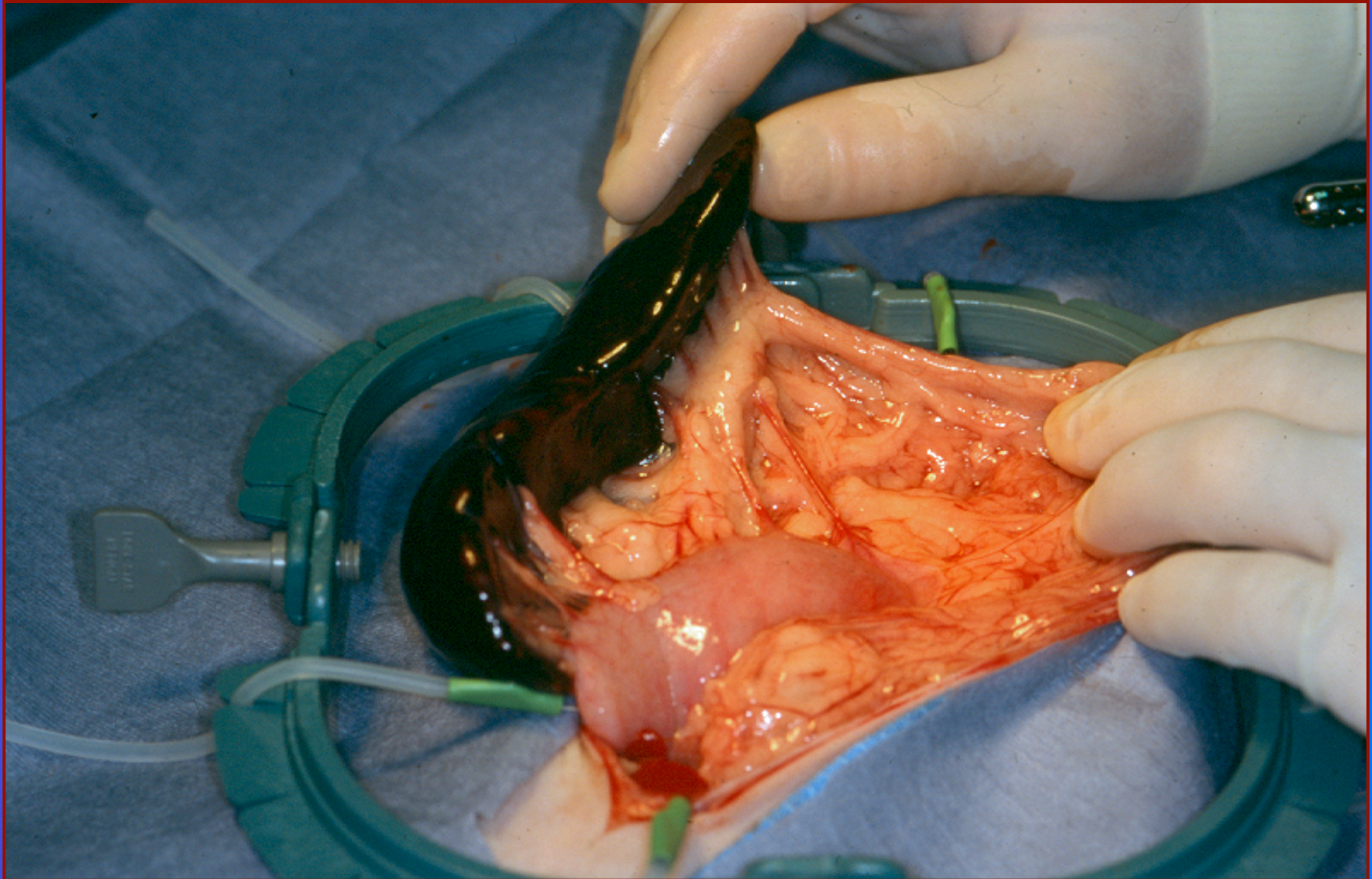
Splenomegaly

- **Partial splenectomy**
 - **Row of mattress sutures**
 - Full thickness
 - Transect distal to sutures
 - **Stapling device**
 - **Tissue sealing devices**
 - Ligasure
 - Harmonic Scalpel

Splenomegaly

- Splenectomy
 - For diffuse splenic pathology
 - Standard technique
 - Short gastric vessels
 - Pancreatic branch

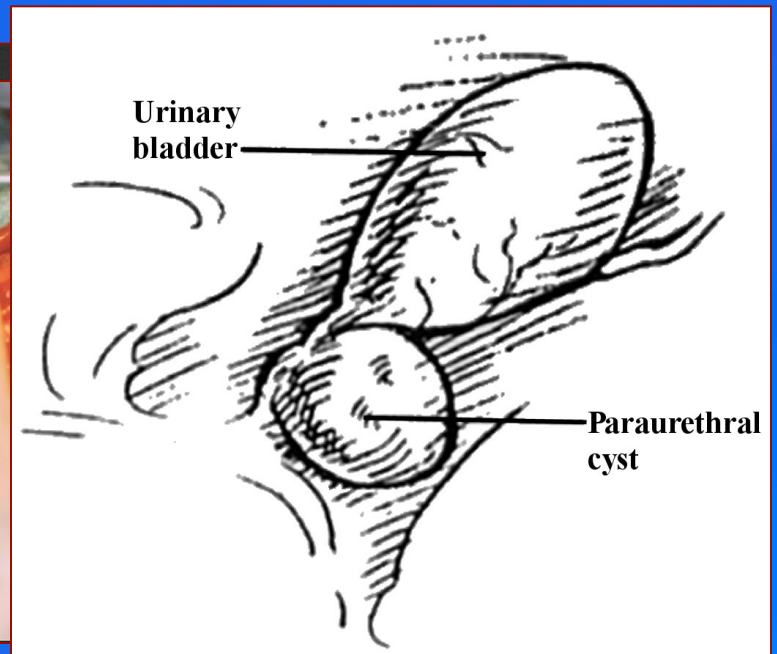






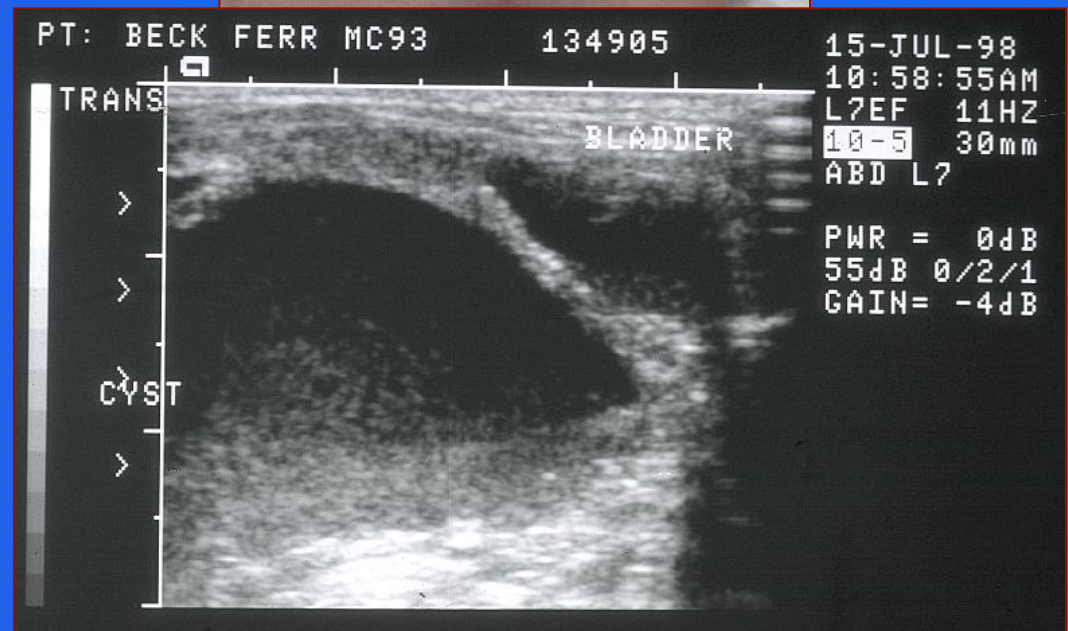
Paraurethral or Prostatic Cysts

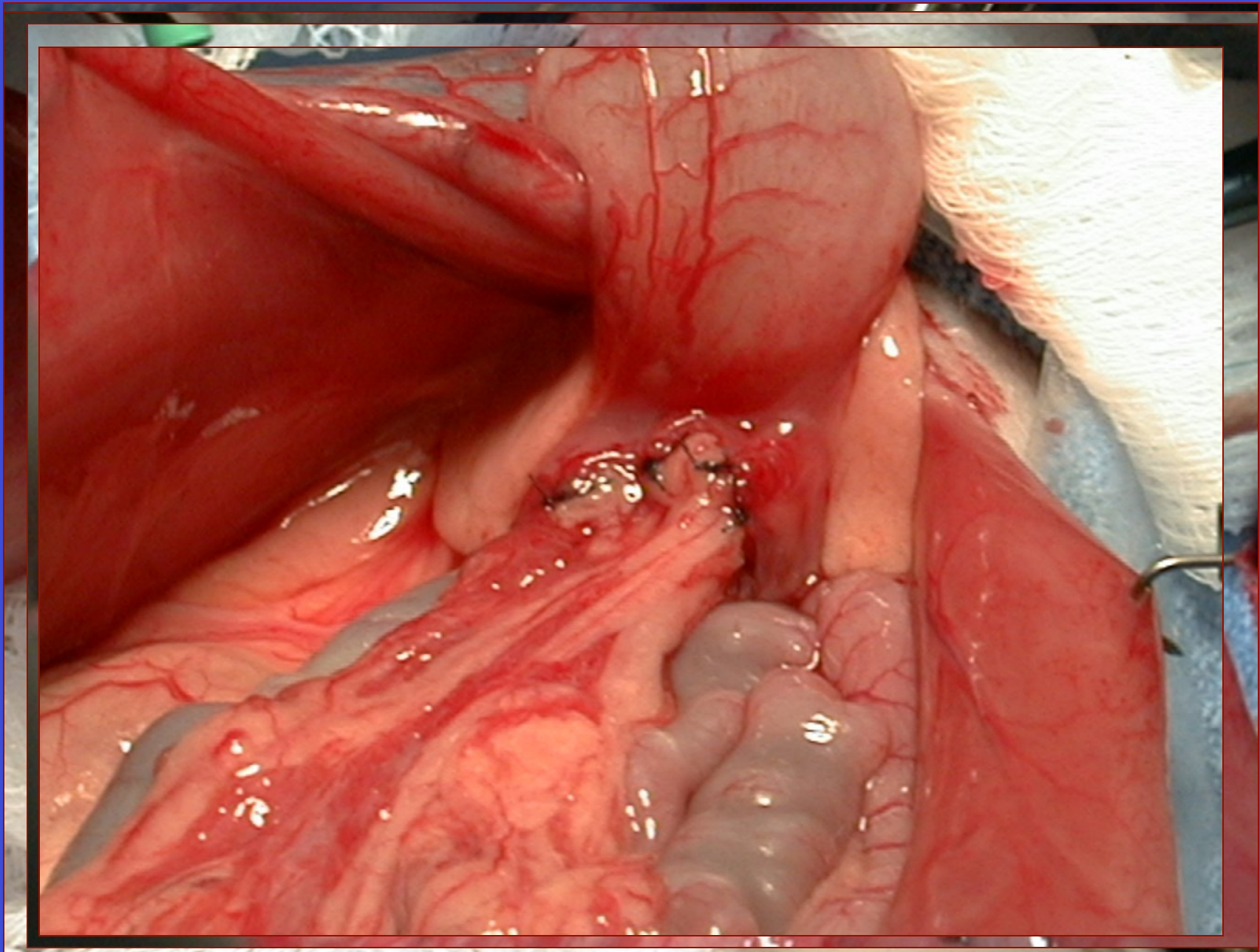
- Adrenal disease
- Urethral obstruction
- Often larger than bladder
- Thick, green, odiferous material

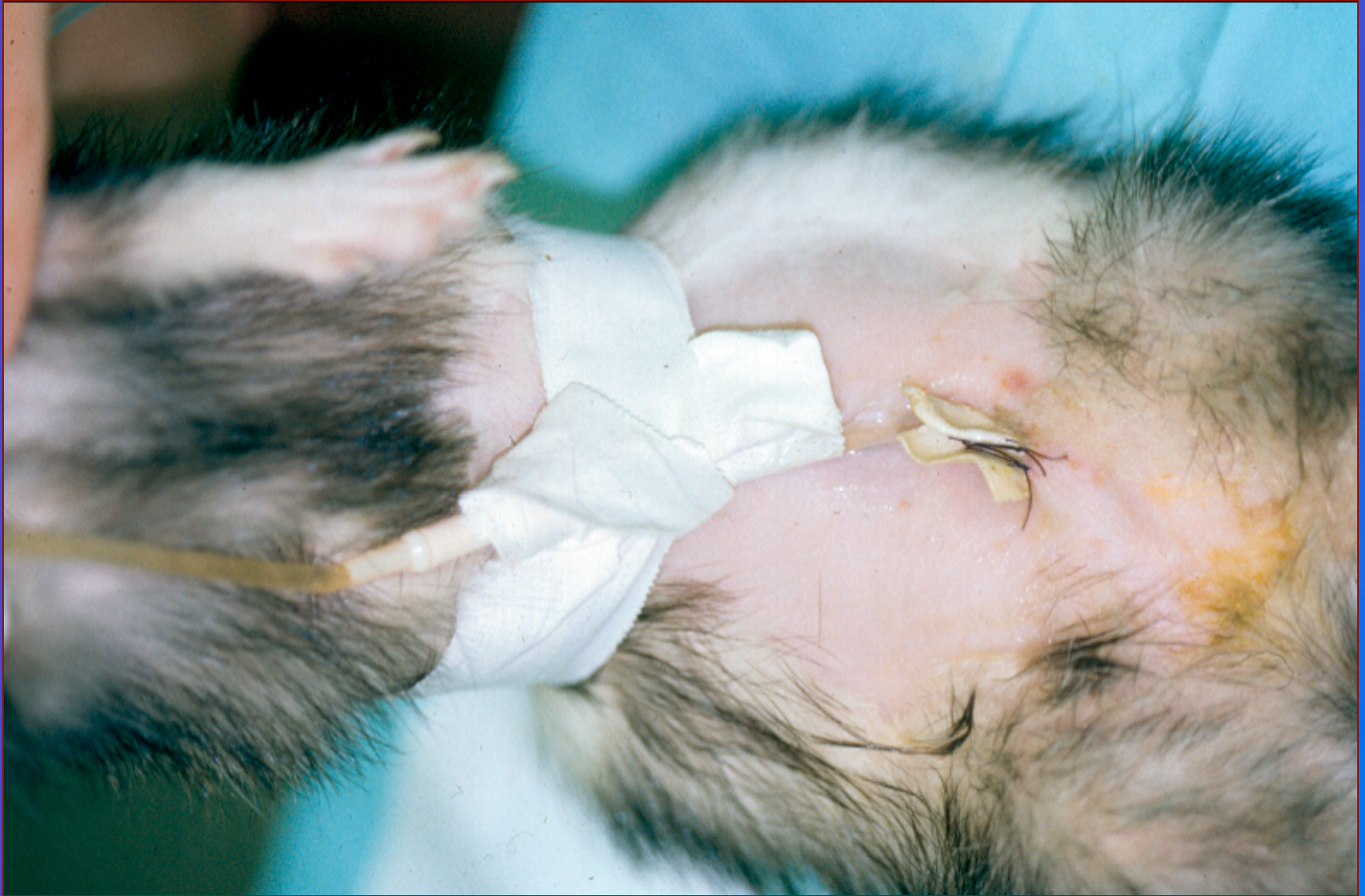


Paraurethral Cysts

- Remove adrenal
- Drain cyst
- Culture
- Omentalization







Omentalization

- **Check for urethral defects**
 - Catheterize penis (3.0 fr) and inject saline
- **If defect can leak urine into abdomen**
 - Leave indwelling urinary catheter for 1-2 d
- **Monitor for uroabdomen postoperatively**

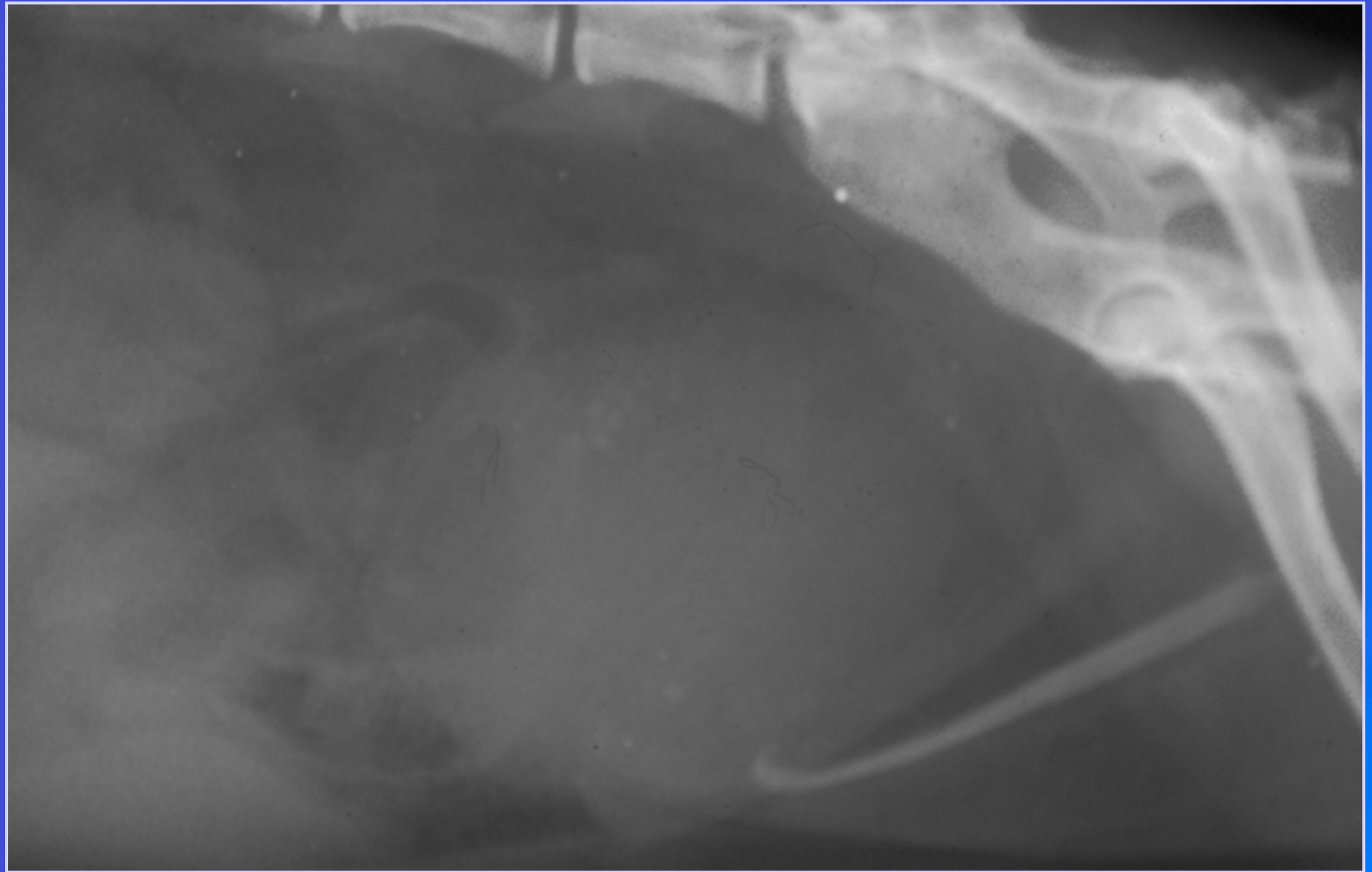
Marsupialization

- Suture cyst wall into a hole in body wall
- Material exits the hole
- Once disease under control (adrenalectomy) closes by second intention
- Good option if urine leakage and large cyst

Perineal or Scrotal Urethrostomy

- Palliate chronic crystaluria
- Reconstruction after penile amputation
- Postoperative
 - Fluids
 - Antibiotics
 - E collar
 - Analgesics





Urethrostomy

- **Incision 1-1.5 cm**
 - **Microsurgery techniques**
 - **Stoma must be at least 1 cm**
 - **1-2 cm ventral to anus**
 - **Area of scrotum**
 - **Avoid cavernous tissue lateral**

Urethrostomy

- **Suture sub q to cavernous tissue**
 - **Decrease tension on skin sutures**
- **Suture mucosa to skin**
 - **5-0 to 6-0 monofilament suture**
- **Sedation/anesthesia for suture removal or Vicryl Rapide**

Preputial Masses

- Preputial orifice
- Adenoma or adenocarcinoma
- Partial urinary obstruction
- Preoperative biopsy
 - Benign or malignant
 - Determine need for wide margins



Preputial Adenomas

- **Local excision**
- **Better prognosis**
- **Preputial reconstruction**
- **Most tolerate exposure well**



Preputial Masses

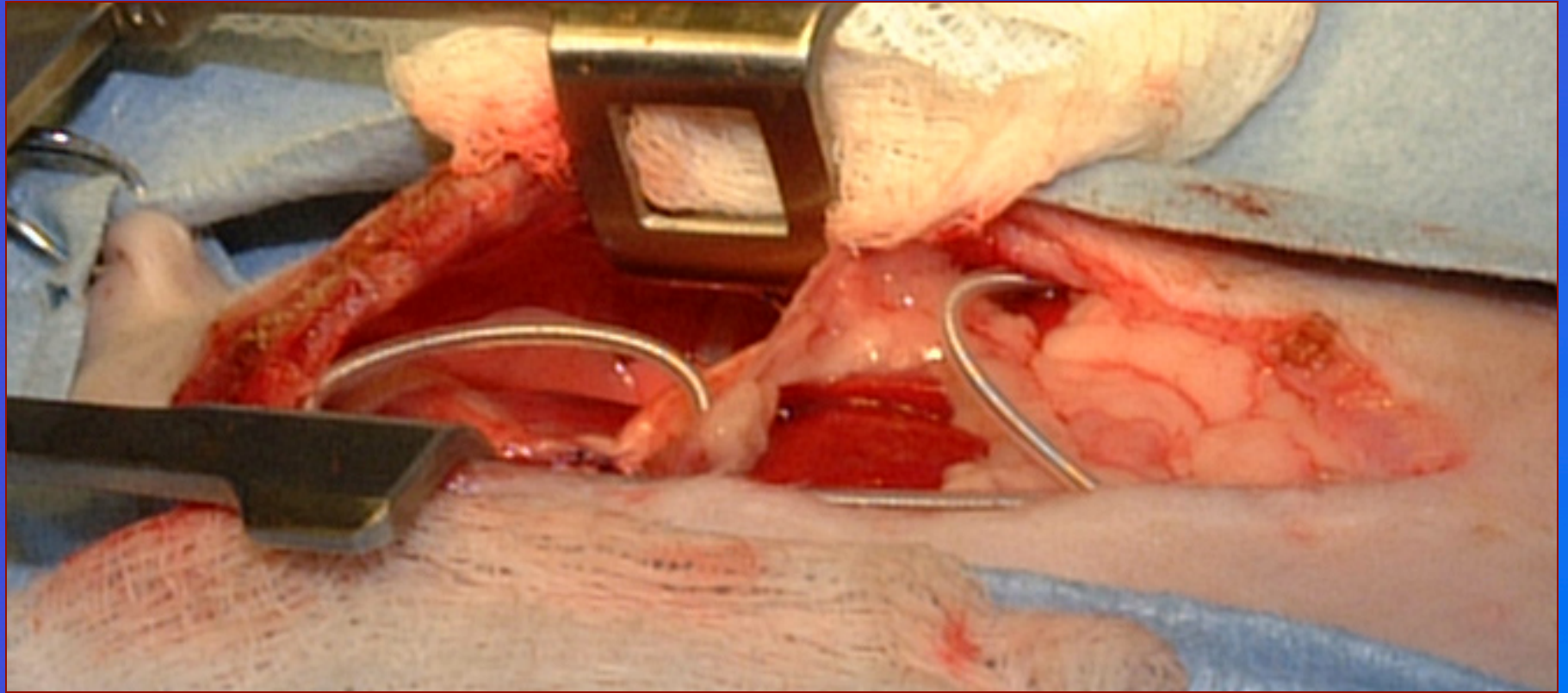
- Adenomas may progress to Adenocarcinoma
- Adenocarcinomas – Wide margins
 - Penile amputation
 - Perineal urethrostomy

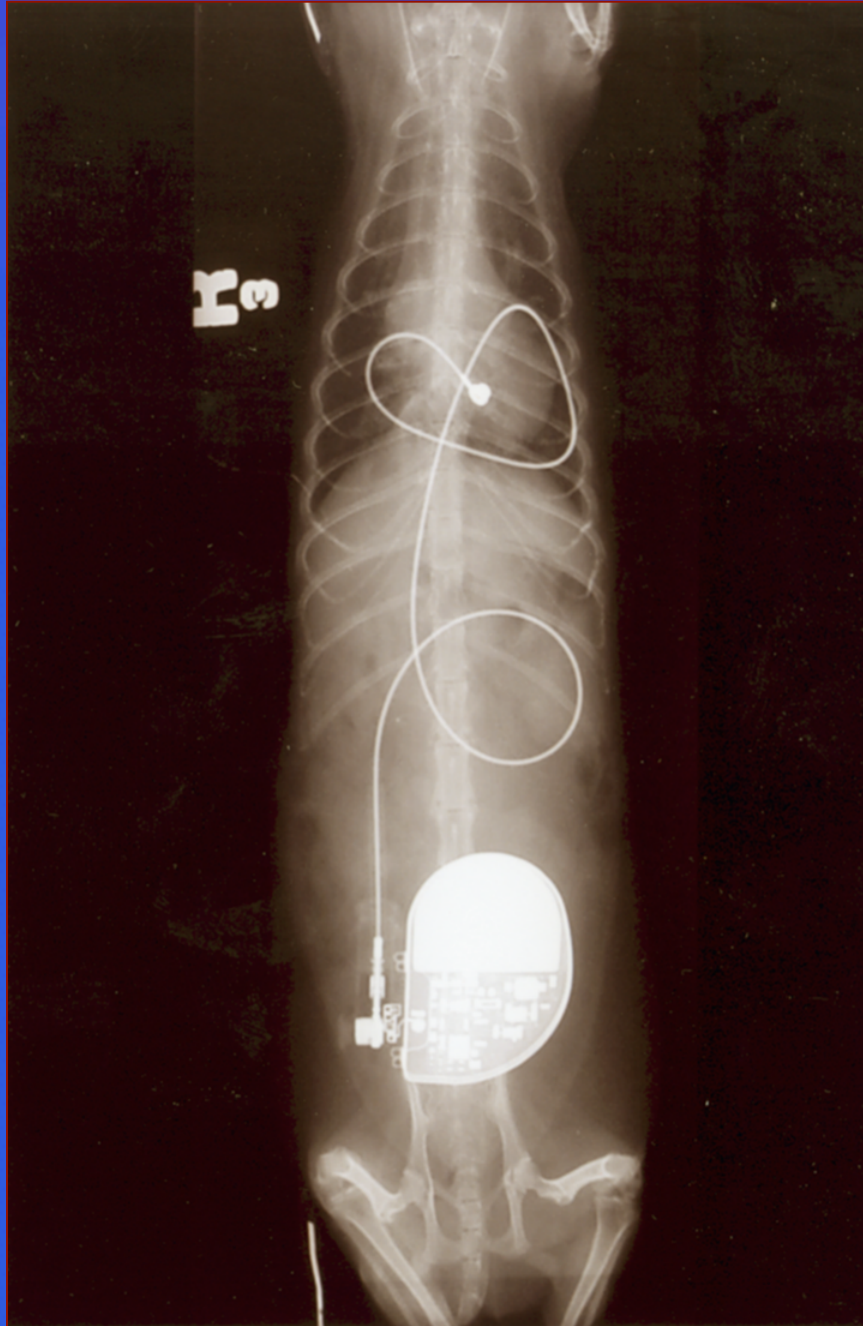




Cardiac Pacemaker

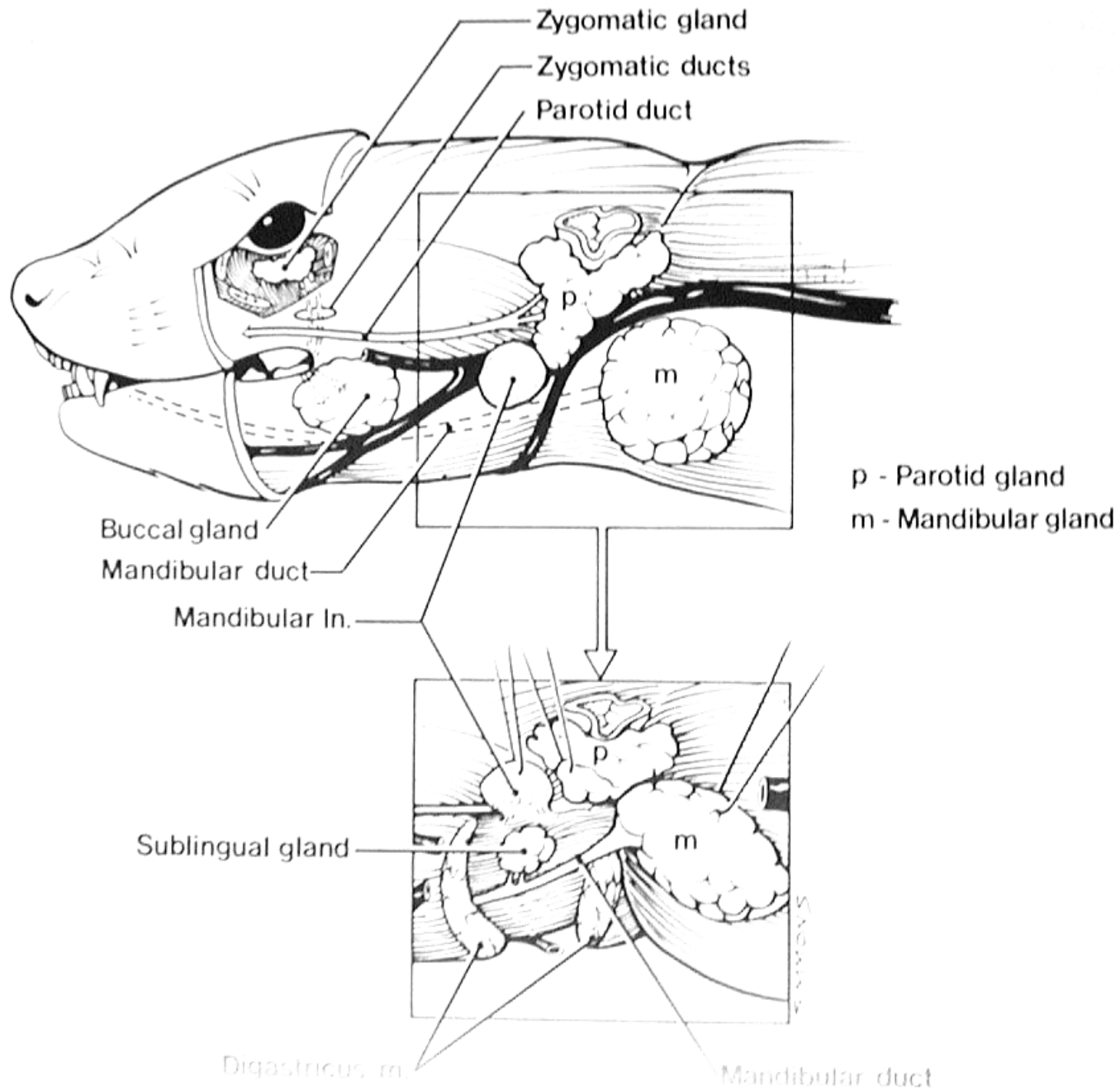
- **Similar to dogs and cats**
- **Bradyarrhythmias – 3rd degree block**
 - **Lead to ventricular myocardium**
 - **Through diaphragm**
 - **Pulse generator in abdomen**
 - **Seems large but think of their spleens!!**

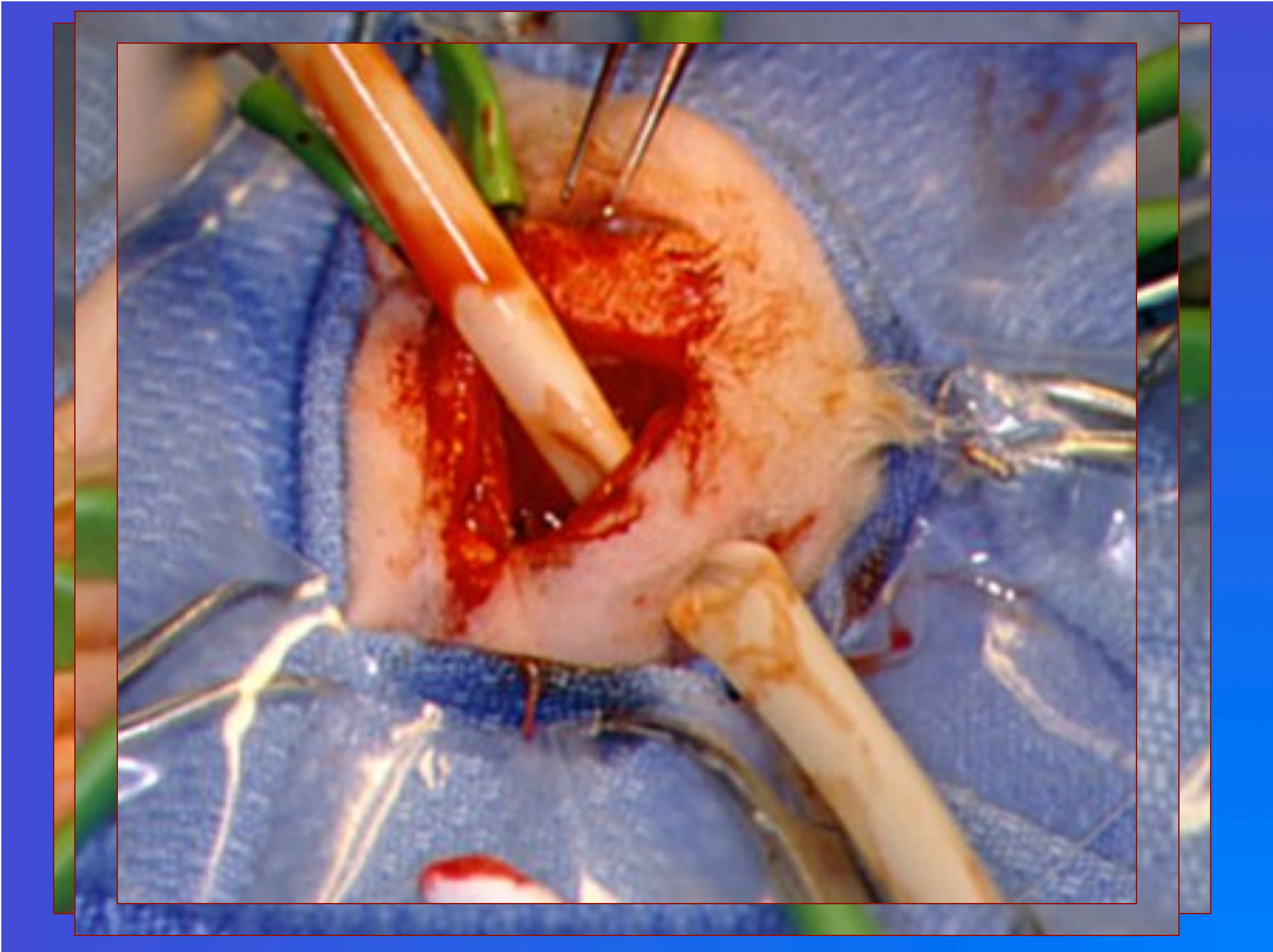




Salivary Mucoceles

- **Five pair**
 - Parotid, mandibular, sublingual, buccal, zygomatic
- **Buccal in depression on border of masseter**
- **Sublingual a single gland**
 - Duct separate from mandibular





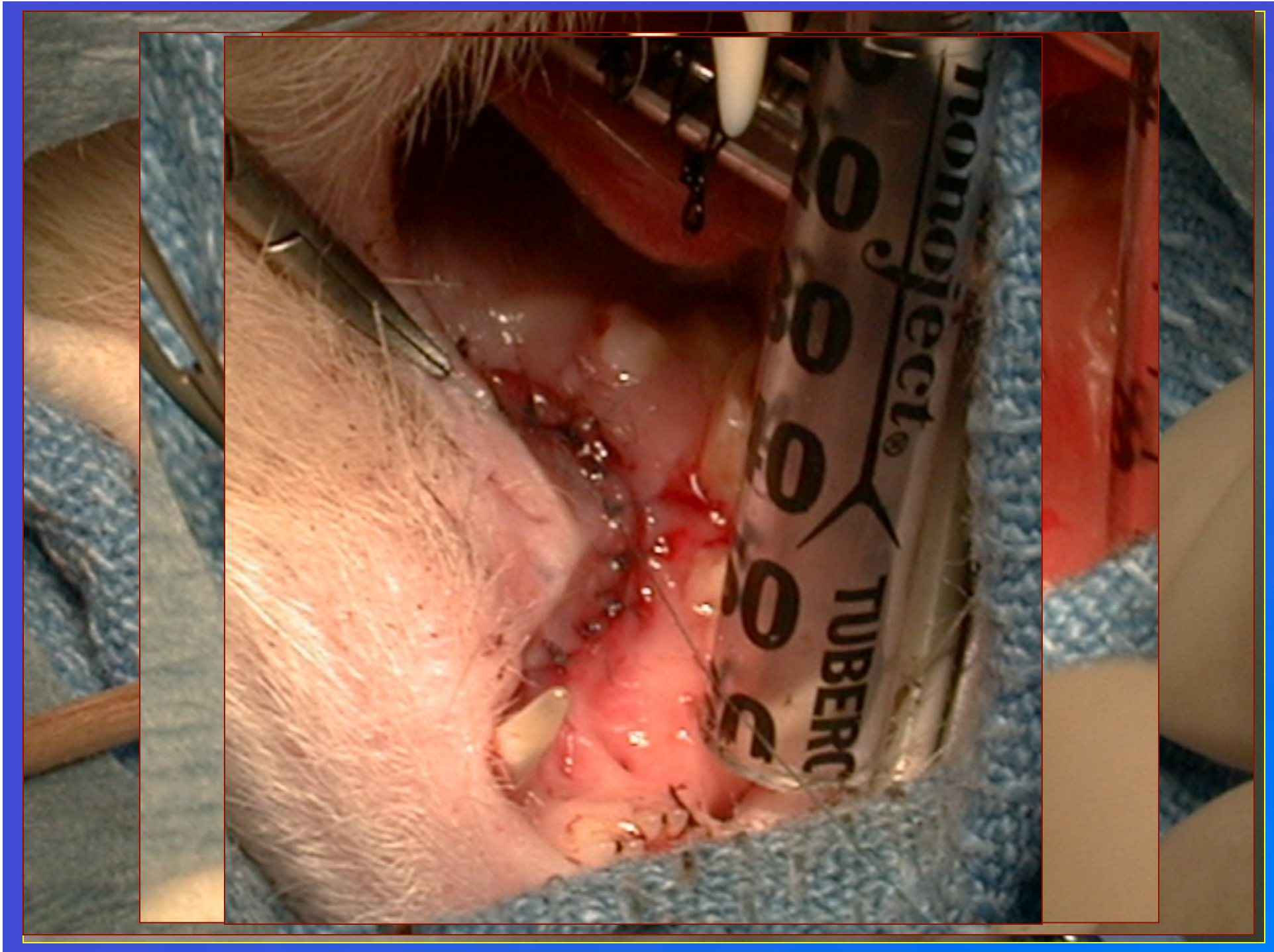


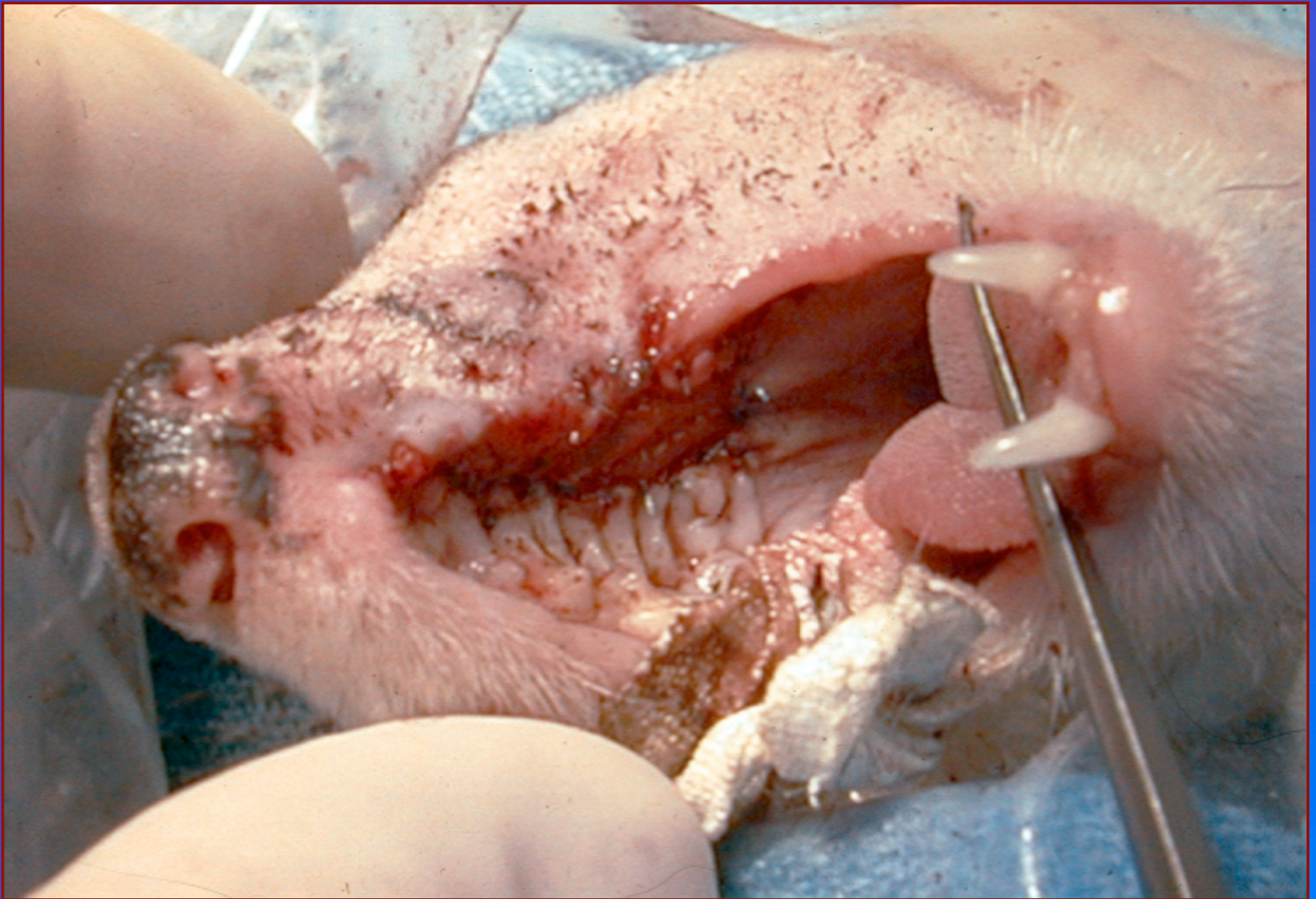
Oronasal Fistulae

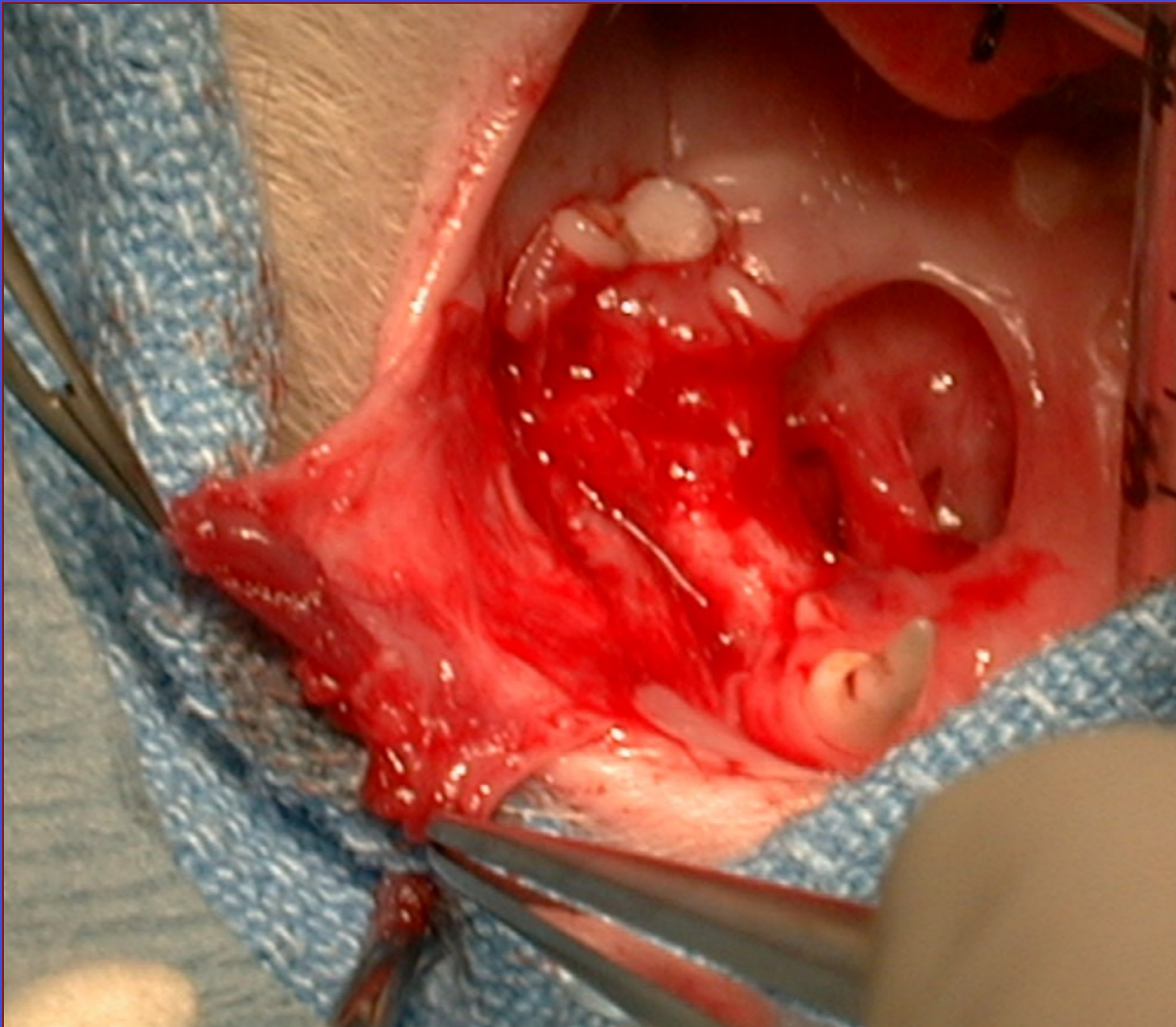
- **Etiologies**
 - **Similar to dogs and cats**
 - **Chewing on electric cords**
 - **Dental abscesses**
 - **Others**

Oronasal Fistulae

- **Reconstruction techniques similar to dogs and cats**
- **Appears must reconstruct both an oral and a nasal mucosa**
- **Challenging due to size**









Esophagostomy Feeding Tube

- Insert hemostat into mouth to exit left
- Small incision
- Hemostat exits and grasps tube
- Pull tube in mouth
- Cut off ends
- Add holes
- Push into esophagus





Maxillectomy

- **Removal of tumor**
- **Techniques similar to dogs and cats**
- **Appears need to reconstruct oral and nasal mucosa**
- **Requires two flaps**

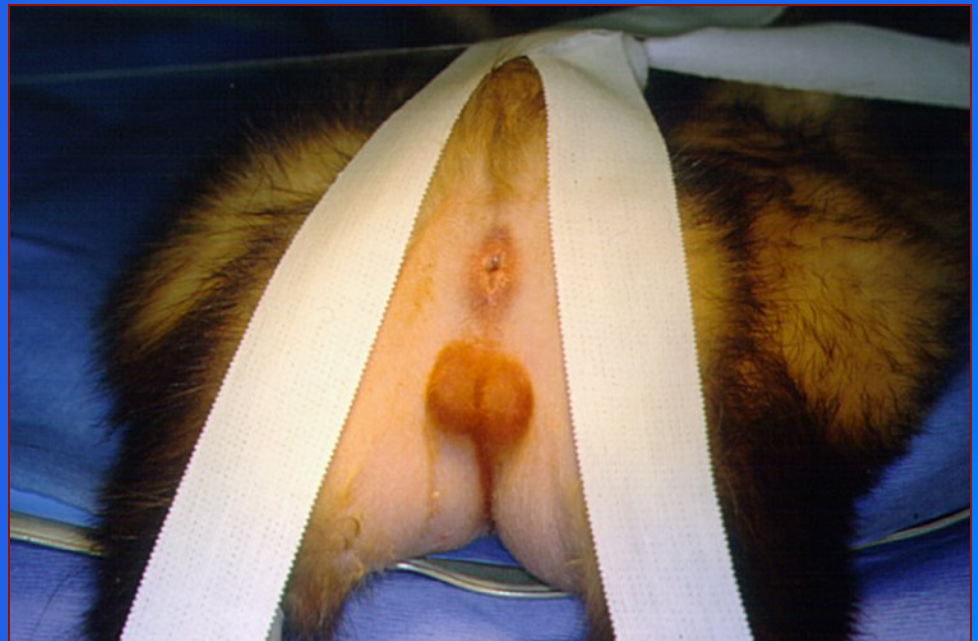


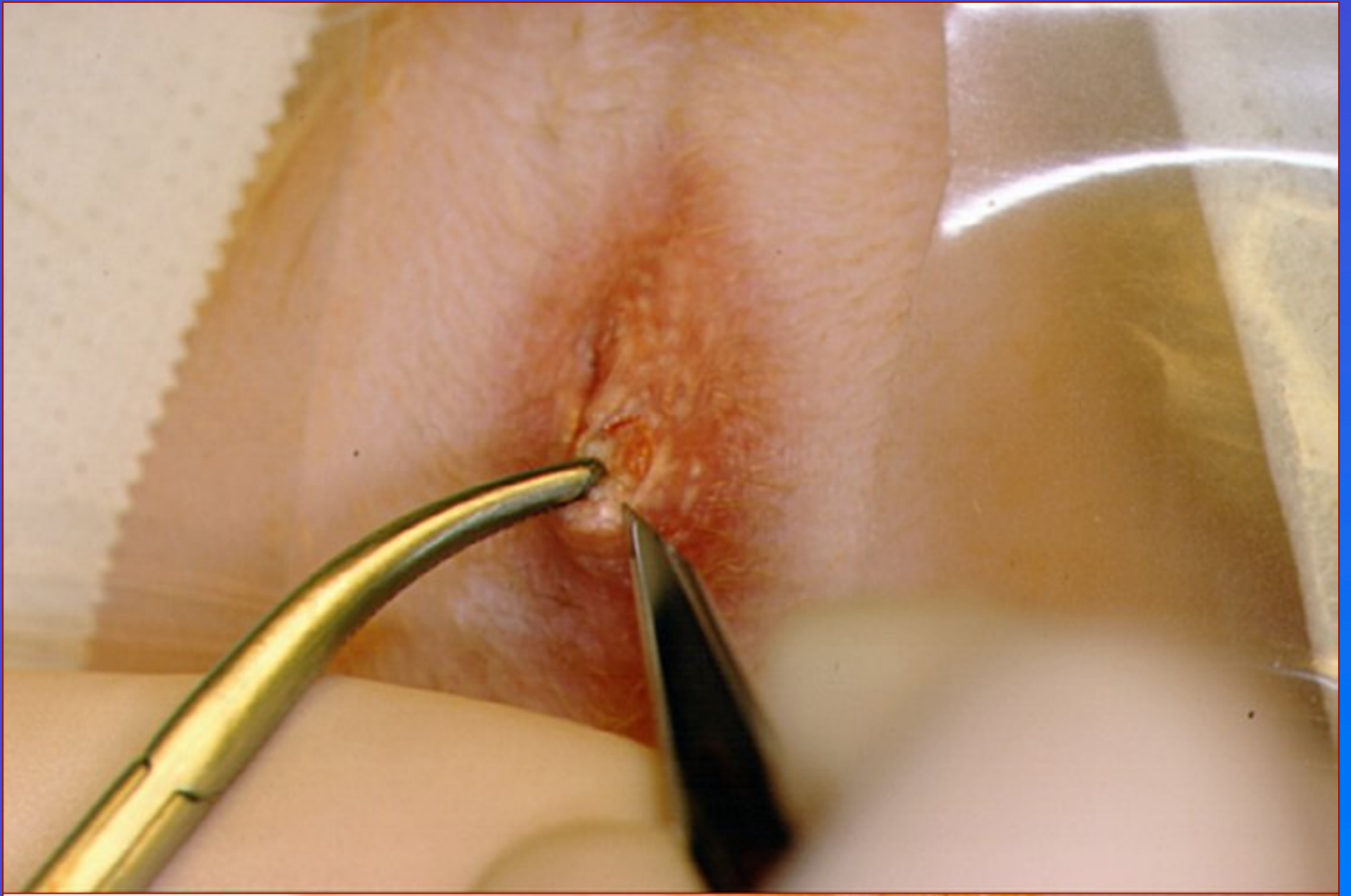
Anal Sacculectomy

- **Sacs collect secretions from glands**
- **Not possible to remove all glands**
- **Still have an odor**
- **Castration alone decreases odor**
 - **Can still express if angry**
- **Antibiotics - contaminated**

Anal Sacculectomy

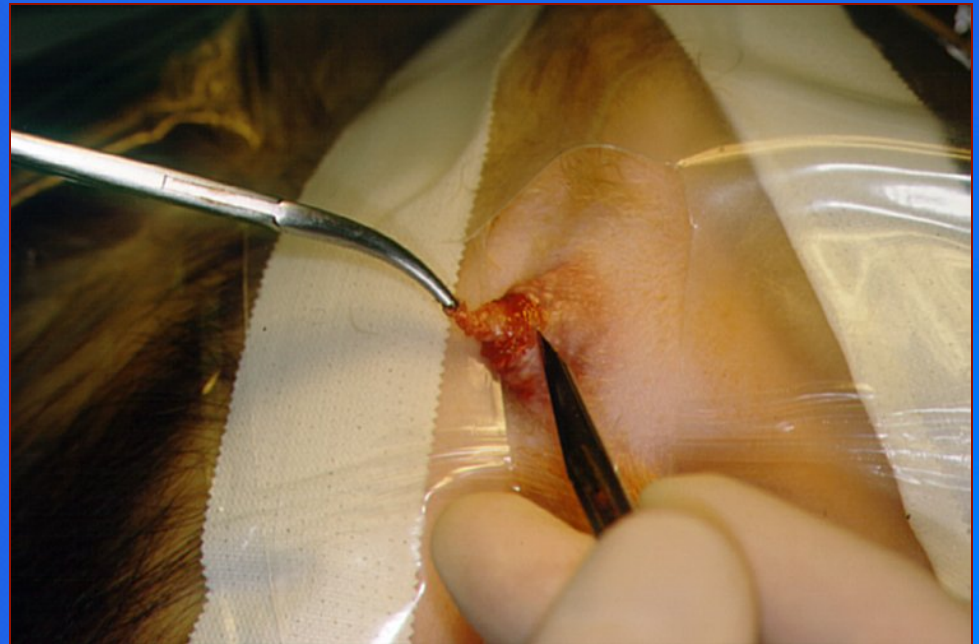
- Ducts at 4 and 8 o' clock positions
- Clamp duct with hemostat
- Circumferential incision
 - No. 11 blade

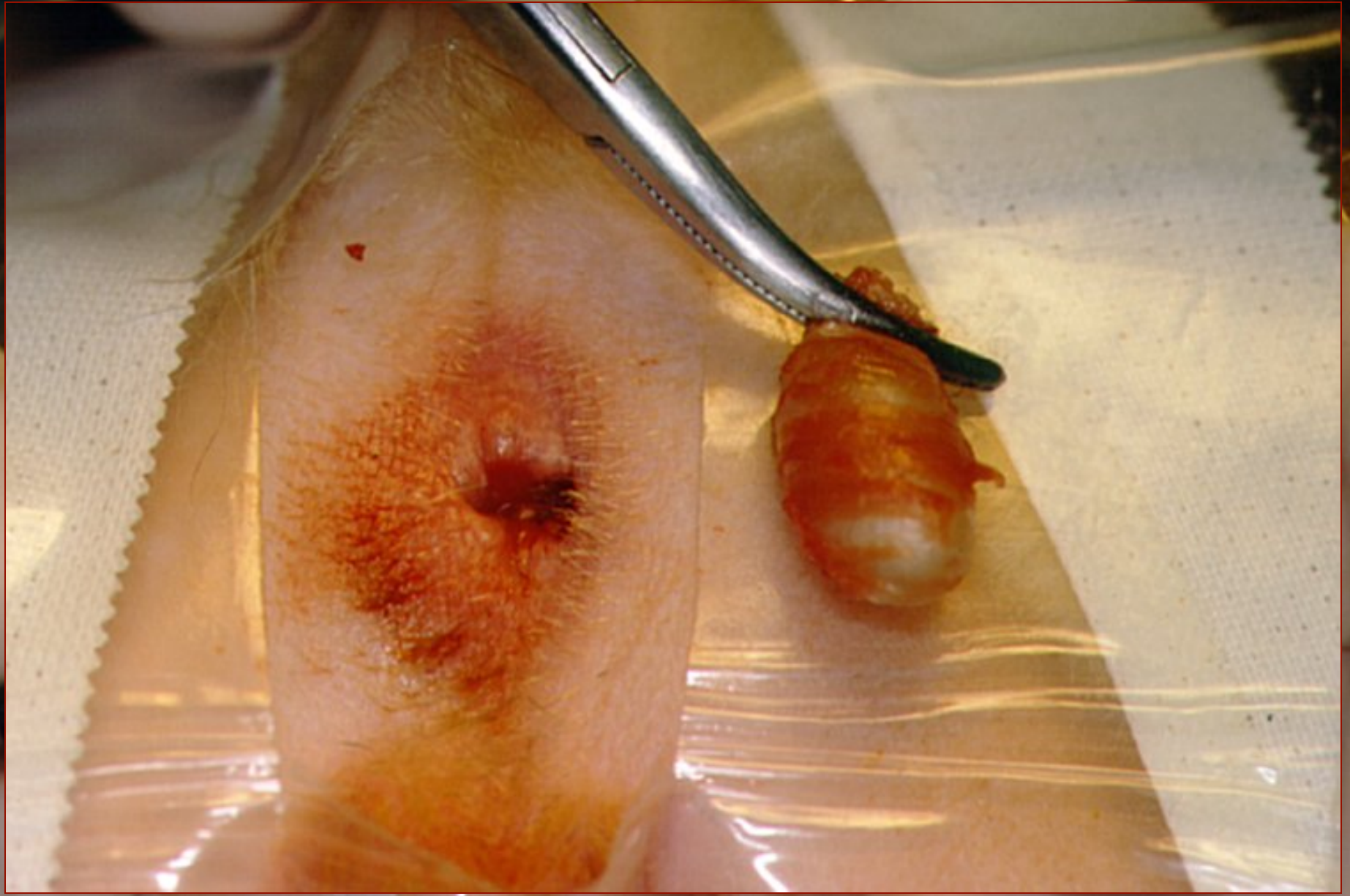




Anal Sacculectomy

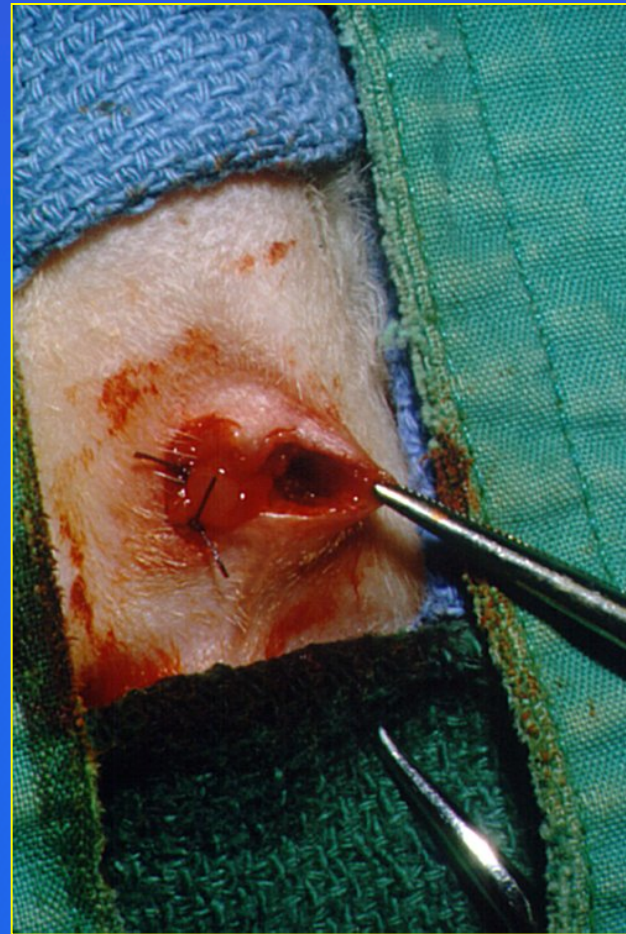
- Start at duct and work toward base
- Scrape anal sphincter muscle off
- Heal by second intention
- **DO NOT BREAK**
 - Staff will leave the hospital





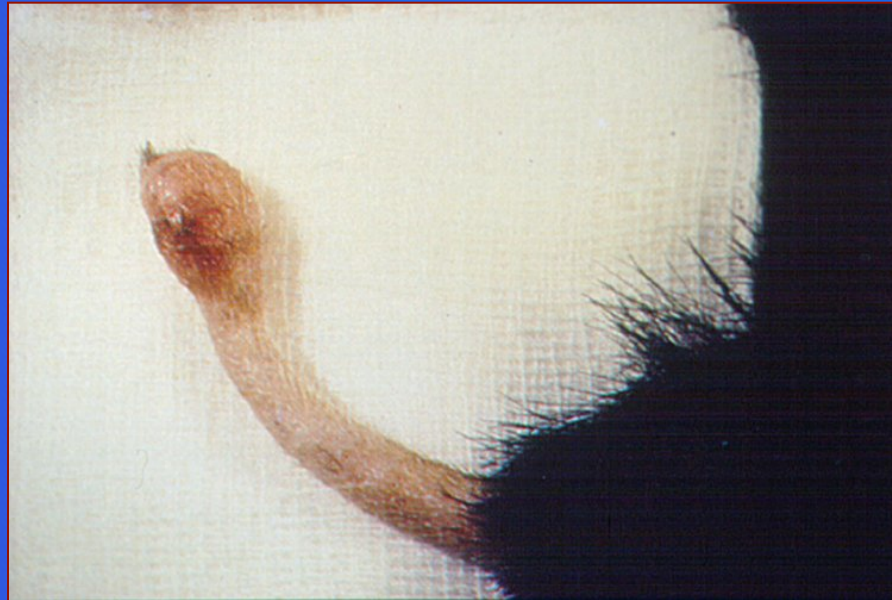
Anal Saccullectomy

- **Complications**
 - Infection
 - Incontinence
 - Fistula
 - Constipation



Chordomas

- **Remnant of notochord**
- **Usually at tip of tail**
- **Young ferrets**
- **Can occur in thoracic and cervical spine**



Chordomas

- **Histologically similar to chondrosarcomas**
- **Differentiated using immunohistochemical stains**
- **Tail chordomas**
 - **No neurologic abnormalities**
 - **Amputation of tail recommended**



Chordomas

- **Cervical and thoracic chordomas**
 - **May be neurologic due to compression**
 - **Benign tumor but large**
 - **CT or MRI**
 - **Evaluate compression**
 - **Plan surgery**
 - **Margins**

Chordomas

- **Surgery**
 - **Decompress spinal cord**
 - **Debulk or remove if possible**
 - **Resolution of clinical signs**
 - **Duration**
 - **Severity of compression**

Cutaneous Mast Cell Tumors

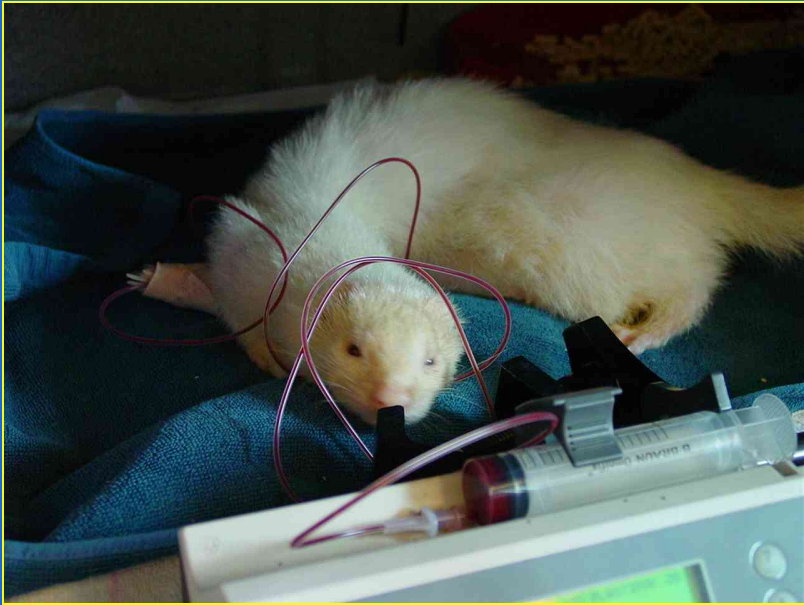
- Generally considered benign
- Neck, shoulders, trunk
- Small, red, raised , hairless, well circumscribed nodules
- Single or multiple



Cutaneous Mast Cell Tumors

- **Cytology**
 - Mature mast cells
- **Surgical excision with narrow margins**
 - Usually curative
 - Histamine blockers not given





Vertebral Trauma

- Conservative management
- Surgical stabilization

