An Introduction to Minimally Invasive Surgery II
Advanced Laparoscopy and Thoracoscopy

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Laparoscopic cholecystectomy

- **Main indication:** Uncomplicated gall bladder mucoceles
- **Case selection criteria:**
  - No evidence of extra-hepatic biliary tract obstruction
  - No evidence of bile peritonitis
  - Good candidates for anesthesia and pneumoperitoneum
  - Dogs over ~4kg
Patient positioning and port placement for LC

- **Dorsal recumbency**
- **Slight Trendelenburg**
- **4 port technique**
- **10mm port on midline**
- **One 5mm port for retractor on far left side at mid-abdominal level**
Ligating the cystic duct
Dissection around the cystic duct
Lap chole - GB removal
Laparoscopic adrenalectomy (LA) is standard of care in humans.

- Provides advantage of a lateral approach without the painful paramedian incision.

- Case selection is critical for success.

- Perioperative management is key to success just as it is with "open" adrenal surgery.
Case selection for laparoscopic adrenalectomy

+ Must rule out vascular invasion by diagnostic imaging:

-Ultrasound: sensitivity 80%, specificity 90% (Kyles et al. 2003)

-Computed tomography (CT): Sensitivity 92% Specificity 100% (Schulz et al. 2009)

+ If vascular invasion present do “open” approach

+ Tumor size:

-If diameter >3-4cm probably not suitable for LC
Case selection for LA Imaging: Ultrasound

Poor case for LA:
Tumor with vascular invasion into the caudal vena cava
Case selection for LA Imaging: Computed Tomography

Non-invasive Left-sided Pheochromocytoma

Moving cranial to caudal
Case selection for LA Computed Tomography

Left-sided tumor invading phrenicoabdominal vein and vena cava
Surgical approach for LA

- Patient positioned in lateral or near lateral recumbency with the affected side up

- 3-4 port technique in triangulating pattern around adrenal

Left approach

Right approach
**LEFT SIDED LA**

+ Dissect into retroperitoneum over gland.

+ Dissect out as much as possible of the surrounding fat.

+ Identify phrenicoabdominal vein (PV) and ligate/clip

+ Take care to observe renal vein

+ Once PV is dissected off then dissect dorsally
Left sided adrenalectomy
Laparoscopic Ureteronephrectomy

+ **Case selection – key to success**

+ **Suggested indications:**
  - small circumscribed neoplasms
  - idiopathic renal hematuria
  - renal dysplasia
  - mild hydronephrosis ± infection

+ **Suggested contraindications:**
  - large neoplasms
  - active pyelonephritis with extension beyond capsule

+ **If in doubt use advanced imaging (CT or MRI)**
**Surgical Technique**

- **Early dissection of the ureter is helpful**

- **Be careful to accurately identify the ureter and not confuse this with other structures**

- **Ureter can then be grasped and used as a handle for elevation of the kidney during artery and vein dissection**
Lap Ureteronephrectomy
Retroperitoneal dissection

• The technique begins with dissection of the retroperitoneal attachments of the kidney using a vessel-sealer
**Artery and Vein Dissection**

+ **Must dissect out all of the soft tissue around the renal artery and vein**

+ **Take care to dissect adrenal gland off the kidney**

+ **Use right angle dissector to get around the vessels**

+ **For ligation of artery and vein:**
  - Small dogs and cats: vessel-sealer, hemoclips
  - Larger dogs: Hemoclips, EndoGIA
Lap ureteronephrectomy
Dissecting renal artery and vein
Thoracoscopy

Human literature:
- Less pain, thoracic drainage, hospital stay, sepsis, pneumonia, death

Thoracoscopic procedures described:
- Pericardial window
- Subphrenic pericardecotomy
- Cranial mediastinal mass
- PDA ligation
- Thoracic duct ligation
- Vascular ring ligation
- Lung biopsy
- Lung lobe resection
Thoracoscopv
Instrumentation

- **Endoscopic tower**
- **Insufflator not required for most cases**
- **30 degree telescope is best**
- **Thoracic cannulae don’t need one-way valves**
Thoracoscopy instrumentation

EndoGIA stapling device

Suction/irrigation

Specimen retrieval bags
Anesthesia for thoracoscopy

Working space is provided by a pneumothorax after entry of first cannula

Thoracoscopy under pneumothorax:
- Ventilate for patient
- Monitor oxygenation by pulse oximetry and blood gas analysis
- Monitor ventilation by capnography and/or blood gas analysis

To increase working space:

1) Insufflate with CO2 (generally not well tolerated)
2) One-lung ventilation
Anesthesia for thoracoscopy

One-lung ventilation

+ **Respiratory rate by ~20%**
+ **Tidal volume by one half**
+ **PEEP (2-5cm H2O)**
+ **Close monitoring**

**Complications:**
- Balloon overinflation
- Hypoventilation
- V/Q mismatch
OLV: ENDOBRONCHIAL BLOCKER

+ Balloon-tipped catheter placed into right or left mainstem bronchus

+ Bronchoscopic guidance required

In some cases balloon not big enough.
OLV: Double-Lumen Endobronchial Tubes

Tube has two lumens; one terminates in bronchus and one in trachea

- Left and right sided tubes
  - Can use left sided tubes only
Patient Positioning

+ Lateral recumbency:
  - Thoracic duct ligation
  - Lung biopsy and lobectomy
  - PDA and vascular anomaly

+ Dorsal recumbency:
  - Pericardial window and subphrenic pericardectomy
  - Cranial mediastinal mass
  - Lung biopsy and lobectomy

+ Sternal recumbency
  - Thoracic duct ligation
**Thoracic access: Port placement**

- **Always use blunt cannulae**
- **Dorsal recumbency: Camera portal at subxiphoid location**
- **Lateral recumbency: Camera portal intercostally**

2-3 instrument portals intercostally
Thoracoscopic pericardecctomy

Techniques

Idiopathic or neoplasia-associated pericardial effusion:

- **Pericardial window** - small opening in pericardium to drain excess fluid - 3x3 cm or 4x4cm

+ Constrictive pericarditis and idiopathic chylothorax:

- **Subphrenic pericardecctomy** - removal of the pericardium ventral to the level of phrenic n.
Patient positioning and Port placement

- **Pericardial window:** Lateral or dorsal recumbency
- **Subphrenic pericardecotomy:** Dorsal recumbency
  - Subxiphoid camera portal
  - Instrument ports at 4-6th intercostal spaces located very ventral
Pericardial resection

+ Can be done with Scissors sharply but will cause greater hemorrhage
+ Use vessel-sealing device if possible
+ Always elevate the pericardium away from heart before activating vessel-sealer to avoid thermal/electrical injury to myocardium/coronary vessels
Surgical Technique: Pericardial Window

- Grasp the pericardium over heart apex
- Incise with vessel-sealing device
- Remove a 4x4cm window of pericardium
- Place in specimen retrieval bag
Specimen Retrieval

- If specimen is small can be retrieved through a large thoracic cannula
- If large sample then place in specimen retrieval bag

Port site metastasis has been described after pericardium affected with mesothelioma was pulled through an unprotected port incision (Brisson et al. Portal site metastasis of invasive mesothelioma after diagnostic thoracoscopy in a dog JAVMA 2006;229:980-983)
Lung Lobectomy in Small Animals

+ Indications:
- Primary lung neoplasms
- Metastatic neoplasia if single or confined to one lobe
- Chronic consolidation
- Pulmonary abscessation
- Lung lobe torsion
- Pulmonary bullae/blebs
TLL: Evidence from Human Literature

+ TLL is associated with a 4.6-6.7% conversion rate in humans
+ Complication rates (34-39%) and mortality (1.4-1.6%) are similar
+ TLL is associated with decreased:
  - hospital stay
  - chest tube times
  - prolonged air leak
  - renal failure
  - sepsis
  - pneumonia

Thoracoscopic lung lobectomy (TLL): Case Selection

+ **Patient size:**
Dogs over 20kg best candidates
Small dogs and cats: difficult due to stapler size and OLV

+ **Disease process:**
- Primary and metastatic neoplastic lesions
- Well-circumscribed pulmonary abscess/consolidated lobes
- Pulmonary bullae/blebs

+ **Lesion Characteristics:**
- Lesion Size: <8-9cm diameter (dogs over 25kg)
- Location: lesions away from the pulmonary hilus
**TLL: Good case selection**

- **Large mass but well away from Hilus**

- **Large dog...37kg Labrador**
TLL: Poor case selection

Very large mass close to hilus

- Small dog...7kg terrier
Patient positioning and port placement

**Patient positioning**

- **Single lesions in known lobe:**
  - Lateral recumbency with affected lobe up

- **Multiple lesions in different hemithoraces or unknown lesion location:**
  - Dorsal recumbency

**Port Placement**

- **Lateral**
  - Camera portal at level of lung hilus
  - Instrument portals: triangulate around hilus

- **Dorsal recumbency:** will depend on lesion location
Caudal Lobes:
Incision through pulmonary ligament
TLL: STAPLING ACROSS THE HILUS

- Use EndoGIA 60mm cartridge with 3.5mm staples in all medium to large dogs
- Will often need a second staple cartridge to complete the resection
Lung Lobe Retrieval

 Always retrieve neoplastic samples through protected port incision
**Idiopathic Chylothorax**

- Accumulation of chyle within the pleural cavity results in respiratory distress, pleural fibrosis, hypoproteinememia

**Treatment options:**
- Thoracic duct ligation (TDL)
- Pericardectomy (PC)
- Cisterna chyli ablation (CCA)
- Omentalandization
- Thoracic duct embolization
- Rutin therapy
- Drainage techniques (Denver shunt, SVAP placement)
Thoracoscopic treatment of idiopathic chylothorax

**TDL ONLY**
- Dogs and cats: ~50% resolution

**Open TDL+PC**
- 10/10 dogs and 8/10 cats resolved
  (Fossum TW et al. JVIM 2004)

**Minimally invasive TDL+PC**
- 7/8 dogs resolved
- 6/6 dogs resolved
  (Mayhew et al. In press)
**Technique - TDL**

- 3 ports established at 7-9th ICS in triangulating pattern around caudal mediastinum
- ~5cm paracostal “port” on right side
- Lymphangiograms pre and post-operatively can be used
- Methylene blue injected into mesenteric LN
- TDL performed by clip application after dissection
TD visualization

- Exteriorize the lymph nodes around the ileo-cecocolic junction
- Inject diluted methylene blue
TDL ligation
Cranial mediastinal mass resection

- Most cranial mediastinal masses too large at time of diagnosis for MIS
- However if modestly sized may be resectable
- Advanced imaging very important pre-operatively
Complications after thoracoscopic lung surgery

**Hemorrhage:**

- From pulmonary hilus: Grasp bleeding vessel, clip, re-staple or endoloop

- From intercostal artery/vein: Suture around rib

**Air leak**

- From hilus: Use clips or re-staple

- From iatrogenic damage to other lobes
Conclusions

- Many new and exciting developments in the rapidly growing area of minimally invasive surgery
- Requires a team approach
- Case selection, training and the right equipment are the keys to success
Any Questions?

Yosemite National