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Minimally Invasive Surgery

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TYPES OF SURGERY

- Thoracic
- Abdominal
- Gastrointestinal
- Urogenital
- Neurologic
- Orthopedic
- Skin and Reconstructive
- Surgical Oncology
- Ophthalmic
- Minimally Invasive





Minimally invasive surgery

- · History of Endoscopy
- Role in Veterinary Medicine
- Advantages/Disadvantages
- Equipment
- Laparoscopy
- Thoracoscopy
- Arthroscopy
- Future Directions



History of endoscopy

- 1806 Philip Bozzini built an instrument that could be introduced into the human body to visualize internal organs.
- He termed this instrument the LICHTLEITER
- At that time people did not understand this procedure.
- He was reviewed by the Vienna medical faculty and punished for his





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History of endoscopy



- 1853 Antoine Jean Desormeaux - first introduced Bozzini's Lichtleiter into a patient.
 - He is considered by many to be the "Father of Endoscopy"

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History of endoscopy

- 1879 Maximilian Carl-Friedrich Nitze - used a heated wire with cooling system and created the first optical endoscope with built-in source of illumination.
- 1887 Nitze Constructed a source of illumination that did not require cooling







History of endoscopy



 1881 - Josef Leiter succeeded in constructing the first useful clinical gastroscope in Billroth's clinic in Vienna

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History of endoscopy

- 1901 Georg Kelling, a German physician from Dresden, performed the first laparoscopy of a dog's abdomen.
- He coined the term 'coelioskope' to describe the technique that used a cystoscope to explore the abdominal cavity of dogs.
- He also used filtered air to create a pneumoperitoneum with the goal of stopping intra-abdominal bleeding. He referred to this technique as 'air-tamponade'.





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History of endoscopy

- 1910 Hans Christian Jacobeaus, a Swedish physician, performed the first laparoscopy and thoracoscopy in a human.
- 1911 *Bertram Moses Bernheim*, from Johns Hopkins
 Hospital, introduced
 laparoscopic surgery to the
 United States. He named the
 procedure "organoscopy".



Bernheim



History of endoscopy



- 1929 Heinz Kalk, a German gastroenterologist, is considered the founder of the German School of Laparoscopy. He used laparoscopy as a diagnostic method for liver and gallbladder disease.
- In 1939 he published his experience of 2000 liver biopsies performed using local anesthesia without mortality.

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History of endoscopy

- 1938 *Janos Veress*, of Hungary, developed the spring-loaded needle. Its main purpose was to perform therapeutic pneumothorax to treat patients suffering from tuberculosis.
- Today, it is mainly used to create a pneumoperitoneum to aid in laparoscopy.



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History of endoscopy

- 1980 Patrick Steptoe, from England started to perform laparoscopic procedures in the operating room under sterile conditions.
- 1981 The American Board of Obstetrics and Gynecology made laparoscopy training a required component of residency training.
- 1982 First solid state camera was introduced. This is the start of "video-laparoscopy".
- 1987 Phillipe Mouret, performed the first video-laparoscopic cholecystectomy in Lyon, France.
- 1994 A robotic arm was designed to hold the laparoscope camera and instruments with the goal of improving safety, reducing resource utilization and improving efficiency and versatility for the surgeon.
- 1996 First live broadcast of laparoscopic surgery via the Internet.



History of veterinary endoscopy

- 1977-GF Johnson described the use of laparoscopy in dogs for the diagnosis of neoplasia. Vet Clinics.
- 1977-DC Twedt described the use of laparoscopy in the evaluation of dogs with liver disease. Am J Dig Dis.
- 1983-GF Grauer described using laparoscopy for renal biopsy in dogs and cats.
 JAVMA.
- 1993-LD Silva described a laparoscopic technique for vasectomy in male dogs. J Reprod Fertil Suppl.
- 1999-DC Twedt described the use of laparoscopy in the diagnosis of pancreatic disease in dogs. Small Animal Endoscopy.
- 2002-CA Rawlings described laparoscopic gastropexy technique. JAAHA.
- 2002-CA Rawlings described the use of laparoscopy for small intestinal biopsy and feeding tube placement. AJVR.
- 2008 American College of Veterinary Surgeons made minimally invasive surgery training a required component of residency training for residency class of 2011.

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Endoscopy: advantages

- · Less post-operative pain
- · Faster return to function
- Smaller incisions are more cosmetic
- · Potentially faster
- Excellent magnification and image capture
- Better documentation of lesions



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Endoscopy: disadvantages



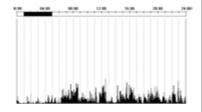
- Expense of the equipment
- Setup time of equipment
- Techniques can be very difficult
- Long learning curve
- · Surgical team required
 - Usually require a camera operator
- Not all procedures can be performed via laparoscopy/ thoracoscopy
- Potential need to convert to open procedure



Pain measurement

- Subjective pain scoring systems
- Activity monitoring
 - Indirect measure of discomfort?, pain?
 - Validated for use in dogs (Hansen et al. 2007)
 - Multiple studies have proven decreased activity postoperatively with open procedures relative to laparoscopic procedures
 - Laparoscopic ovariectomy (LOV) (Culp, et.al, 2008)
 - Significantly lower activity levels in small dogs (<6 kg) with open procedure versus LOV
 Highlights that laparoscopic
 - Highlights that laparoscopic procedures are useful even in our small patients
 - Laparoscopic gastropexy (Mayhew & Brown, 2008)
 Totally Laparoscopic Gastropexy (TLG)
 resulted in 25-33% greater activity
 compared to Laparoscopic-Assisted
 Gastropexy (LAG) in 7d post-op
 - Effect lasted for ~5 days post-op

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Activity monitor counts



Equipment

- Rigid Laparoscope/Arthroscope
 - 3mm, 5mm, or 10mm
 - 0 degree or 30 degree
- Camera 1 chip or 3 chip, HD
- Light source halogen or xenon
- Monitor flat screen or crt
- Video or digital image recording
- Insufflator and CO₂
 (Laparoscopy)
- Electrosurgical unit
- Selection of trocars and instruments







Equipment

- Instruments:
 - Selection of trocars
 - Sharp trocars
 - Hasson trocar
 - Veress needle
 - Obturators





Equipment



- Instruments:
 - Scissors
 - Dissecting forceps
 - Grasping forceps
 - Biopsy instruments
 - Blunt Probe
 - Suturing instruments
 - Stapling equipment
 - Suction / Irrigation
 - Electrocautery

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Laparoscopy

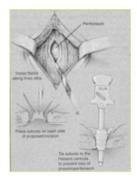
- Procedure:
 - Establishment of pneumoperitoneum
 - Open vs. closed techniques
 - Placement of trocars for laparoscope and instruments, location and number depends on procedure
 - Air tight seal needed

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Establishment of pneumoperitoneum

- Open technique:
 - Small incision made into peritoneal cavity
 - Hasson trocar is placed
 - Gas introduced through trocar (fast)
 - Slower due to incision
 - Less risk of damaging organs



Hasson Technique



Establishment of pneumoperitoneum



Veress Needle

Closed technique:

- Use Veress needle to place gas in abdomen
- Faster than open technique
- More risk of iatrogenic damage to internal organs

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Gilroy BA. Fatal air embolism during anesthesia for laparoscopy in a dog. JAVMA. 1987.



Effects of laparoscopy

- Effects of abdominal insufflation:
 - Usually use CO₂ but N₂O may be used
 - Keep intra-abdominal pressure < 15mmHg
- Detrimental effects of increased IAP:
 - Respiratory depression
 - Cardiovascular depression
 - Decreased perfusion of internal organs

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Duke T. Cardiopulmonary effects of using CO2 for laparoscopic surgery in dogs. Vet Surg. 1996.



Laparoscopy

- Helpful hints:
 - Use positioning to your advantage
 - Empty bladder prior to procedure
 - Position trocar slightly off midline to avoid falciform fat





Laparoscopy

- Indications:
 - Biopsy of:
 - Liver
 - Pancreas
 - Kidney
 - Omentum
 - Peritoneum
 - Intestine
 - Abdominal exploratory
 - Prophylactic gastropexy
 - Cryptorchid castration

- Ovariohysterectomy
- Ovariectomy
- Staging of tumors
- Cholecystocentesis/ ectomy
- Cystotomy
- Feeding tube placement
- Adrenalectomy leftsided



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Laparoscopy



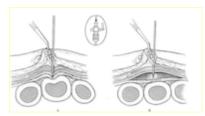
- Contraindications:
 - Previous abdominal surgery?
 - Adhesions?
 - Clotting abnormalities?
 - Diaphragmatic hernia
 - Large masses
 - Septic peritonitis



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Laparoscopy

- Complications:
 - Effects of excessive insufflation
 - Hemorrhage
 - Organ damage
 - Sub-cutaneous emphysema
 - Gas embolism
 - Herniation at trocar site





Laparoscopic port placement



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Laparoscopic exploratory



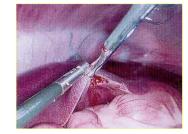
- Examine the cupola of diaphragm
- Examine the liver lobes dorsally and ventrally
- Examine the gall bladder and some of the common bile duct
- Examine the kidneys
- Examine the spleen
- · Examine the bladder
- Run the intestinal tract from descending duodenum to cecum

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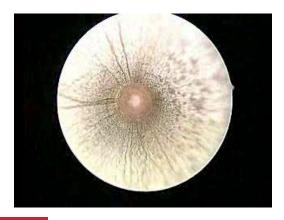
Laparoscopic liver biopsy

- Identify abnormality
- Punch biopsies
 - Obtain multiple
- Guillotine peripheral lobe
 - Endoloop suture





Laparoscopic liver biopsy

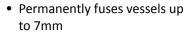


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Vessel sealing devices





Coagulates, cauterizes, divides



- Harmonic scalpel
 - Ultrasonic technology
- Can be used in open or laparoscopic procedures

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Laparoscopic ovariohysterectomy

- Ovariohysterectomy
 - Three port technique
 - Camera port
 - Two instrument ports
 - Assisted or intracorporeal
- Ovariectomy
 - Two port technique
 - Camera port
 - One instrument port
 - Suture to hold proper ligament



Laparoscopic-assisted Spay with EnSeal



Laparoscopic cryptorchidectomy

- Laparoscopicassisted
 - Two port technique
- Laparoscopic
 - Three port technique



Laparoscopic-assisted cryptorchidectomy

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Laparoscopic gastropexy

- Totally laparoscopic stapled gastropexy (Hardie RJ et al. 1996)
 - Adv: Totally laparoscopic
 - Disadv: extended surgical time, 14% gastric perforation, expensive
- Laparoscopic-assisted gastropexy (Wilson ER et al. 1996; Rawlings CA 2001&2002)
 - Adv: User-friendly, rapid, cheap
 - Disadv: full thickness body wall incision, infection
- Laparoscopic intracorporeally sutured gastropexy (Mayhew & Brown, 2008)
 - Adv: Totally laparoscopic, decreased pain relative to open or LAG
 - Disad: extended surgical time, long learning curve

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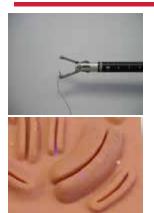


Laparoscopic-assisted gastropexy





Endostitch™



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- Automatic suture pass
- 10mm port required
- Allows intracorporeal suture manipulation
- Precludes the need for laparoscopic-assisted surgery
- Learning curve
- Expensive
- Four suture types available



Laparoscopic gastropexy

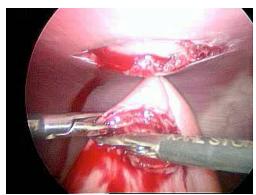


- Three port technique
 - Camera port
 - Two instrument ports
 - Suture to hold stomach

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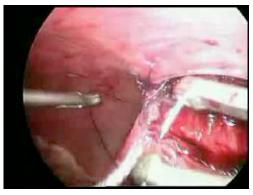
Laparoscopic gastropexy



Gastropexy incision made with laparoscopic scissors



Laparoscopic gastropexy



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Laparoscopic gastropexy

- EN-S Ski needle with 2-0 polyglactin 910
- 5mm Szabo-Berci parrot-jaw needle holders



EN-S

• Two simple continuous suture lines placed

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Laparoscopic gastropexy



Gastropexy with intracorporeal suture passers



Laparoscopic-assisted



Alexis Wound Retractor (2-4cm)

- Initial laparoscopic exploratory
- Alexis wound retractor
 - Intestinal resection and anastomosis
 - Gastrointestinal biopsies
 - Foreign bodies

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Veterinary thoracoscopy

- 1995-AM Remedios described laparoscopic and thorascopic fenestration of the intervertebral disk in dogs. Vet Surg.
- 1998-KK Faunt described using thoracoscopy for lung lobe biopsy. AJVR.
- 2000-K Isalow described the use of thoracoscopy to ligate the ligamentum arteriosum in dogs with PRAA. JAVMA.
- 2001-MacPhail and Monnet also described thorascopic ligation of PRAA in dogs. JAAHA.
- 2001-ED Malone described thorascopic diaphragmatic hernia repair in a dog. Vet Surg.
- 2002-MG Radlinsky described thorascopic ligation of the thoracic duct in dogs. Vet Surg.
- 2002-J Jackson described thorascopic partial pericardectomy in 13 dogs. JAVMA.

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Thoracoscopy

- Also called Video Assisted Thoracic Surgery (VATS)
- Same instrumentation as laparoscopy
- Can be positioned in lateral or dorsal recumbency
- Airtight seal not necessary



Thoracoscopy

- Advantages:
 - Dramatically less pain
 - Faster recovery
 - Faster procedure
 - Cosmetic
 - Decreased hospitalization



Pericardectomy



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Thoracoscopy

- Disadvantages:
 - Not all procedures possible
 - · Careful anesthetic monitoring is required
 - · Impossible if inadequate space in thoracic cavity
- Potential complications:
 - Hemorrhage
 - Inadvertent lung injuries
 - Inability to complete procedure and need to convert to open procedure

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Thoracoscopy

- Indications:
 - · Biopsies of:
 - Pleura
 - Mediastinum
 - Pulmonary masses
 - Lymph nodes
 - Pericardium
 - Thoracic exploratory
 - Chylothorax
 - Thoracic duct ligation

- · Pulmonary masses
 - Peripheral, single
 - Lung lobectomy
- Thymoma excision
- Spontaneous pneumothorax
- Pericardectomy
 - Window or Subtotal
- PRAA division
- PDA division



Thoracoscopy

- Contraindications:
 - Severe adhesions from previous surgery
 - Pulmonary gas exchange abnormalities
 - Ascites
 - Large lung tumors
 - Pleuritis



Normal pericardium



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Thoracoscopy



Ports

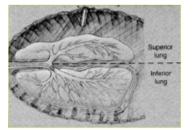
- Procedure:
 - Creation of pneumothorax
 - Placement of trocars for thoracoscope and instruments, location and number varies
 - Intubation of one bronchus if one lung ventilation is needed

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Thoracoscopy

- Methods to increase working space:
 - Bilateral pneumothorax
 - Thoracic insufflation (4-6 mmHg)
 - One lung ventilation (OLV)





Thoracoscopy



Double lumen endotracheal one lung ventilation

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- One lung ventilation
 - Double lumen endotracheal tubes
 - Allow alternating hemithorax inflation
 - Bronchial blockers
 - Allow collapse of one side of lung to increase visualization



Thoracoscopic lung lobectomy

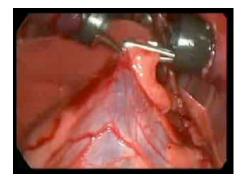
- Lung Lobectomy
 - Ideal cases:
 - Peripheral, single masses
 - Any lobe
 - Ligation:
 - Endoloop suture
 - EndoGIA stapler



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Thoracoscopic pericardectomy



Arthroscopy

- Procedures performed:
 - Shoulder:
 - Osteochondritis dissecans (OCD)
 - Bicipital tenosynovitis
 - Shoulder instability
 - Joint mice
 - Elbow:
 - Fragmented medial coronoid process (FMCP)
 - Humeral OCD
 - Ununited anconeal process (UAP)
 - Stifle
 - Joint exploratory
 - Meniscal tear excision

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Methods to improve skill level

- Practice, practice, practice
 - Laparoscopic training aid
 - Use laparoscopic spays to hone skills
 - Incorporates explore, soft tissue handling, and port management
- Play lots of video games
 - Facilitates 2-D to 3-D spatial awareness



Laparoscopic Simulator





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Veterinary Endoscopy Society

- Yearly conference
- Sponsor training at national conferences
- Aid in training surgery residents
- Facilitates cross-specialty interaction involving generalists, internists, and surgeons



QUESTIONS		
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