Minimally Invasive Surgery

• Pre Test Questions:
  1. Carbon dioxide is used to create a pneumoperitoneum for laparoscopic surgery because it can be easily absorbed across the peritoneum?
     A. True
     B. False

Minimally Invasive Surgery

• Pre Test Questions:
  2. Laparoscopy is contraindicated for pregnant women in the third trimester?
     A. True
     B. False

Minimally Invasive Laparoscopic Surgery (MILS)

• Objective:
  – Discuss History of MILS
  – Discuss Physiology of Pneumoperitoneum
  – Discuss types of surgeries performed with minimal invasion
  – Discuss Advantages of MILS
  – Discuss Pre and Postoperative care
  – Discuss most common general laparoscopic surgeries
  – Discuss possible complications and their management.
  – Present and Future advancements in Laparoscopy

Minimally Invasive Laparoscopic Surgery (MILS)

• History of MILS
  – Kelling 1901: Placed cystoscope into the abdomen for the first time
  – Hopkins 1950: Described the rod lens which allowed light to be transmitted without heat
  – 1950s: Thin quartz fibers were discovered leading to flexible fiberoptics
  – 1970s: Flexible endoscopy was developed
  – 1980s-Present: Compact high resolution video cameras
Minimally Invasive Laparoscopic Surgery (MILS)

- Physiology of MILS
  - Pneumoperitoneum
    - CO₂
      - Gas specific effects:
        - Respiratory Acidosis caused by Carbonic Acid production
        - Bones are the largest reserve of buffers
        - Respiratory system takes over when buffers are saturated
      - Pressure specific effects:
        - Decrease in venous return and cardiac output (pressure on IVC)
        - Bradycardia is the most common arrhythmia
        - Vagovagal response (treated with desufflation and atropine)
        - Prevented by being normovolemic

- Transabdominal incisions:
  - Laparoscopy allows us to visualize the entire abdominal compartment with minimal trauma
  - Transection through the rectus muscles or midline can create severe pain and respiratory dysfunction

- Endocrine balance:
  - Laparoscopic surgery allows for a more rapid equilibration of most stress mediated hormone levels.
  - Immune suppression is less after laparoscopy

If a procedure is performed with the same basic principles, both open or laparoscopically, the chances are it will be successful.

Minimally Invasive Laparoscopic Surgery

- Advantages of MILS
  - Decreased risk of surgical site infections
  - Decrease length of stay
  - Fewer complications
  - Less pain
  - Cosmetic (Smaller scars)
  - Lower risk of incisional hernias
  - Less adhesions

Minimally Invasive Laparoscopic Surgery

- Surgeries being performed with minimally invasive techniques:
  - Cholecystectomy
  - Appendectomy
  - Hernia repair (incisional, inguinal, ventral)
  - Colon resection (cancer and diverticulitis)
  - Bariatric surgery (Gastric Band, SG, RYGB)
  - Endocrine (adrenalectomy and pancreatectomy)
  - Splenectomy
  - Foregut surgery

Minimally Invasive Laparoscopic Surgery

- Decreased Surgical Site Infections (SSI):
  - Annals of Surgery 2003
    - 54,500 inpatient Cholecystectomies
    - 554 SSI were reported mostly Gram + bacteria
    - 69% were discovered in the hospital and 38% in postop follow up
    - Risk of SSI 0.62% in laparoscopy and 1.82% in the open procedure.
Minimally Invasive Laparoscopic Surgery

• Advantages of Laparoscopy:
  – The Lancet 2002
  • Randomized trial
  • 219 patients with colon cancer were treated with either
    Laparoscopic-assisted colectomy or open colectomy.
  • Laparoscopic group had a shorter hospital stay than the open
    group: 5 days: 8 days.
  • Fewer complications: 12:11 vs. 31:108
  • Relative risk reduction for LAC vs. OC was 61% for tumor
    relapse; 52% for death and 62% for cancer related death.

Minimally Invasive Laparoscopic Surgery

• Preoperative Evaluation:
  – Most patients are candidates for laparoscopic surgery
  – Patients who have had prior abdominal
    surgeries pose some risk and have a higher
    conversion rate
  – All major surgical cases should have basic
    labs and studies prior to surgery
    • CBC, CMP, Chest X-ray and EKG

Minimally Invasive Laparoscopic Surgery

• Preoperative Evaluation (special cases)
  – Pregnant patients:
    • SAGES 2009
    – 1:500 pregnant women will undergo non-obstetrical
      surgery
    – Most common surgeries are appendicitis, cholecystitis
      and intestinal obstruction
    – Radiation exposure and fetal age are the most important
      factors with cumulative ionized radiation dose of 5-10
      rads and weeks 10-17 as the most critical time.
    – Laparoscopy and pneumoperitoneum is safe
    – US and MRI without gadolinium are safe
    – CT scan usually gives 2-4 rads.

Minimally Invasive Laparoscopic Surgery

• Preoperative Evaluation (special cases)
  – Pregnant patients:
    • SAGES 2009
    – Laparoscopy can safely be performed during any
      trimester of pregnancy
    – Laparoscopy reduces the risk of uterine irritability
    – Slightly higher risk of DVT so TED and SCD placement
      with early ambulation is recommended.

Minimally Invasive Laparoscopic Surgery

• Preoperative Evaluation (special cases)
  – Incisional hernias
    • All patients should have CT scan to determine the
      size, location and content of hernias
    – If the hernia is large, multiple or contains
      significant amount of intra-abdominal contents
      should consider open procedure and possible
      component separation.

Minimally Invasive Laparoscopic Surgery

• Laparoscopy for Cancer
  – Annals of Surgery 2009
  • Retrospective study of 471 patients undergoing
    resection for rectal cancer (238 Laparoscopy and
    233 Open)
  • Mortality 0.8% vs. 2.6%, Morbidity 22.7% vs.
    20.2% and quality of surgery 92% vs. 90%.
  • Findings: Laparoscopic resection is as effective as
    open and there is similar long-term local control
    with improved cancer-free survival rate.
Minimally Invasive Laparoscopic Surgery

• New indications for Laparoscopic Sigmoidectomy

Most Common Laparoscopic Surgeries

• Cholecystectomy:
  – Most common major abdominal procedure in Western countries
  – 1882: Carl Langenbuch performed first case
  – 1987: Philippe Mouret (France) performed first laparoscopic cholecystectomy
  – Revolutionized laparoscopy in the US
  – Now the standard of care for gallbladder surgery

Most Common Laparoscopic Surgeries

• Cholecystectomy:
  – Indications:
    • Symptomatic Gallstones
    • Decreased Ejection Fraction and recreation of symptoms by HIDA scan
  – Contraindications:
    • Uncontrolled coagulopathy
    • End-stage liver disease
  – Relative contraindications:
    • COPD, CHF with EF<20%

Most Common Laparoscopic Surgeries

• Cholecystectomy:
  – Preoperative Testing:
    • CBC, Liver function test
    • US +/- HIDA scan
  – Risk:
    • Mortality rate is 0.1%
    • Possible complications
      – Bile duct injury
      – 0.55% risk of major injury
      – 0.3% risk of minor injury
      – Total of 0.85%
      – Bowel injury

Most Common Laparoscopic Surgeries

• Cholecystectomy:
  – Diagnosis of Bile Duct Injury
    • 25% are identified at time of injury
    • 50%+ will present within the first month
    • Rest present over the next months to years
    • Symptoms:
      – Pain, Fever, elevation in LFTs and jaundice
      – CT scan can identify bilomas or free fluid in the abdomen
      – HIDA scan can identify active leak
      – ERCP can be used to stent bile duct and relieve obstruction

Most Common Laparoscopic Surgeries

• Cholecystectomy
Most Common Laparoscopic Surgeries

• Appendectomy:
  – 1800’s: Claudius Amyand performed first Open Appendectomy
  – 1983: Semm performed first Laparoscopic Appendectomy
  – Requires 3 small incisions
  – Benefits:
    • Less pain
    • Length of stay is less

Most Common Laparoscopic Surgeries

• Colon:
  – Cancer
  – Diverticulitis

Most Common Laparoscopic Surgeries

• Hernia Repair:
  – Incisional or Ventral
    • Indications:
      – Same as for open
    • Candidates:
      – Procedure is widely used today.
      – Elderly and Obese patients
      – Diabetics (avoid large wounds)
    • Relative contraindications:
      – Patients with large hernias where the rectus muscles are far apart
      – Adhesions (most can be removed laparoscopically)
      – Multiple hernias along the midline

Most Common Laparoscopic Surgeries

• Hernia Repair:
  – Inguinal
    • Indications for Laparoscopy is same as for open.
      – Asymptomatic reducible hernia has a 1% risk of incarceration
      – Symptomatic patients should undergo repair
    • Hernia is not repaired the same as for open technique.
      – Total Extraperitoneal approach (learning curve 250 cases)
      – Transabdominal peritoneal repair (learning curve of 25)
      – May reduce postoperative pain and have similar recurrence rates as compared to open technique.

Minimally Invasive Laparoscopic Surgery

• Postoperative Complications
  – DVT/PE
  – Wound infection
  – Hernia

Surgical Complications

• Pulmonary Embolism
  – Symptoms: SOB, hypoxemia, tachypnea, right heart strain on EKG.
  – Source: Lower extremity venous clots
  – Diagnosis: Chest CT angiogram and lower extremity ultrasound
  – Prevention: TEDs and SCDs and or anticoagulants, early postoperative ambulation
  – Treatment: low molecular weight heparin or Coumadin for 3-6 months.
Surgical Complications

• Abdominal Abscess:
  • Presentation:
    • Vague complaints
    • Pain, fever, leucocytosis, and change in bowel habits.
    • Diffuse peritonitis requires surgical exploration.
  • Evaluation:
    • CT scan
  • Treatment
    • Antibiotics broad spectrum at first
    • Percutaneous drainage

Surgical Complications

• Necrotizing Fasciitis:
  • Fulminant soft tissue infection
  • Causes: 30-70% mortality
    • Group A streptococcal infections
    • Clostridium perfringens
    • Clostridium septicum
  • Septic Shock
    • Less than 6 hours after inoculation
  • Treatment:
    • Surgical emergency requiring wide debridement with multiple trips to the OR
    • Antibiotics: Mixed synergistic infections

Surgical Complication

• Ileus:
  • Cause: Dysfunction of the neural reflex
  • Prevention: Laparoscopic procedures, epidural anesthesia, early ambulation
  • Treatment: Bowel rest, erythromycin (motilin-agonist)

Surgical Complication

• Wound Infection
  • Prevention
    • Skin Prep (shaving patient in the operating room)
    • Antibiotics (not to exceed 24 hours unless treating active infection)
  • Clinical Signs
    • Rubor, tumor, calor, and dolor (redness, swelling, heat, and pain)
  • Treatment:
    • Open drainage is most definitive
    • Antibiotics use should be limited.

Surgical Complication

• Incisional Hernia:
  • Incidence
    • 10-15% of all laparotomies
  • Cause:
    • Healing failure
  • Symptoms:
    • Asymptomatic
    • Pain, incarceration, or strangulation
  • Risk:
    • Chronic cough, wound infection, malnutrition, obesity, immunosuppression
  • Treatment:
    • Primary repair has a high failure rate approximately 43%
    • Mesh repair is the treatment of choice (usually laparoscopically)
Minimally Invasive Laparoscopic Surgery
• Present and Future of Laparoscopy
  – Single Incision Laparoscopy
    • Cholecystectomy
    • Appendectomy
    • Bariatrics
  – NOTES
    • First clinical trials with humans is underway looking at NOTES cholecystectomy vs conventional laparoscopy.
    • Support from SAGES, ACS, ASGE is growing

Minimally Invasive Surgery
• Post Test Questions:
  1. Carbon dioxide is used to create a pneumoperitoneum for laparoscopic surgery because it can be easily absorbed across the peritoneum?
   A. True
   B. False

Minimally Invasive Surgery
• Post Test Questions:
  2. Laparoscopy is contraindicated for pregnant women in the third trimester?
   A. True
   B. False

Minimally Invasive Surgery
• Post Test Questions:
  3. Which of the following diagnosis should be exclusively treated in the traditional open surgical technique?
   • A. Gangrenous Cholecystitis.
   • B. Acute appendicitis in a 24 week gravid female.
   • C. 65 y.o. male with a right colon cancer
   • D. 30 y.o. male with a reducible inguinal hernia
   • E. None of the above.

References
• Annals of Surgery 2003;237(2) Does using a laparoscopic approach to cholecystectomy decrease the risk of surgical site infection.
• Lancet, The 2002 Laparoscopy may be better than open colectomy for colon cancer.
• SAGE 2009; What diagnostic or imaging techniques and surgical treatment modalities to use for the pregnant patient with common surgical illnesses?
• Annals of Surgery 2009;250(1) Laparoscopic versus open surgery for rectal cancer: Long-Term oncologic results.