AnatomyGuy Articles

Laparoscopic Cholecystectomy:

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INDEX:

Introduction:

Laparoscopic cholecystectomy is the minimally invasive surgical procedure for removal of the gallbladder. The first laparoscopic cholecystectomy was performed in German in 1985. Since that time, it has become the procedure of choice for gallbladder removal amongst surgeons and patients. Laparoscopic cholecystectomy has been shown to decrease hospital length of stay, decrease patient pain, and decrease visible surgical scars as compared to the open approach.

Indications:

Cholecystectomy is indicated in patients with:

- Symptomatic cholelithiasis
- Acute or chronic cholecystitis
- Choledocholithiasis causing cholangitis – once appropriate treatment has been administered
- Gallstone pancreatitis
- Acalculous cholecystitis
- Gallbladder polyps >1cm
- Biliary dyskinesia
- Immune compromised patients with any type of biliary disease (i.e. diabetics, sickle cell patients)

Contraindications:

- Inability to tolerate anesthesia
- Uncorrected coagulopathy
- Gallbladder carcinoma
- End-stage liver disease
- Extensive prior abdominal procedures

Risk Factors for Biliary Disease:

- Obese
- Rapid Weight loss
- Pregnancy
- Female
- Age
- Ileal disease, resection or bypass

Differential Diagnosis for Biliary Disease:

Cholecystitis:

- Inflammation of the gallbladder caused by obstruction of the cystic duct. The gallbladder distends and the wall becomes edematous and thickened. Patients generally experience constant right upper quadrant pain that is more severe than episodes of biliary colic

Symptomatic cholelithiasis/Biliary colic

- Patients with gallstones (also called cholelithiasis) may experience pain after eating fatty foods. After a fatty meal, the gallbladder contracts and stones may intermittently obstruct the cystic duct and cause pain. This pain generally occurs in the epigastric or right upper quadrant regions and will dissipate after a matter of hours

Choledocholithiasis

- Gallstones may pass from the gallbladder, through the cystic duct and into the common bile duct. The condition with stones in the common bile duct is termed choledocholithiases. These stones may pass through the sphincter of Oddi on their own or may become blocked and impede the flow of bile into the duodenum. Obstruction may lead to cholangitis and cholecystitis may be seen concurrently. In addition, stones obstructing near the ampulla may also cause gallstone pancreatitis. Laparoscopic common bile duct exploration at the time of cholecystectomy or ERCP with sphincterotomy is the procedure of choice for treating choledocholithiasis.

Cholangitis

- Infection of the biliary system often caused by obstructive choledocholithiasis or biliary strictures. Patients may present with charcot's triad of right upper quadrant pain,

jaundice and fever (Reynold's pentad includes shock and mental status changes). Treatment requires urgent cholangiogram with bile duct drainage.

Biliary dyskinesia

- Patients presenting with symptoms of biliary colic but have no gallstones should be evaluated for biliary dyskinesia. A HIDA scan with CCK injection may be performed to determine the gallbladder ejection fraction (<35% is considered abnormal).

Gastroenteritis

- Viral infection of the intestinal tract, generally self-limited

Peptic ulcer disease

- May present with epigastric pain and may be associated with eating. Patients should undergo trial with an H2-blocker or PPI. Endoscopy may be used to visualize ulcers if the diagnosis is unclear or if medical therapy fails

GERD (Gastroesophageal reflux disease)

- May present as epigastric pain. Treatment includes H2-blockers or PPI

Hepatitis

- May present as right upper quadrant pain with elevated transaminases. Diagnosis may be made with a hepatitis panel

Pancreatitis

- Seen as epigastric pain and most often caused by gallstones or alcohol. Gallstone pancreatitis will present with elevated alkaline phosphatase and hyperbilirubinemia as seen with choledocholithiasis. In addition, lipase is elevated. Treatment includes relieving the obstructing stones and bowel rest with IVF until the pancreatitis resolves. These patients require cholecystectomy to prevent future episodes.

Diagnostic Tools:

- History and physical exam may reveal risk factors for gallstones as noted above. Patients may present with right upper quadrant pain, right shoulder pain, epigastric pain, jaundice or postprandial pain depending on their disease process

- Laboratories may be normal in many cases of symptomatic cholelithiasis, early cholecystitis or biliary dyskinesia. Leukocytosis may indicate an inflammatory process such as cholecystitis or cholangitis. Elevated bilirubin or alkaline phosphatase suggests an obstruction of the common bile duct, such as from choledocholithiasis. In addition, elevated lipase may indicate obstruction of the pancreatic duct, which may also be caused by choledocholithiasis. Transaminases may also be mildly elevated in obstructive processes.

- Right upper quadrant ultrasound is highly sensitive and specific for gallbladder pathology. It is commonly used for initial imaging in cases of suspected gallbladder disease because of its noninvasive nature. Key elements seen on ultrasound are:
    - Gallstones or sludge is often visualized in the gallbladder. Occasionally, these can also be seen in the common bile duct
    - Thickness of the gallbladder wall may be an indication of inflammation if >4mm
    - Pericholecystic fluid may signify inflammation or ascites
    - Diameter of the common bile duct may indicate obstruction if >6mm
    - Masses visualized may suggest polyps or carcinoma, though rarely seen

- HIDA scan (hepatobiliary iminodiacetic acid scan) is the gold-standard test for diagnosing cholecystitis. Technetium-99m is injected into the blood and circulates through the liver to be excreted into bile. Bile flow can then be tracked from the liver bed into the duodenum. Nonfilly of the gallbladder suggests cholecystitis. Nonfilling of tracer into the duodenum suggests obstruction.

- MRCP (magnetic resonance cholangiopancreatography) may be used for visualization of the biliary and pancreatic systems. This test is more costly than ultrasound but may provide a clearer picture. It is often used to further delineate the cause of common bile duct obstruction.

- ERCP (Endoscopic retrograde cholangiopancreatography) is used for diagnostic and therapeutic purposes. It employs the use of endoscopy to directly visualize the stomach and duodenum, as well as cholangiography to indirectly image the biliary and pancreatic systems. ERCP can be used to diagnose and treat strictures and choledocholithiasis. It is also used to obtain tissue samples when necessary.

- CT (computed tomography) is a test sometimes ordered when patients present with vague symptoms. In the case of biliary pathology, it is less sensitive and specific than ultrasound. CT may reveal an inflamed gallbladder or dilated ductal system. It may also show compression of the common bile duct by a pancreatic head mass.

Port Placement:

Standard laparoscopic cholecystectomies generally employ the use of four ports. The umbilical port is usually placed first and used for the camera. An epigastric port is then placed just to the right of the ligament of Treitz under direct visualization. Two retraction ports are then placed in the right subcostal region.

Standard Operative Approach:

1. Patient should be supine on the operating table

2. Prep and drape in a sterile fashion
3. Make a small incision at the umbilicus
4. Use either a veress needle or the Hassan technique to insufflate the abdomen to 12-15mm Hg and establish pnemoperitoneum
5. Place camera port at the umbilicus
6. Identify the ligament of Treitz and place a working port in the epigastric region under direct vision
7. Place two retraction ports in the right subcostal region under direct vision
8. Position the patient in reverse trendelenberg and left side up if needed
9. Retract the gallbladder at the fundus and infundibulum
10. Dissect out the "critical view" of the triangle of Calot to clearly identify the cystic duct and cystic artery. Identify the position of the common bile duct
11. Perform an intraoperative cholangiogram at this time if desired
12. Use a clip applier to place clips on the cystic duct and cystic artery – 1 proximal to the gallbladder, 2 distal to the gallbladder
13. Use shears to divide the cystic duct and cystic artery between the proximal and distal clips
14. Using electrocautery remove the gallbladder from the liver bed and maintain hemostasis
15. Remove the gallbladder from the abdomen using an endocatch bag
16. Inspect the abdomen and liver bed for hemostasis
17. Desufflate the abdomen
18. Close ports (may require Carter-Thomason technique prior to desufflation for 10/12mm ports)
19. Apply sterile dressings

Complications:

- Common bile duct injury
    - Most common bile duct injuries are recognized intraoperatively or in the immediate postoperative period. Repair depends on the type and degree of injury. A small non-cautery injury may be managed with T-tube placement in the operating room. If there is significant heat injury or if the injury is >30% of the bile duct circumference, then an end-to-side choledochojejunostomy with Roux-en-Y jejunal limb should be performed. If a hepatic duct is involved, the patient may require a Roux-en-Y hepaticojejunostomy.
- Insufficient clip placement
    - Bile leak from cystic duct →biloma and need for drainage and/or ERCP + stent
    - Bleeding from cystic artery – need to control with an additional clip or convert to an open procedure if uncontrolled
- Liver laceration
    - May cause heavy and uncontrolled bleeding. May require conversion to an open procedure.
- Retained stone
    - Can lead to cholangitis, strictures or gallstone pancreatitis

- Patient will need ERCP + sphincterotomy if intraoperative bile duct exploration fails

Pneumoperitoneum:

Physiology

- CO_2 is used for insufflating the abdomen. It is rapidly absorbed by the body and is easily monitored in the form of $PaCO_2$. Toxicity is seen on the EKG in the form of arrhythmias. In addition, CO_2 is easily eliminated, suppresses combustion and is available and inexpensive.
- Pneumoperitoneum causes a decrease in cardiac output. Increased intraabdominal pressure compresses the inferior vena cava and causes decreased venous return to the heart. Cardiac depression may also lead to arrhythmia. In addition, increased intraabdominal pressure can cause decreased renal blood flow leading to renal failure, as well as altered ventilation because the diaphragm cannot as easily contract and the lungs have less room to expand.

Establishing Pneumoperitoneum

- Veress Needle:
  - Spring-loaded needle with a sharp tip. A small incision is made often near umbilicus. The abdominal wall is pulled up with towel clamps as the needle is inserted through the fascia. Once the needle is placed into the peritoneum, its position can be verified by the free flow of saline down the shaft, aspiration of peritoneal fluid, or by the hanging drop test. Attach the insufflation tubing to the veress needle and insufflate the abdomen to ~15mmHg to establish pneumoperitoneum.
  - To place a trocar, remove the veress needle once pneumoperitoneum has been established. Pull up on the abdominal wall and insert the trocar through the previously made incision. Use a twisting motion while inserting the trocar through the fascia. Stop when the trocar has entered the peritoneal cavity.
- Hassan Trocar:
  - An incision is made often at the umbilicus. Bluntly dissect down to fascia and place stay sutures in fascia. Between the two stay sutures, make a small incision in the fascia. Insert a finger through the fascia into the peritoneal cavity and directly palpate that the appropriate position has been reached. Insert the Hassan trocar into the peritoneal cavity and secure in place with the stay sutures. Attach the insufflation tubing to the Hassan trocar and insufflate the abdomen to ~15mmHg to establish pneumoperitoneum.

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