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Laparoscopic Cholecystectomy

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Continuing Education Activity

Laparoscopic cholecystectomy is a minimally invasive surgical procedure used for the removal of a diseased gallbladder. Since the early 1990s, this technique has largely replaced the open technique for cholecystectomies. Laparoscopic cholecystectomy is currently indicated for the treatment of acute or chronic cholecystitis, symptomatic cholelithiasis, biliary dyskinesia, acalculous cholecystitis, gallstone pancreatitis, and gallbladder masses or polyps. This activity describes the indications, contraindications, and potential complications of laparoscopic cholecystectomy and highlights the role of the interprofessional team in the management of patients with gall bladder disease.

Objectives:

- Describe the indications for a laparoscopic cholecystectomy.
- Review the technique for performing a laparoscopic cholecystectomy.
- Summarize the complications of laparoscopic cholecystectomy.
- Explain why careful planning and discussion amongst the interprofessional team members involved in the management of patients undergoing laparoscopic cholecystectomy will improve outcomes.

Access free multiple choice questions on this topic.

Introduction

Laparoscopic cholecystectomy is a minimally invasive surgical procedure for removal of a diseased gallbladder. This technique essentially has replaced the open technique for routine cholecystectomies since the early 1990s[1]. At this time, laparoscopic cholecystectomy is indicated for the treatment of cholecystitis (acute/chronic), symptomatic cholelithiasis, biliary dyskinesia, acalculous cholecystitis, gallstone pancreatitis, and gallbladder masses/polyps[2]. These indications are the same for an open cholecystectomy. Cases of gallbladder cancers are usually best treated with open cholecystectomy. Approximately 20 million people in the United States have gallstones. Of these people, there are approximately 300,000 cholecystectomies performed annually. Ten percent to 15% of the population has asymptomatic gallstones. Of these, 20% are symptomatic (biliary colic). Of the 20% who are symptomatic approximately 1% to 4% will manifest complications (acute cholecystitis, gallstone pancreatitis, choledocholithiasis, gallstone ileus)[3]. The incidence of gallstones increases with an increase in age, with females more likely to form gallstones than males. Age 50 to 65 approximately 20% of women and 5% of men have gallstones. Overall, 75% of gallstones are composed of cholesterol, and the other 25% are pigmented[4]. Despite the composition of gallstones the clinical signs and symptoms are the same.

Anatomy and Physiology

The gallbladder lives on the inferior aspect of the liver bed, more specifically under liver segments 4b and 5. The gallbladder can be up to 10 cm in length and physiologically can hold up

to 50 cc of fluid (bile). A line from the gallbladder to the inferior vena cava separates the liver into right and left lobes. There are four anatomical sections to the gallbladder: fundus, body, infundibulum, and neck. There is great variation in the biliary ductal anatomy[5]. The cystic duct most commonly arises from the common bile duct and inserts at the neck of the gallbladder. The branch point of the cystic duct from the common bile duct marks the beginning of the common hepatic duct superiorly. The blood supply to the gallbladder is from the cystic artery which originates approximately 90% of the time from the right hepatic artery. Again, there is great variation in the course and origin of the cystic artery. The hepatocystic triangle (triangle of Calot) is a surgical anatomical landmark created by the cystic duct laterally, the common hepatic duct medially, and the liver edge superiorly. This triangle is of surgical importance because this is the location for the most common path of the cystic artery to the gallbladder. There sentinel lymph node of the gallbladder resides within the hepatocystic triangle, also known as Lund's node (and erroneously referred to as the node of Calot)[6].

Indications

- Cholecystitis (Acute/Chronic)
- Symptomatic cholelithiasis
- Biliary dyskinesia- hypofucntion or hyperfunction
- Acalculous cholecystitis
- Gallstone pancreatitis
- Gallbladder masses/polyps

Contraindications

- Inability to tolerate pneumoperitoneum or general anesthesia
- Uncorrectable coagulopathy
- Metastatic disease

Please note that although gallbladder cancer was once a contraindication to a laparoscopic cholecystectomy, the current literature supports laparoscopic intervention[7].

Equipment

- Two laparoscopic monitors
- One laparoscope (5/10 mm, 0/30 degrees) including camera cord and light source
- Carbon dioxide source and tubing for insufflation
- 5 mm to 12mm trocars (average three 5 mm working trocars and one 10 mm to 12 mm trocar)
- Laparoscopic instruments: Atraumatic graspers, Maryland grasper, clip applier, electrocautery (e.g., hook, spatula), and a retrieval bag
- Scalpel (11/15 blade), forceps, needle driver, and absorbable sutures
- Major open tray, for possible conversion

Personnel

- Operating surgeon (patient's left)

- Surgical assist (patient's right)
- Scrub tech/nurse (patient's left)

Preparation

The patient should be medically optimized preoperatively.

Preoperative antibiotics should be given within 30 minutes of incision per protocol.

An aseptic surgical field is created from just above the bilateral costal margins to the pubic tubercle and laterally to the right and left flanks. The sterile surgical field should allow for the possibility of an open procedure if needed.

Technique or Treatment

After induction of anesthesia and intubation, the laparoscopic cholecystectomy may begin.

First, insufflation of the abdomen is achieved to 15 mmHg using carbon dioxide. Next, four small incisions are made in the abdomen for trocar placement (supraumbilical x1, subxiphoid x1, and right subcostal x2). Utilizing a camera (laparoscope) and long instruments the gallbladder is retracted over the liver. This allows for exposure of the proposed region of the hepatocystic triangle. Careful dissection is carried out to achieve the critical view of safety. This view is defined as (1) clearance of fibrous and fatty tissue from the hepatocystic triangle, (2) the presence of only two tubular structures entering into the base of the gallbladder, and (3) the separation of the lower third of the gallbladder from the liver to visualize the cystic plate. Once this view is adequately achieved, the operating surgeon can proceed with confidence that he/she has isolated the cystic duct and cystic artery. Both structures are carefully clipped and transected. Electrocautery or harmonic scalpel is then used to separate the gallbladder from the liver bed completely. Hemostasis should be achieved after the abdomen is allowed to deflate to 8 mmHg for 2 minutes. This technique is employed to avoid missing potential venous bleeding that can be tamponaded by elevated intra-abdominal pressure (15 mmHg). The gallbladder is removed from the abdomen in a specimen pouch. All trocars should be removed under direct visualization. Closure of port sites is surgeon specific; this author recommends fascial closure of trocar sites greater than 5 mm to avoid incisional hernias in the postoperative period.

Complications

Common complications include but are not limited to bleeding, infection, and damage to the surrounding structure. Bleeding is a common complication as the liver is a very vascular organ. Experienced surgeons must be knowledgeable about anatomical anomalies of arteries to prevent potential significant blood loss. The most severe complication is an iatrogenic injury of the common bile/hepatic duct. Injury to either of these structures may require a further surgical procedure to divert the flow of bile into the intestines. This procedure usually requires a specially trained hepatobiliary surgeon[8].

Lastly, although not a complication, conversion to an open procedure has become a rare event as the experience of surgeons has increased over the years. Conversion to an open procedure creates a larger abdominal incision, causes significant pain control issues postoperatively, and leads to a cosmetically displeasing scar. Please note that conversion to an open procedure should not be viewed as a complication but as a well-educated decision made by an experienced surgeon to care for the patient[9] safely.

Bile leaks might complicate the procedure and present with vague abdominal pain fever, with or without the characteristic features of direct hyperbilirubinemia. The complicated patients usually present within the first week following the surgery. Management should be initiated with diagnostic ultrasonography and or abdominal CT scan. In the case of retained

choledocholithiasis, biliary sphincterotomy is mandatory. High-grade leaks should be managed with sphincterotomy and stenting. A HIDA scan evaluating bile leaks is recommended in equivocal findings on CT or ultrasonography.[9]

Clinical Significance

The etiology of gallbladder disease is associated with a poorly functioning gallbladder and superconcentrated bile. Normally, the gallbladder empties its contents in response to physiologic changes associated with digestion (cholecystokinin, vagal input from antral distension, migrating myoelectric complex). High concentrations of cholesterol within the gallbladder is a known cause for precipitation of cholesterol gallstones. Pigmented stones precipitate typically from hemolytic diseases (black stones) or from infection (brown stones) where bacterial enzymes break down bilirubin into an insoluble content. Stasis within the gallbladder or bile ducts increases the likelihood of stone formation. Gallbladder disease is exemplified by obstruction of the cystic duct. Patients may experience acute obstruction of the cystic duct by stones, or occasionally, in most critically ill patients, there is acute acalculous cholecystitis, where there is no mechanical obstruction but a functional obstruction. This obstruction, mechanical or not, in conjunction with attempted bile excretion for digestion will cause acute inflammation of the gallbladder.

A classic finding for gallbladder disease is right upper quadrant or epigastric abdominal pain. The pain typically has an onset 30 minutes to two hours after consumption of fatty foods. The pain can last from one to two hours, up to more than 24 hours. Pain lasting more than 24 hours is associated with a secondary infection known as acute cholecystitis. Pain radiates from the right upper quadrant to the right flank, and occasionally to the right shoulder due to sympathetic innervation. Associated symptoms include but are not limited to nausea, vomit (bilious), fever, chills, and diarrhea. Less specific symptoms may be experienced like indigestion, GERD-like symptoms, PUD symptoms, and dyspepsia. Earlier in the disease process pain will be intermittent and associated with oral intake of fatty foods. As the process progresses, pain may become more frequent and occur regardless of oral intake.

Complete a thorough history and physical examination, including abdominal examination, and specifically check for a “Murphy’s Sign.”

- Murphy’s sign: deep palpation in the right upper quadrant while the patient inspires deeply. A positive test is when the patient abruptly stops their inspiration secondary to pain[10].
- Labs: Complete Blood Count (CBC) with differential (leukocytosis), Liver function panel (Elevated total bilirubin, alkaline phosphatase, and possible transaminitis), Amylase/Lipase (Elevation can indicate gallstone pancreatitis).
- Imaging:

1. Abdominal ultrasound of the right upper quadrant will identify the presence of gallstones/sludge/polyps/masses, thickness of the gallbladder wall (normal limits less than 3 mm), width of common bile duct (normal limits less than 6 mm, however, 1 mm may be added per decade of life after 50 years of age or in pregnant women), and the presence/absence of pericholecystic fluid
2. Magnetic resonance cholangiopancreatography (MRCP): MRI imaging study for noninvasive visualization of biliary and pancreatic ducts
3. Endoscopic Retrograde Cholangiopancreatography (ERCP): an invasive endoscopic procedure is utilizing x-rays and dye to visualize biliary and pancreatic ducts. The advantage of ERCP is that it is both diagnostic and therapeutic. However, this is an invasive procedure and comes with procedural risks

4. Hepatobiliary Iminodiacetic Acid (HIDA) Scan: imaging study to visualize liver, gallbladder, and bile ducts. A radioactive tracer is injected into the vein, attaches with bile substrates, and is processed by the liver. A nuclear scanner then tracks the flow of the tracer through the liver, into the bile ducts, gallbladder, and into the duodenum. The addition of cholecystokinin, CCK, in the absence of gallstones is useful to diagnose acalculous cholecystitis. A measured ejection fraction of less than 35% is usually indicative of a poorly functioning gallbladder. Reproduction of symptoms with administration of cholecystokinin also has been shown to predict the resolution of symptoms after cholecystectomy. Cholecystokinin should not be administered in the presence of gallstones as this may provoke passage of the stones into the common bile duct.

Enhancing Healthcare Team Outcomes

When patients present to the emergency department physician, primary care provider and nurse practitioner with gallstones, they should be educated about the options of treatment. While laparoscopic cholecystectomy is now the standard of care, patients should be informed about the possibility of conversion to an open procedure. The risk of injury to the bile duct is always a possibility depending on the experience of the surgeon. For those patients who are asymptomatic, it is important to recommend a healthy low-fat diet, maintenance of low body weight and regular exercise.

Review Questions

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