

Learning curve and intraoperative cholangiography in prevention of iatrogenic injuries of the biliary tract

Curva de aprendizado e colangiografia intraoperatória na prevenção de lesões iatrogênicas do tracto biliar

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ABSTRACT

Cholecystectomy is the most commonly performed abdominal operation in the world. Laparoscopy is the standard procedure for performing this operation, and it have advantages over conventional surgery. However, a higher rate of iatrogenic lesions of the biliary tract is attributed to laparoscopy when compared to conventional cholecystectomy. Due to the importance of the topic, the purpose of this review was to analyze the factors involved in the largest number of lesions of the biliary tract observed during laparoscopic cholecystectomy compared to open surgery, and to evaluate the role of the learning curve and intraoperative cholangiography in the prevention of primary injuries of biliary tree.

Key words: Cholecystectomy, laparoscopy, Cholangiography, Biliary Tract, Injuries.

RESUMO

Colecistectomia é a cirurgia abdominal mais frequentemente realizada no mundo. A laparoscopia é o procedimento padrão para a realização desta operação, e tem vantagens sobre a cirurgia convencional. No entanto, uma taxa mais elevada de lesões iatrogênicas das vias biliares é atribuída à laparoscopia quando comparada à colecistectomia convencional. Devido à importância do tema, o objetivo desta revisão foi analisar os fatores envolvidos no maior número de lesões das vias biliares observadas durante a colecistectomia laparoscópica comparado à cirurgia aberta, e avaliar o papel da curva de aprendizado e colangiografia intra-operatória na prevenção de lesões primárias de árvore biliar.

Descritores: Colecistectomia, Laparoscopia, Colangiografia, Lesões biliares.

INTRODUCTION

Laparoscopic cholecystectomy was introduced worldwide, and in Brazil it was firstly performed in 1990 in San Paulo^{1,2}. Over time it became the gold standard in the management of benign gallbladder disease, symptomatic cholelithiasis and acute cholecystitis^{1,3-6}. The LC is associated with low morbidity, reduced hospital stay, low postoperative pain, early return to work and better cosmetic results when compared to open cholecystectomy¹.

Despite the clear benefits of LC, the rate of bile duct injury rose from 0.1 to 0.2 % during the era of open cholecystectomy⁷⁻¹⁰ to 0.4% to 0.6% after the introduction of LC¹¹⁻¹³. An incidence of 3% have been reported¹⁴⁻¹⁷. Of all the types of biliary trauma, iatrogenic injury during LC has been the most frequent¹. Recent publication showed that incidence of biliary injuries are about 0.2% to 0.6 %, inversely proportional to the learning curve, but still remains high when compared to open cholecystectomy¹⁶.

Starting from the principle that laparoscopic cholecystectomy is considered the gold standard procedure in the treatment of cholelithiasis, the incidence of injury to the biliary tree should be low¹⁸. In agreement with the literature, it is believed that the lesions of the bile duct during laparoscopic cholecystectomy could be avoided through knowledge and understanding of the causes, risk factors, mechanisms, types of injuries and the practice of preventive measures during the laparoscopic procedure¹⁹⁻²¹.

Therefore, the present study aimed to evaluate the role of the learning curve in laparoscopic cholecystectomy and the importance of intraoperative cholangiography in the prevention of primary biliary injuries.

CLASSIFICATION OF BILIARY TRACT INJURIES

Several classification systems have been developed to describe anatomical lesions of bile ducts and help in treatment options. It is useful to classify biliary injuries for documentation purposes, as they help to establish prognosis after repair²². Biliary injuries occurring during laparoscopic cholecystectomy tend to be more severe than those resulting from open cholecystectomy. The reasons for this are many, considering that the LC is performed in a retrograde manner (standard technique), then the level of injury can affect bile ducts of second and third order within the hepatic parenchyma²³. Three main systems were developed to classify the injuries of the biliary tract (IBT):

Table 1. Bismuth classification of biliary strictures

TYPE	CRITERIA
I	Stenosis at more than 2 cm from the confluence
II	Stenosis at less than 2 cm from the confluence
III	All the common hepatic duct without involvement of confluence
IV	Complete or partial destruction of the confluence
V	Injury to a right segmental branch, with or without involvement of the common hepatic duct

Adapted from Jarnagin WR, Blumgart LH. Benign biliary strictures. Surgery of the liver, biliary tract, and pancreas. Fourth Edition. 2007. P.634.

Table 2. Strasberg Classification.

A	Leakage of the cystic duct or leakage of small ducts in the liver bed
B	Occlusion of the right hepatic duct
C	Transection without ligation of an aberrant right hepatic duct
D	Lateral injury of common bile duct
E	Bismuth Classification from E1-E5
E1	Stenosis at more than 2 cm from the confluence
E2	Stenosis at less than 2 cm from the confluence
E3	All the common hepatic duct without involvement of confluence
E4	Complete or partial destruction of the confluence
E5	Injury to a right segmental branch, with or without involvement of the common hepatic duct

Strassberg SM, et al .¹⁰

Table 3. Classification of laparoscopic bile duct injury.

Class	Criteria
I	Cystic duct confused with common bile duct, but recognized; incision extended from cystic duct to common bile duct, for cholangiography
II	Lateral damage of the common hepatic duct by cauterization or clips, and bleeding associated with poor visibility.
III	Common bile duct confused with cystic duct, or unrecognized; common bile duct, common hepatic, right hepatic or left hepatic transected or resected.
IV	Right hepatic duct confused with cystic duct; right hepatic artery confused with cystic artery; sectioned right hepatic duct and right hepatic artery; lateral damage of right hepatic duct by cauterization or clips.

Way LW, et al²⁶.

Despite the various classification systems developed to describe the lesions of bile ducts, none of them is free from any deficiencies¹.

CAUSES OF MAIN BILIARY TRACT INJURIES

ANATOMICAL VARIATIONS

Although the mechanisms of bile duct injury during laparoscopic cholecystectomy are varied, the common denominator is the failure to recognize the anatomy of the triangle of Calot. This failure is attributed to anatomical risk factors, inadequate surgical technique or training²⁴.

Anatomical distortions are the result of severe chronic or acute inflammation, morbid obesity bleeding and anatomical anomalies or variations²⁵.

IMPROPRIATE TECHNIQUE

The bile duct injury during laparoscopic cholecystectomy results in most cases, the misinterpretation of the surgeon, errors of skill, knowledge or judgement²⁶.

Inflammation in the triangle of Calot area can result in approximation of the cystic duct and common bile duct. Excessive retraction of the gallbladder body or insufficient lateral retraction of the infundibulum. This can align the cystic duct to the common bile duct. In these cases, the common bile duct may be confused with cystic duct, clamped and divided, resulting in its transection²⁷⁻²⁹.

LEARNING CURVE

The inexperience of the surgeon with laparoscopic technique has been identified as an important cause of iatrogenic injury of bile ducts. This is the learning curve phenomenon that evolves previous operative experience at the level of open cholecystectomy^{30,31}. The learning curve is defined as the number of repetitions required for the learner to develop skills and achieve proficiency, at which time the surgeon can perform the procedure without supervision³².

Surgical skill is acquired through hours of training, plus the knowledge of anatomy and operative technique, that enable surgeons to perform more complex operations³³.

Reviewing studies on laparoscopic cholecystectomy, it is observed that the point of proficiency average is around 30 procedures³⁴. However, there are studies where this number exceeds 200 cases³⁵. A review of more than 1.6 million LC showed an incidence of 0.5% biliary tract injury, which did not decrease with increasing surgical experience¹¹.

The Brazilian Society of Videosurgery established on 25 the minimum number of procedures for the surgeon to apply for the Certificate of Qualification³⁶. The Brazilian College of Surgeons in association with the Brazilian College of Digestive Surgery and the Brazilian Society of Coloproctology, established various stages of the competition for obtaining the Certificate of Qualification, and required participation in theoretical and practical courses and proof of 15 videolaparoscopic surgeries³⁷. Thus, two key elements are to gain experience in quality training and supervision³⁸.

The proficient surgeon should be able to recognize the anatomical variations or dissect it safely despite the intense inflammatory process³⁹.

DIAGNOSIS OF INJURIES

Most biliary injury during laparoscopic cholecystectomy are diagnosed to late. Patients complain of nonspecific symptoms such as vague abdominal pain, nausea, vomiting, low fever, usually resulting in leakage of bile into the peritoneal cavity. Some patients may develop sepsis from severe biliary peritonitis, jaundice or intra-abdominal abscess⁴⁰. Those who have early ligation or stenosis of bile ducts may present with jaundice and cholangitis. The median time to onset of symptoms was been two days⁴¹.

The bile duct injuries occur with sudden leakage of bile from the liver, soft tissue adjacent to the portal vein or persistent bilious drainage after section of the cystic duct. When there is doubt about the biliary anatomy, intra-operative cholangiography should be performed. In case of confirmed bile duct injury, referencing an experienced surgeon is the best decision⁴².

An important step in assessing the bile duct injury is the identification of patency of vascular structures. Doppler ultrasonography should be performed to assess vascular integrity due to the fact that 12-32% of patients have concomitant arterial injury⁴³.

The most commonly image exam performed for the diagnosis of bile duct injury is retrograde cholangiopancreatography (ERCP) and magnetic cholangiography. ERCP can confirm the presence of biliary injury and provide a definitive management through temporary internal stent⁴⁴.

INTRAOPERATIVE CHOLANGIOGRAPHY

There is evidence that the use of intraoperative cholangiography promotes a higher rate of identification of bile duct injury, reducing costs, length of stay and mortality^{45,46}. Surgeons who are against cholangiography routinely emphasize that their adoption does not reduce the number of injuries and adds greater time and cost⁴⁷. All who are in favor, argue that their use does not prolong surgical time when performed by trained personnel⁴⁸.

Thus, intraoperative cholangiography should be based on clinical and laboratory criteria or when the anatomy not seem clear intraoperatively, providing a lower cost/benefit ratio when used routinely⁴⁹.

MANAGEMENT OF INJURIES

Additional tests should be requested to identify abdominal collections and determine if there is dilatation of the intrahepatic bile ducts. The final stage in the management of the bile duct injury includes defining the biliary anatomy and restoration of bilio-enteric communication. The extent of the injury determines the course of the operation⁵⁰.

The best long-term results are obtained when the bile duct injury are recognized intraoperatively and repaired imediatamente. Estudios show that less than one third of iatrogenic lesions of the biliary tract are detected intraoperatively^{51,52}.

Biliary injuries diagnosed postoperatively. Biliomas are treated by percutaneous drainage, and injuries by endoscopic stenting or Roux-en-Y reconstruction. The delayed repair is associated with poor outcomes (stenosis, narrowing) and high financial cost⁵³.

In patients who underwent laparoscopic repair bile duct injury there was increase in morbidity and mortality. Patients who develop recurrent biliary strictures complain of chills followed by high fever. Pain in the right upper quadrant may or not be present. A high index of suspicion is necessary and initial episodes can be treated conservatively with antibiotics^{54,55}.

PREVENTION

As with any surgical procedure, prevention of complications through careful dissection and identification of the structures before transection is the best way for a favorable outcome. Whenever the anatomy of Calot's triangle can not be clearly defined, conversion to open surgery should be indicated⁵⁶.

FINAL THOUGHTS

The bile duct injury is a delicate and fascinating subject where we should always aim prevention of injuries. We have confirmed through the data and studies that caution and knowledge of the anatomy are the best ways to prevent such injuries. These injuries may interfere in the patient live or in their quality, being considered by some the most malignant of benign injuries.

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