REVIEW ARTICLE

Strasberg's Critical View: Strategy for a Safe Laparoscopic Cholecystectomy

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Abstract

Background: Every year, worldwide, the celebration for patient safety is carried out; since about 2.6 million people are documented who die each year from events that can potentially be avoided during their medical care, it is even estimated that around 15% of hospital costs can be attributed to treatment resulting in patient safety. As an important part of its dissemination in the medical–surgical community, we present the following article in relation to the critical vision of safety in the bile duct, promoted and published initially by Dr Steven Strasberg, which aims to reduce the number of complications during laparoscopic cholecystectomies.

Materials and methods: A bibliographic search was carried out in PubMed, Medline, Clinical Key, and Index Medicus. From May 2020 to July 2021 in Spanish and English with the following.

Conclusions: Strasberg's critical view is a proposed strategy to minimize the risk to zero during laparoscopic gallbladder surgery. It consists of obtaining a plane in which the surgeon can visualize the anatomical structures that make up the bile duct, as well as its irrigation and drainage. Being able to clearly observe these structures allows the surgeon to cut freely and safely to avoid bile duct injuries which are not so uncommon during this procedure.

Keywords: Biliary injury, Cholecystectomy, Cholelithiasis, Laparoscopic cholecystectomy, Strasberg critical view, Surgery, Triangle of Calot.

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Background

Currently, laparoscopic cholecystectomy (LC) is considered the gold standard for the treatment of gallstones worldwide.[1] LC is the most practiced elective surgery around the world, reporting an incidence of complications between 6.8 and 7.7%.[2,3] Common bile duct injury (CBDI) or hepato-common bile duct injury is often considered the main complication of LC.[4]

The implementation of LC brought a significant increase in iatrogenic lesions in the bile ducts, which tripled since its introduction. Currently, we estimated this complication in 1 of every 200–300 laparoscopic approach cholecystectomies, with a prevalence in bile duct injury (BDI) of 0.2–0.4%, generating significant medical, psychological, and socioeconomic burdens.[5] In general, bile duct injuries are associated with a significant increase in hospital costs, length of stay, readmission to a period of less than 30 days, and medical reference to an institutional post-acute care center.[6]

In addition to the aforementioned repercussions, around the world, medical–surgical complications generate absenteeism from work and dissatisfaction with the surgical team which can potentially have legal repercussions against the surgeon.

In the United States, injury to the bile duct during a gastrointestinal surgery is the most common cause of criminal lawsuits, of which laparoscopic surgery lawsuits represent about 20% of all general surgery lawsuits, and of these 50% of these lawsuits are for iatrogenic damage to the bile duct.[7] This legal problem has meant that in recent decades there has been an attempt to standardize those surgical techniques that minimize the risk of injury to the bile duct.

In recent years, a safe cholecystectomy has been proposed, which is defined as "that safe LC for the patient (without bile duct/vascular lesion) and the surgeon (with no margin for litigation or minimal)"[6] that is, it includes from an adequate insertion of the abdominal ports to their closure, but even more relevant, the "safe LC" will be defined by the surgeon's accurate vision of each of the structures to be dissected and cut; since for decades it has been described that the worst error of the surgeon is the excess of confidence during a surgical procedure, which limits the ability to recognize when the identification of surgical planes has been lost due to anatomical changes or severe inflammation of the structures.

In 2017, Dr Strasberg noted that after 20 years, many surgeons have little understanding of the criteria for achieving a critical view of safety (CVS), especially in those who were not trained to implement CVS in LC during their residency, so they prefer easier

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methods, such as the infundibular technique (IT), representing a greater risk of injury to the bile duct.[8] Today, it is estimated that only 10.8–69% of LCs achieve a complete CVS.[9–11]

As usual and since the introduction of laparoscopy, surgeons begin LC by dissecting the gallbladder using "IT", which by intraoperative recognition of the cystic duct and the union of the gallbladder begins the hilar dissection of the gallbladder. However, it was not until 1995 that Dr Strasberg introduced CVS as a technique that promoted the recognition of gallbladder elements to reduce the risk of BDI avoiding errors due to anatomical alterations and visual perception.[12]

CVS has anatomical foundations taken by Budde's description in 1906 who described an anatomical triangle (cystic duct, hepatic duct, and liver), which he called "gallengangsdreieck," interpreted as "bile duct triangle," containing the cystic pedicle (cystic artery, cystic vein, and clusters of the celiac plexus), the right hepatic artery, the right branch of the portal vein, abnormal bile ducts, and lymph nodes. This triangle can be divided into two sectors: one medial (critical triangle) and the other lateral (safety triangle); however, international anatomical terminology, and the interpretation of the translation of "gallangangsdreieck," carried out over the years, led to errors and confusion in the recognition of limits of these topographic areas; for these reasons, Jean François Calot (1861–1944) carried out his doctoral thesis entitled "De la colecystectomie" where he describes an isosceles triangle integrated by the cystic artery and duct in its superior and inferior limits, respectively, and by the hepatic conduit medially; that is, the triangle described by Calot corresponds to the lower triangle described by Budde. Calot firmly insisted that "the surgeon must work by sight and not by faith."[13]

Recently, the Society of Gastrointestinal and Endoscopic Surgeons (SAGES) formed a working group on strategies for a safe cholecystectomy, with the mission of creating a universal culture of safety and reducing the incidence of biliary lesions, proposing the "Delphi" consensus as a series of strategies (including CVS) to reduce biliary lesions.[5] Clinical guidelines, such as the Tokyo Guidelines, for the management of cholecystitis and acute cholangitis strongly recommend CVS to prevent BDI.

The main causes of a BDI are generally due to an illusion of visual perception, that is, the surgeon believes that he/she is cutting the cystic duct when he/she is actually manipulating the common bile duct, so to achieve CVS, the surgeon must first clear the hepatocystic triangle of adipose and connective tissues and dissect the lower part of the gallbladder from its liver bed to obtain an unobstructed view of only two tubular structures (cystic duct and cystic artery) entering the gallbladder (Fig. 1).[14]

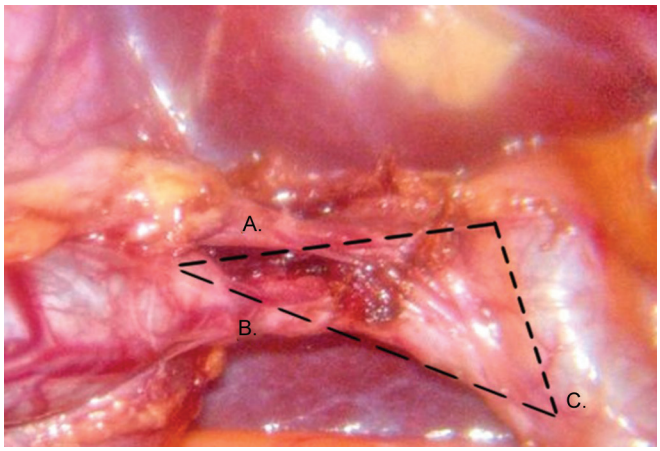

Fig. 1: CVS. Formed by the (A) Cystic artery (arteria cística); (B) Cystic duct (cístico); and (C) Common bile duct (colédoco)

The CVS can be summarized in three criteria:

- The hepatocystic triangle (formed by the cystic duct, the common hepatic duct, and the lower border of the liver) must be clear of all fatty and fibrous tissues. The common bile duct and the common hepatic duct are searched for but not exposed for dissection.
- The lower third of the gallbladder is separated by up to 30% from the liver to expose the cystic plaque. The cystic plaque is defined as the liver bed attached to the gallbladder and represents the gallbladder fossa.
- Two, and only two structures entering the gallbladder, representing the cystic duct and artery, should be seen in the anterior and posterior views.

Once this vision is established, we recommend a pause and confirmation between the surgeon and the surgical assistant before cutting any structure.[15]

Despite the recommendations of Dr Strasberg and various consensuses, there are multiple conditions for which the anatomy of the bile duct may be altered, and this could be secondary to Mirizzi syndrome, carcinogenic processes, anatomical variants, such as situs inversus or a more frequent scenario, cholecystitis.

Several studies have shown that severe inflammation of the gallbladder wall is associated with a greater probability of conversion to an open surgery.[16,17] In addition to the friability of the tissues, severe inflammation can produce a subversion of the Calot triangle's anatomy and a condition that the application of CVS may be difficult and finally consider alternative procedures, such as fundus or subtotal cholecystectomy, or as a final step, conversion to open surgery for difficult cholecystectomy.[16–18]

During LC, there are several recommendations that can support the skills of an experienced surgeon to optimize the available resources. The use of a forward oblique laparoscope with the viewing lens at an angle of 30–45° is suggested, and this allows great versatility in the visualization of the surgical field, so the surgeon can look up, down, left, or right by rotating the laparoscope 360° and observe regions of the Calot's triangle that are impossible to visualize with a laparoscope in the absence of this type of lens; a flexible laparoscope can be a functional alternative to the forward oblique laparoscope.

Full exposure of the Calot's triangle is achieved by retracting the gallbladder toward the right shoulder, combined with elevation of the head from the operating table by 20°. Dissection of the gallbladder will begin from the junction of the infundibulum with the cystic duct, keeping the dissection plane always in the gallbladder or the cystic duct. Dissection of the triangle of Calot from its dorsal and ventral plane is generally performed using a blunt dissection and electrocautery, expanding them through the incision of the serosa. The gallbladder infundibulum should be pulled laterally and inferiorly to create a large angle between the cystic duct and the common bile duct, and it should be lateral and ventral to widen the dorsal border of the triangle of Calot. Tissues surrounding the area, such as the omentum, transverse colon, or duodenum, have to be carefully exposed and divided, with blunt dissection, unlike adhesions, which require dissection with scissors or electrocautery.

Electrocautery is useful for cleaning the surrounding tissues, such as fat and fibrous tissues in Calot's triangle; however, the surgeon must take care to preserve the adjacent viscera, such as

the bile duct, liver, portal vein, and artery. The common bile duct is usually upward, and the roofed common bile duct is difficult to recognize when the cystic duct is unusually short, so surgical dissection must continue distally until there is sufficient length to occlude with clips. The cystic artery is usually medial in the triangle of Calot and slightly posterior to the cystic duct.[19]

At present, despite the surgeon's experience in LC, SAGES recommends performing a momentary intraoperative pause after the dissection of structures throughout the LC to confirm that CVS has been achieved, using doublet view.[20]

Risk Factors for BDI

Latrogenic BDIs have become a common complication of LC, so avoiding difficult LC may be one of the contemporary challenges of general surgery.

Difficult LC refers to the surgical removal of the gallbladder when there are some associated conditions of the same organ, its nearby organs, or the patient, which do not allow an easy, fast, and comfortable dissection of the gallbladder, and which result in prolongation of the surgical time and increased risk of complications. Factors, such as age over 65 years, obesity, diabetes mellitus, acute cholecystitis, previous abdominal surgery, leukocytosis, ultrasound findings of a thickened gallbladder wall, pericholecystic fluid, calcified or scleroatrophic gallbladder, Hartmann's pouch stones, or bile duct dilation can make the LC difficult.[21]

Aberrant anatomy can be considered one of the frequent causes of BDI, which can include a short cystic duct, aberrant hepatic ducts, or a right hepatic artery that crosses in front of the common bile duct,[22] so we could say that anatomical variation and inflammatory changes may make CVS difficult. Mercado et al. observed that the surgeon often claims that the patient suffers from Mirizzi syndrome as the cause of the injury. This rare injury is caused by an impacted stone in the neck of the gallbladder or in the cystic duct, causing compression of the common bile duct, which can progress to a cholecystocholedochal fistula, and is usually a high-risk dissection without the possibility of obtaining a critical Strasberg vision, mainly due to the inflammatory state of the gallbladder that also involves the triangle of Calot, also known as "disappeared Calot" where the triangle is destroyed by intense inflammation, the traction of Hartmann's pouch is completely transferred to the main duct, and the surgeon begins dissection between the hepatic artery and the main duct due to misidentification, resulting in an injury as a consequence.[23]

Cholelithiasis, in its acute or chronic form, requires surgical treatment, which is why in various studies it has been determined that the acute or chronic process can contribute to tissue weakness, the reason why as the severity of the cholecystitis increases, the risk of BDI grows as well. Severe acute cholecystitis was associated with a significant increase in the risk of BDI, and moderate cholecystitis (Tokyo grade II) doubled the risk, while mild acute cholecystitis (Tokyo grade I) did not significantly increase the risk of injury. In addition, a trend toward an even higher risk was observed among the most severe cases of acute cholecystitis, that is, patients with ongoing acute cholecystitis had twice the risk of suffering a biliary injury compared to patients without acute cholecystitis.[24]

Despite being the misidentification of the structures of the bile duct, the most common cause of biliary injury, factors associated with inadequate surgical instruments can also contribute to and be the primary cause of the incorrect technique to achieve a CVS and cause injuries, such as thermal burn, dislocation of clips, incision of a bile duct in the gallbladder bed, and the "tent effect" by clips placed very close to the common bile duct.[25]

There are other factors that do not depend directly on the patient that can make cholecystectomy difficult. One of the most important is the "surgeon factor" which has an important impact. It is well known that the number of procedures that a surgeon has performed, his/her familiarity with the surgical technique, and the knowledge of how to survive in adverse conditions in the face of lost or difficult surgical planes and distorted anatomy can modify the outcome of the procedure. It is estimated that the number of procedures to consider a high-volume surgeon in LC varies between 15 and 25 procedures per year.[26,27]

The investigation carried out by Moura Santos et al. showed that an incredible 64.7% of surgeons did not correctly recognize the elements that make up the CVS. Even more alarming was the fact that among the group that declared knowledge of the subject, more than half were wrong, in addition to associating that a shorter surgeon career was closely related to a greater knowledge of CVS and that, in this way, BDI occurred approximately 50% less in this group. Such results go in the direction of the perception that the technique is more widespread among recent graduates and well proposed in academic circles, which contributes to the focus on surgeon training.[28]

Evidence has shown prevention to be a much less expensive tool than repair of iatrogenic injuries: the management of BDI may require additional treatments ranging from endoscopic retrograde cholangiopancreatography, restorative surgery, and even liver transplantation in selected cases, leading to a significant increase in morbidity, mortality, and postoperative costs.[29] In the attempt to reduce the costs of BDI and its repair in recent decades, the use of preventive measures, such as the routine use of intraoperative cholangiography, has been proposed; however, showing the intraoperative anatomy, it is not considered a routine procedure because it does not prove to be useful in preventing BDI or modifying their prognosis; however, we must always consider the great importance and value of a second opinion during a difficult cholecystectomy and even the help of another surgeon colleague with more expertise because the probability of an injury is much lower before an expert surgeon.

Failure in the progression of the dissection, anatomical disorientation, difficulty in visualizing the surgical field or failure of instruments, or the inability of the forceps to grasp the gallbladder may be factors that indicate the need for conversion to open surgery, and it should be taken into account that the negative effects of conversion are minor when compared to the negative effects of a lesion on the bile duct.[25]

Repairs of minor iatrogenic damage, such as leaking cystic duct or gallbladder bed, or partial lacerations of the common bile duct, diagnosed intraoperatively, should be repaired immediately, if the surgeon who is operating or another colleague available in the operating room or at the institution possesses the required knowledge and skills. If the iatrogenic damage is greater, such as section of the common bile duct or lesion of an aberrant duct, these are repaired by a hepaticojejunostomy; this type of repair requires special skills that are more easily found in specialized units of hepatobiliary surgery.[30]

The objective of disseminating CVS is to reduce the rate of BDIs and it has been a worldwide initiative improving the safety of LC, which is why this technique has been adopted in several schools

around the world, and although the decrease in BDI rates has not been demonstrated, it is a fact that factors, such as inexperience and incorrect application of the technique, may be confronting the data that when training younger surgeons and being aware of CVS, it would have lower rates of BDI, performing a LC using safety steps, reduces the risk of an adverse event, including injury to the bile duct. Even in the presence of a serious complication, which leads to a legal case, performing LC, using standardized safety steps, may be the only evidence that conclusively determines whether or not there is a legal responsibility for a major complication.[31]

The education of practicing surgeons in the application of CVS during LC may result in greater implementation and quality of CVS, and observational studies should be carried out that may partly explain the sustained incidence of BDI despite greater experience with cholecystectomies.

Conclusions

Strasberg's critical view or CVS aims to standardize a "mandatory" pause during LC and to make correct identification of the structures as part of safe surgical practice. Dissemination of this strategy will allow students, residents, and surgeons to identify the hepatocystic triangle routinely, prior to cutting the structures to minimize the risk of BDI; we consider it essential that as part of postgraduate teaching, in addition to the surgical moment, tools, such as videos and/or simulators, can show the correct technique to achieve optimal CVS, even testing the surgical skills of surgeons in adverse situations or severe inflammation that distort the anatomy and by using CVS help minimize the variability in the surgical care of patients undergoing cholecystectomy, reducing the risk of BDI and improving morbidity and quality of life for each of the patient. We hope that in the near future CVS will become a mandatory pause in all LCs and will be known to the entire surgical community. Also, we encourage surgeons to develop further research about BDI rates when practicing CVS so more evidence gives a better support of what we know so far about this necessary intervention.

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