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Strategies to Avoid Bile Duct Injuries when the Critical View of Safety (CVS) Cannot be Achieved

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ABSTRACT
Bile duct injuries are more common in laparoscopic cholecystectomy than open cholecystectomy to reduce the number of biliovascular injuries the SAGES introduced the safe cholecystectomy program in which they described the critical view of saftey and how to achieve it. This article describes the various methods to be used when the cvs cannot be achieved and thereby avoid biliovascular injuries.

INTRODUCTION

Laparoscopic cholecystectomy is considered as the gold standard of treatment for cholelithiasis even though the incidence of bile duct injury (BDI) is higher than that of open cholecystectomy. Taking into account meta-analyses and prospective studies, the incidence of serious injury patterns now seems to be between 0.08 and 0.5%[1,2,3]. If minor injuries are included, an overall incidence of 0.3-1.5% can be expected[4,5,6,7,8]. in laparoscopic cholecystectomy.

To improve the standards of the surgery and reduce BDI, The SAGES introduced the safe cholecystectomy program adopting a universal culture of safety in cholecystectomy (COSIC). It included six crucial steps namely.

- To understand and apply the critical view of safety (CVS)
- Understand and recognize the aberrant anatomy
- Intraop time out before cutting, clipping any ductal structure
- Liberal use of cholangiography or other modalities
- Recognise difficult cholecystectomy
- Get help for difficult cases.

Based on the recent Delphi consensus The Tokyo guidelines 2018 proposed the following safe steps in laparoscopic cholecystectomy for Acute Cholecystitis.

- Decompression of a distended GB with needle aspiration.
- Effective retraction of the GB to develop a plane in the Calot's triangle area and identify its boundaries.
- Starting dissection from the posterior leaf of the peritoneum covering the neck of the GB and exposing the GB surface above Rouvière's sulcus.
- Maintaining the plane of dissection on the GB surface throughout laparoscopic cholecystectomy.
- Dissecting the lower part of the GB bed (at least one third) to obtain the critical view of safety.
- Always obtaining the critical view of safety

According to the SAGES, three Criteria are Required to Achieve the CVS:

- The hepatocystic triangle should be cleared of fat and fibrous tissue.
- The lower one third of the gallbladder should be separated from the liver to expose the cystic plate.
- Two and only two structures should be seen entering the gallbladder.

The Concept of CVS was introduced by Steven Strasberg in the year 1995 itself to reduce the rate of bile duct injury in an analytical review[9-12]. He described CVS as a reworking of a method of secure identification in open cholecystectomy in which the cystic duct and artery are identified and divided, after which the gall bladder is taken off the cystic plate so that the gall bladder is attached by two structures. But in laparoscopic surgery complete separation of the gall bladder makes the clipping of the structures difficult. so this was modified and only one third of the gall bladder was separated from the cystic plate before clipping and cutting any cystic structures. But it did not get world wide appreciation immediately.

MATERIALS AND METHODS

Now the strategy of the critical view of safety is recommended as the most effective stand alone method to identify crucial structures, such as the cystic artery and the cystic duct, in the best possible way. But it is only a part of a larger schema to avoid BDI. Even after the introduction of CVS the BDI remained the same. Then came a study from Netherlands by Nijssen *et al.* which studied the intra op notes of operating surgeons and reviewed the operating video. The video revealed that the CVS was reached in only 10.8% of cases. The CVS was not reached in any of the patients with BDI. The surgeons were actually doing the infundibular technique of laparoscopic cholecystectomy for gall bladder hilar dissection since the introduction of laparoscopic cholecystectomy in the early 90's. It is easy to do but there is increased chances of BDI because of the common error trap. The CVS approach has only been recently talked about in controlled studies.

Strasberg says that there are 2 principal lines of evidence that the CVS is an effective method of target identification. First, there are several reports containing several thousand patients in which CVS was used for target identification without a biliary injury due to misidentification, whereas, based on an incidence of biliary injury of 3-4/1000 cases, about 20 biliary injuries would be expected. Secondly, in studies that have examined the mechanisms of major biliary injury, CVS has rarely been described as the method of target identification. Taken as a group, these studies are highly supportive of the value of CVS, but from the perspective of evidence-based medicine, they are at a low level of evidence. A randomized trial cannot practically be performed because the event rate is so low that about 4500 patients per arm would be required[11].

There are some scenarios where the cvs cannot be achieved and in those cases the following techniques have to be resorted to. Intraoperative cholangiography enables the identification of the extra- and intrahepatic bile duct system as well as the differentiation between the cystic duct and the common bile duct. Some studies show that the risk of bile duct injuries is reduced, while other studies have contradictory findings[13-16]. only approximately 30% of iatrogenic bile duct injuries are detected intraoperatively, this additional examination method can contribute to an increase in patient safety.

RESULTS AND DISCUSSIONS

Another strategy is to inject indocyanine green, which allows infrared light to illuminate the intra-and extrahepatic bile ducts during the process. This means that the cystic duct is never confused with the common bile duct as much as possible. The technology's limitations are due to the restricted penetration depth of near-infrared light, which restricts the results in the case of pronounced visceral obesity and inflammatory processes. With regard to the assessment of intrahepatic bile ducts, anatomical norm variants and choledocholithiasis, the method is inferior to intraoperative cholangiography.

Misinterpretation of anatomical structures is mostly (>60%) responsible for biliary and vascular injury patterns. it is advisable to get a second opinion from colleagues experienced in unclear situations. This is especially so because they are not subject to the bias of the OR team and the previous operational process. there is the option of interrupting the procedure at a point in time where it is still possible to initiate antibiotic therapy and to perform the cholecystectomy later, in about 3 months.

In conditions like morbid obesity, previous upper abdominal surgery, acute cholecystitis, chronic cholecystitis, Mirizzis syndrome liver cirrhosis, male sex and old age doing a laparoscopic cholecystectomy can be difficult. In these conditions consider doing a percutaneous cholecystostomy by Foleys or Malecot catheter. In cases of Mirizzis syndrome the gall bladder neck may be tethered, fused or fistulized to the cbd. Biliary reconstruction may be indicated for type 2 Mirizzis in such cases place a cholecystostomy tube and refer.

A Delphi consensus 2017 cites that the Critical view of safety is an important landmark and for Impacted gallstone and Severe fibrosis or scarring in Calot's triangle, bail-out procedures may be indicated. The bail out procedures are open conversion, subtotal lap cholecystectomy, fundus first technique or dome down technique and cholecytostomy only.

In Tokyo Guidelines 2013, conversion to open cholecystectomy was the only recommendation in cases of Acute Cholecystitis for which Laparoscopic Cholecystectomy was difficult. In The Tokyo guidelines 2018, the specific bail out procedures subtotal cholecystectomy, fundus first technique and open conversion are suggested and it is strongly recommended that surgeons make appropriate judgments and choose a bail out procedure based on intraoperative findings in order to avoid secondary damage. Owing to its proneness to errors, the fundibular technique has been linked to a higher incidence of iatrogenic bile duct injuries. The risk of injury to vessels and bile ducts is significantly increased due to the proximity to the right pedicle, particularly in inflammatory processes that lead to thickening of walls and shrinking processes in the gallbladder bed. If the artery and cystic duct cannot be isolated using this technique, there is still the option to perform the cholecystectomy in a subtotal form.

Subtotal cholecystectomy is an operative alternative for local, risky conditions due to which the safe dissection with total removal of the gallbladder is not possible. The procedure involves making an incision in the GB, aspirating the contents and then removing as much of the GB wall as possible and treating the stump instead of removing the entire GB has been in use since the days of open cholecystectomy[10].

Strasberg *et al.* designated all procedures in which as much of the GB wall as possible is removed as subtotal (rather than partial) resection and proposed that resection of the fundus alone should be referred to as fundectomy. The term Partial cholecystectomy has been removed from usage. Subtotal cholecystectomy is deemed reconstituting when a closed GB remnant is left and fenestrating when the remnant is left open or the internal opening of the cystic duct is closed.

Converting a laparoscopic cholecystectomy to an open cholecystectomy is a strategy that can be used to prevent or repair iatrogenic injury. It is not a mistake, but rather a reflection of the surgeon's sense of accountability and it may save the patient's life. Conversion is more likely due to the following factors. The male sex, old age, obesity, prior procedures, the severity of the inflammation and the length of time after the last operation are all factors to consider[13,14].

If the Calot triangle representation is inadequate or unlikely, the anatomical circumstances are unknown, severe (excessive) bleeding occurs, the procedure does not proceed (for high-risk patients >30 minutes and for low-risk patients >60 minutes), or a bile duct injury has occurred, conversion should be considered.

To conclude, when the cvs is not achieved, techniques like intraop cholangiography, ICG, Lap ultrasound should be used and a bail out strategy like conversion to open, cholecystostomy or laparoscopic subtotal cholecystectomy should be employed.

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