

## Critical View of Safety: An ideal method of ductal identification in Laparoscopic Cholecystectomy

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### Abstract:

Laparoscopic cholecystectomy (LC) has been the standard of care in gallstone disease since its introduction in the early 1990s. A higher rate of biliary injuries associated with LC has been at the center of debate in the literature ever since and timeless efforts have been made to circumvent this problem. Fundamentals of laparoscopic cholecystectomy have remained the same over years. Different strategies have been tried to prevent bile duct injury (BDI). Critical view of safety (CVS) is widely viewed as a safe method of ductal identification in laparoscopic cholecystectomy for preventing bile duct injury. The purpose of this article is to find out if critical view of safety is really an ideal method of identification of ductal structures during laparoscopic cholecystectomy.

**Keywords:** Critical view of safety, bile duct injury, laparoscopic cholecystectomy, hepatocystic triangle

**Abbreviations:** LC: laparoscopic cholecystectomy, CVS: Critical View of Safety, HCT (hepatocystic triangle), STC: subtotal cholecystectomy, BDI: bile duct injuries

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### Introduction:

The performance of first laparoscopic cholecystectomy (LC) by Professor Eric Mühe of Germany on 12<sup>th</sup> September 1985 was a giant leap revolutionizing minimally invasive surgery, especially the treatment of gallstone disease.<sup>5</sup> Mühe's marvelous achievement went unrecognized for several years until laparoscopic cholecystectomy was formally introduced into practice.<sup>6</sup> In the USA, the first laparoscopic cholecystectomy was performed in early 1989 and soon became the standard method of cholecystectomy for benign disease.<sup>7</sup> This historic advancement was accompanied by a sharp rise in the rate of BDI to 0.5%-0.6% compared to 0.2% in open cholecystectomy.<sup>8-11</sup> BDIs cause serious complications like cholangitis, biliary cirrhosis, portal hypertension and lead to decreased survival, impaired quality of life, economic loss to the family and health care and costly litigation.<sup>8,12,14</sup>

John G. Hunter first described the five basic principles of laparoscopic cholecystectomy as: routine use of a 30° oblique viewing telescope, upward retraction of the gallbladder fundus, right lateral retraction of the infundibulum to bring the cystic duct at right angles to the bile duct, dissecting the cystic duct at the infundibulum and performance of routine intra-operative cholangiography. According to him, the surgeon must convert the procedure to open if clear and safe anatomy can not be achieved with these steps.<sup>2</sup> Although these foundational steps still govern the principles of laparoscopic cholecystectomy, the BDI continues to occur and misidentification of ductal structures in the hepatocystic triangle (HCT) is recognized as the main cause of BDI.<sup>9-11</sup>

Several strategies have been promoted since 1991 for reducing BDI including techniques of dissection and intra-operative biliary imaging

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during laparoscopic cholecystectomy. Critical view of safety (CVS) and infundibular techniques are two popular methods currently used for ductal identification. In CVS technique, only two structures should be attached to the gallbladder as cystic duct and artery at the end of dissection.<sup>10,11</sup> Achieving a complete CVS essentially eliminates the risk of biliary injury.

**Critical view of safety:** The idea of CVS was conceived by Steven M. Strasberg in 1992.<sup>13</sup> It was formally adopted as a method of ductal identification in LC in 1995 to reduce the risk of BDI.<sup>11,14</sup> Extensive efforts have been made to identify and prevent BDI.<sup>15</sup> Ductal misidentification in the HCT has been recognized as the main culprit behind major biliary injury.<sup>16,17</sup> The concept of CVS is to clearly dissect structures in the HCT allowing clear identification of cystic duct and cystic artery before clipping and dividing them. The fundus of the gallbladder is retracted upward toward the right shoulder. The infundibulum is retracted laterally to the right, placing the cystic duct away from and at right-angle to the bile duct without tenting it.<sup>2,11</sup> Dissection starts at the gallbladder neck clearing the cystic duct. Peritoneum between the liver and infundibulum is completely opened. Distal third of the gallbladder is separated from the underlying cystic plate. This widens the HCT, allowing the infundibulum to be reflected back and forth easily for dissection on both sides.<sup>11</sup> Cystic plate and adjacent liver should now be clearly visible through the triangle. On successful achievement of CVS, the two structures inserting on the gallbladder surface can only be cystic duct and cystic artery.

If this view cannot be achieved due to difficult dissection because of severe inflammation and scarring or unclear anatomy, a cholangiogram is obtained to delineate the anatomy and decide about changing the course of the operation to a subtotal cholecystectomy (STC) or cholecystostomy. CVS may not be achievable when the cystic duct is absent, short or fused with the hepatic or bile ducts or is obscured by the infundibulum adherent with the bile duct. These factors plus any anatomical variations increase

the risk of BDI. Struggling for a total cholecystectomy under these circumstances can lead to serious BDI.<sup>11,17-20</sup>

The CVS comprises these three principals:

1. The HCT is cleared of all fibro-fatty tissue. The bile and common hepatic ducts need not be exposed.
2. The cystic plate is exposed by dissecting the lower third of the gallbladder away from the liver.
3. Two and only two structures should enter the gallbladder as the cystic duct and artery.

**The doublet view photography:** CVS is confirmed by intraoperative video-recording or Doublet View Photography. Images of the dissected HCT are taken on its anterior and posterior aspects, clearly demonstrating the three components of CVS on both sides. Sanford introduced a six-point scale for assessing the achievement of all three components of CVS, allocating two points for each component. A minimum score of 5 was desirable for an acceptable achievement of CVS.<sup>23</sup>

Does it really work? Despite evidence that CVS is being widely adopted as a method of ductal identification during laparoscopic cholecystectomy, the rate of BDI has not altered significantly over three decades but it has plateaued around 0.6%.<sup>9,11,24</sup> Data analysis of BDI reveals that CVS is not at fault. Instead, it's the lack of understanding and improper practice of CVS which is largely responsible for the rising rate of BDI.<sup>17</sup> This highlights the need to educate practicing surgeons on obtaining CVS to improve surgical outcomes.<sup>18,26</sup> There are several studies describing a decrease in the rate of BDI with the adoption of CVS in laparoscopic cholecystectomy. Most injuries are recorded when the infundibular technique for cystic duct identification was used rather than CVS.<sup>11,14-16,21</sup> In the infundibular technique, the cystic duct is identified by dissecting the funnel shaped infundibulum where it tapers down into the cystic duct, and here lies the trap! In severe inflammation,

the infundibulum maybe fused and seem continuous with the bile duct. Now the bile duct may be mistaken as cystic duct as it flares into the infundibulum and thus gets inadvertently divided.<sup>16,21</sup> This misidentification of cystic and bile ducts is hard to occur in the CVS technique as it requires more dissection, completely exposing the cystic duct, cyst artery and cystic plate with a 360° clarity all-around. Study of BDI has shown that CVS is employed at the start of the procedure but is not completed, therefore eliminating its effectiveness.<sup>28</sup> What is called CVS in such cases is actually the infundibular method of ductal identification with incomplete exposure of the HCT. This occurs because of lack of understanding of CVS by the operator.<sup>9,20,28-30</sup> In extensive inflammation, the surgeon is not required to obtain a CVS. Instead, he must follow the principles of Culture of Safety in Cholecystectomy (COSIC) and opt for a 'bailout' procedure like cholecystostomy or subtotal cholecystectomy (STC) or abort the procedure and refer the patient to expert hands.<sup>31-34</sup> The STC is regarded as the most satisfying bailout procedure when marked inflammatory contraction and adhesions preclude safe identification of cystic structures,<sup>6</sup> either laparoscopically or as open procedure.<sup>15,21</sup> It is commonly indicated in severe cholecystitis, cirrhosis and portal hypertension, gangrenous or perforated gallbladder, previous attempt at cholecystectomy or where previous cholecystostomy is performed.<sup>15,31,34-37</sup> STC has two subtypes: fenestrating and reconstituting. In the fenestrating type, the free wall of the gallbladder is excised leaving a small portion at the neck as a shield against accidentally entering structures in the HCT. All stones are cleared. The posterior wall is left behind after cauterizing its mucosa. The cystic duct opening may be sutured with a purse-string from inside. The remnant of the gallbladder neck is left alone, placing a drain to control possible leakage of bile that may stop spontaneously over days or require an intervention like ERCP and stenting. Attempts to suture the cystic duct from outside can cause an injury. In the reconstituting type, the gallbladder remnant at the neck itself is closed to prevent biliary leakage but this reconstitutes a smaller

neo-gallbladder leading to stone reformation and recurrent symptoms requiring surgical re-intervention.<sup>31-34,37</sup> In difficult gallbladders where CVS cannot be achieved, performing STC is preferable to fundus-first total cholecystectomy which has a dangerously high risk of vasculobiliary injury.<sup>15,38-40</sup>

CVS is thus a safe and logical method of ductal identification that explains the anatomy of structures in the HCT more scientifically than other methods. Once all the three elements of the CVS are attained, it is logical that the two structures attached to the gallbladder can only be cystic duct and cystic artery, therefore eliminating the risk of ductal misidentification due to misperception. If CVS cannot be attained safely due to inflammation and scarring, there are safer options for bailing out. Surgeons must adopt and residents must be taught the principles of COSIC, particularly the CVS.<sup>9,20-22,25-27</sup>

#### **Conclusion:**

Laparoscopic cholecystectomy is a commonly performed procedure. Bile Duct Injury is uncommon but has serious consequences. The Critical View of Safety is an easy, effective, safe and logical method of identification of normal and anomalous structures in the HCT. If CVS cannot be safely obtained, a bailout procedure must be performed to prevent a biliary injury. Surgeons dealing with gallstone disease must master this technique and transfer it to their residents. Considering the high number of cholecystectomies performed every year, thousands of patients suffer the consequences of BDI. There is a continuous need for research in this field and also for educating young surgeons on the risks and consequences of BDI in laparoscopic cholecystectomy in order to improve patient safety and surgical outcomes.

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Zafar ullah Khan, did the research work and wrote the article.

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