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## Critical view of safety-basis of safe cholecystectomy

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### Abstract

Critical view of safety is an approach for safe cholecystectomy as it helps in identification of critically important two tubular structures, cystic duct and cystic artery, before clipping and division. CVS reduces the incidence of biliary duct injury and biliovascular injury. Laparoscopic cholecystectomy complications can be reduced by following critical view of safety approach.

**Keywords:** Biliovascular injury, laparoscopic cholecystectomy, fibrofatty tissues, critical view of safety (CVS), hepatocystic triangle

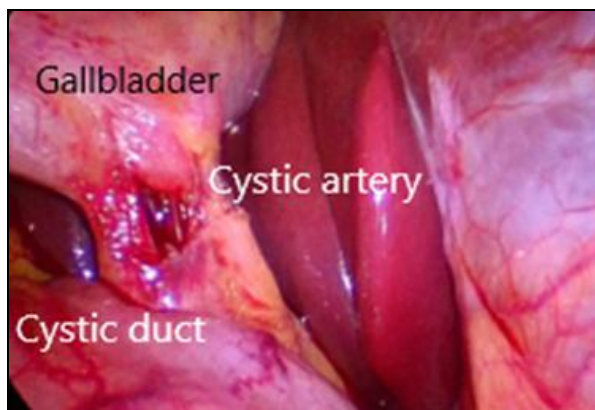
### Introduction

Critical view of safety (CVS) is a method of correctly identifying cystic duct and cystic artery before applying clips during cholecystectomy. It is a surgical technique applied for doing safe cholecystectomy without causing bile duct injury and biliovascular injury mainly. It has become gold standard for safe cholecystectomy. CVS was first described by Strasberg SM, et al; in 1995<sup>[1]</sup>. CVS involves three steps as.

- Complete clearing the hepatocystic triangle of fibrofatty tissues.
- Separation of the lower part of the gallbladder from the cystic plate, so that,
- Two and only two structures are seen entering gallbladder<sup>[2]</sup>.

Two and two structures are cystic duct and cystic artery. Their identification is important. Their injury can lead to serious complications and therefore before they are clipped and divided, they must be accurately identified. Most of the complications in cholecystectomy are commonly due to misidentification of structures and handling other structures instead cystic duct and cystic artery. Therefore, most of the complication of laparoscopic cholecystectomy are preventable. Anatomical variations in biliary anatomy are quite common and so it is essential to identify cystic artery and cystic duct carefully and correctly. However, both the origin and the course of the cystic artery may be highly variable, and in upto 20% of cases, the cystic artery is not found within the anatomical boundaries of the triangle<sup>[3]</sup>. Sometimes right hepatic artery passes near gallbladder and looks similar to cystic artery causing doubt. The cause of most major bile duct injuries is misidentification of ductal structures. In the 'classical' injury, the common bile duct is thought to be the cystic duct and is divided<sup>[4]</sup>. Currently CVS is taught and used widely in laparoscopic surgery. When CVS cannot be attained, there are several bailout strategies such as open cholecystectomy for a case with very severe inflammation<sup>[5]</sup>.

Critical view of safety was developed due to need of the time as that time the laparoscopic cholecystectomy number increased worldwide and so was the rise in bile duct injury (BDI) and vasobiliary injury (VBI). This state of affairs required a method to control these complications with laparoscopic cholecystitis and so the development of CVS occurred. How Plato, Greek philosopher, was right in saying, 'Necessity is mother of invention'. We should not only rely on CVS but have to develop strategy for safe cholecystectomy and CVS should be its important part. As of now a large percentage of surgeons have started achieving CVS in cholecystectomy, there are several reports containing several thousand patients in which CVS was used for target identification without a biliary injury due to misidentification<sup>[6, 7]</sup>. It is not a guarantee to reduce complications of cholecystectomy to zero by strictly following achievement of CVS. Large case series of laparoscopic cholecystectomy, in which the CVS was routinely applied, have reported rates of major bile duct injuries up to 0.54%<sup>[8-10]</sup>.



**Fig 1:** Critical view of safety

### Limitations of CVS

CVS approach is now a standard approach for doing safe cholecystectomy but it also has its limitations. Therefore, dependence only on CVS approach doesn't make zero incidence of complications and one has to consider other options also.

Only approach CVS may not be highly successful in anatomical biliary variations and anomalies which are common. CVS has limitations in case of severe inflammation and extensive adhesions, cementing adhesions also does not allow to achieve CVS. Contracted gall bladder with severe fibrosis also produces problem in achieving CVS in cholecystectomy. The 2020 SAGES guidelines summarized that there was no evidence 'to support CVS over other methods for anatomical identification' [11, 12].

### Experience of critical view of safety

Two hundred patients of acute and chronic cholecystitis with cholelithiasis were operated between Jan 2020 to Jan 2025 for safe cholecystectomy by achieving critical view of safety at Max Hospital, Gurgaon and Haryana, India. Laparoscopic cholecystectomy was done in all cases. In some cases (11, 5.5%) critical view of safety could not be achieved due to same inflammation and extensive adhesions so bail-out procedures were adopted in these cases.

Bail out procedures performed in this series were subtotal cholecystectomy and conversion to open cholecystectomy to avoid complications like bile duct injury and vasobiliary injury. The achievement of critical view of safety had affected the results in this study significantly positive as no BDI or VDI occurred. Only bile leak occurred in 4 cases which subsided within few days.

### Discussion

Laparoscopic cholecystectomy incidence is now increasing and therefore the method of safe cholecystectomy is attracting the mind of surgeons to reduce the complication rate at minimum. Most of the complication of cholecystectomy can be avoided by religious use of CVS and good knowledge of normal and aberrant anatomy of biliary structures. Aberrant anatomy may include a short cystic duct, aberrant hepatic ducts or a right hepatic artery that crosses anterior to common bile duct [13].

Bile duct injury rates have increased since the introduction of laparoscopic cholecystectomy, occurring about 3 per 1,000 procedures performed.<sup>14</sup> Bile duct injuries after cholecystectomy can be life altering complications leading to significant morbidity and cost [15, 16]. The complication

rates of bile duct injuries after laparoscopic cholecystectomy vary from 0.4 to 0.5%, depending on underlying disease and they remain higher than in the open approach [17]. This picture though now slightly affected by following CVS approach.

By definition, the idea behind the CVS was conceived precisely to prevent such anatomical traps due to misidentification. The percentage rate of complication is low due to the high number of cholecystectomies are performed today globally. The answer lies in the fact that although many major biliary injuries still occur, that is, 2000 to 3000 per year in the USA, the even rate is only about 3 per 1000 cholecystectomies (up for about 1 per 1000 in the era of open cholecystectomy). Cholecystectomies performed annually about 8,00,000 in the USA [18].

CVS is not the only way for identification of cystic duct and cystic artery. No consensus conference has published a guideline that CVS is the only effective method of target identification. Many surgeons in current practice use and are confident in other methods [19]. The three features of CVS when achieved then only clipping and division of cystic duct and cystic artery after viewing by doublet vision also. CVS achievement confirms that there are only two tubular structures entering the gall bladder, cystic duct and cystic artery and this significantly reduces the chances of complications. Although CVS achievement cannot bring the complication rate to zero level but it helps a lot in reducing the rate of complication which is confirmed by various studies. In spite of effectiveness of CVS in lowering the complication rate we should not only totally rely on this factor one must be suspicious about the aberrant biliary anatomy.

CVS prevents vascular and bile duct injury by clearing the view of two tubular structures entering the gall bladder, i.e. cystic duct and cystic artery as the injury to biliovascular structure can be serious and CVS plays a great role in avoiding it. Clearing of HCT gives clear view of the structures contained in it and helps in identification of these structures. Dissecting the lower part of the gall bladder from cystic plate of liver helps in clearing the entry of cystic duct and cystic artery in the gall bladder and this improves the confidence of the surgeon that he /she is not making a mistake. CVS achievement also keeps you away from causing trauma to vasculobiliary structures in case of anatomical abbreviation which are quite common in biliary anatomy.

### Conclusion

In laparoscopic cholecystectomy the complication most probably occurs due to misidentification of anatomical structures. Critical view of safety (CVS) achievement is applied in laparoscopic cholecystectomy to reduce the complications due to misidentification. It is now considered a gold standard for safe cholecystectomy. CVS helps in identifying cystic duct and cystic artery clearly with confidence. CVS has some limitations also specially in presence of aberrant anatomy and severe inflammation with extensive adhesions. Biliary anatomy is sometimes highly variable and aberrant vessels can create problem in identifying main structures correctly. CVS does not 100% eliminate the risk of complications but certainly reduces BDI and VBI significantly. CVS is not used by all surgeons and it may be one of the reasons of still BDI and VBI occurring. CVS approach must be used universally.

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## Declaration of patient consent

Informed consent was taken from patients.

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## Conflicts of interest

There are no conflicts of interest.

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