



# A perspective on the critical view of safety in laparoscopic cholecystectomy

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**Abstract:** The critical view of safety (CVS) technique is a means of target identification, the targets being the cystic duct and artery. It was introduced more than 20 years ago in an attempt to reduce the rising incidence of biliary injuries. CVS is based on a method of anatomic identification in open cholecystectomy. The three elements of CVS are to clear the hepatocystic triangle of fat and fibrous tissue, to take the lower part of the gallbladder off the cystic plate and to see that two and only two structures are entering the gallbladder. There is good evidence that CVS identification is effective in preventing biliary injury. Photodocumentation is possible and should be encouraged.

**Keywords:** Laparoscopic cholecystectomy; cholecystectomy; biliary injury; critical view of safety (CVS)

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Laparoscopic cholecystectomy provides several advantages to patients over open cholecystectomy. These include less pain, shorter hospital stay, and faster recovery. However, the introduction of laparoscopic cholecystectomy has been associated with a large increase in the incidence of major bile duct injuries from about 1 per 1,000 to 3 per thousand (1). Major bile duct injuries are quite morbid, as well as costly and the source of litigation. As such they detract from the value of the procedure to patients.

The cause of most major bile duct injuries is misidentification of ductal structures. In the “classical” injury (2), the common bile duct is thought to be the cystic duct and is divided. Division of the common hepatic duct and often injury to the right hepatic artery ensue. Aberrant hepatic ducts may also be misidentified as the cystic duct or cystic arteries. The critical view of safety (CVS) is a method of target identification, the targets being the cystic duct and the cystic artery. Currently CVS is taught and used widely in laparoscopic surgery (3).

## History of the CVS

The concept of the critical view was described in 1992 (4)

but the term CVS was introduced in 1995 in an analytical review of the emerging problem of biliary injury in laparoscopic cholecystectomy (3). CVS was conceived not as a way to do laparoscopic cholecystectomy but as a way to avoid biliary injury. To achieve this, what was needed was a secure method of identifying the two tubular structures that are divided in a cholecystectomy, i.e., the cystic duct and the cystic artery. CVS is an adoption of a technique of secure identification in open cholecystectomy in which both cystic structures are putatively identified after which the gallbladder is taken off the cystic plate so that it is hanging free and just attached by the two cystic structures. In laparoscopic surgery complete separation of the body of the gallbladder from the cystic plate makes clipping of the cystic structures difficult so for laparoscopy the requirement was that only the lower part of the gallbladder (about one-third) had to be separated from the cystic plate. The other two requirements are that the hepatocystic triangle is cleared of fat and fibrous tissue and that there are two and only two structures attached to the gallbladder (5) and the latter requirements were the same as in the open technique. Not until all three elements of CVS are attained may the cystic structures be clipped and divided.

Intraoperatively CVS should be confirmed in a “time-out” in which the 3 elements of CVS are demonstrated. Note again that CVS is not a method of dissection but a method of target identification akin to concepts used in safe hunting procedures

Several years after the CVS was introduced there did not seem to be a lessening of biliary injuries. Operative notes of biliary injuries were collected and studied in an attempt to determine if CVS was failing to prevent injury (6). We found that the method of target identification that was failing was not CVS but the infundibular technique in which the cystic duct is identified by exposing the funnel shape where the infundibulum of the gallbladder joins the cystic duct. This seemed to occur most frequently under conditions of severe acute or chronic inflammation (6). Inflammatory fusion and contraction may cause juxtaposition or adherence of the common hepatic duct to the side of the gallbladder. When the infundibular technique of identification is used under these conditions a compelling visual deception that the common bile duct is the cystic duct may occur (6). CVS is much less susceptible to this deception because more exposure is needed to achieve CVS, and either the CVS is attained, by which time the anatomic situation is clarified, or operative conditions prevent attainment of CVS and one of several important “bail-out” strategies (7) is used thus avoiding bile duct injury.

CVS must be considered as part of an overall schema of a culture of safety in cholecystectomy (8). When CVS cannot be attained there are several bailout strategies such as cholecystostomy or in the case of very severe inflammation discontinuation of the procedure and referral to a tertiary center for care. The most satisfactory bailout procedure is subtotal cholecystectomy of which there are two kinds (7). Subtotal fenestrating cholecystectomy removes the free wall of the gallbladder and ablates the mucosa but does not close the gallbladder remnant. Subtotal reconstituting cholecystectomy closes the gallbladder making a new smaller gallbladder. Such a gallbladder remnant is undesirable since it may become the site of new gallstone formation and recurrent symptoms (7). Both types may be done laparoscopically.

### Does the CVS prevent biliary injuries?

There are two main lines of evidence that CVS is an effective means of target identification. First, there are several reports containing several thousand patients without a biliary injury due to misidentification and in which CVS was

the technique of target identification (9-13), whereas, based on an incidence of biliary injury of 3-4/1,000 cases, about 20 biliary injuries would be expected. Secondly, in studies that investigated the mechanisms of major biliary injury, CVS has not been the method of target identification (14). Taken as a whole 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. One may ask why after 25 years has there not been a randomized trial that compares methods of target identification? The answer lies in numbers i.e., the fact that although many major biliary injuries still occur, for example 2,000-3,000 per year in the USA, the event rate is only about 3 per 1,000 cholecystectomies (up from about 1 per 1,000 in the era of open cholecystectomy). A randomized trial is impractical because the event rate is so low that about 4,500 patients per arm would be required. Despite the low event rate biliary injuries are common because of the huge number of cholecystectomies performed annually—about 800,000 in the USA. Thus remarkably biliary injury has some aspects of a rare disease and some of a common disease. Important corollaries flow from these facts. Single center or multicenter studies of laparoscopic cholecystectomies of laparoscopic cholecystectomies are underpowered to provide insights into the causes of biliary injury because they almost never contain sufficient numbers of patients. Population studies of thousands of patients are required in order to have enough events to gain meaningful insights. That is why going back 100 years, much of what is known about biliary injury has been gleaned not from case series of laparoscopic cholecystectomies but from case series of the injuries themselves (15).

### Problems with CVS

Dissemination of new information is a difficult problem in surgery. Even after more than 20 years, many surgeons have a poor understanding of the criteria for CVS, especially those who were not taught CVS during residency (16,17). Reluctance to adopt new techniques or methods can also be a challenge. In the case of CVS, this is compounded by the low event rate of biliary injury, which makes an error trap like the infundibular technique even harder to overcome. If it fails only 1 in 300 times, then it works 299 out of 300 times and there is a huge reservoir of confidence in it (16). And the infundibular method is easier and takes less dissection than CVS. Attainment of the CVS is not usually recorded

or documented photographically and although the dictated operative note may state that the CVS was achieved, recent evidence suggests this is frequently not the case (14).

### Future of CVS

As noted CVS is part of the Culture of Safety In Cholecystectomy (COSIC) (8) and this problem has been taken up by SAGES in a new effort called "Safe Cholecystectomy" ([www.sages.org/safe-cholecystectomy-program](http://www.sages.org/safe-cholecystectomy-program)). The SAGES Safe Cholecystectomy program aims to better disseminate understanding and use of CVS and other strategies for prevention of biliary injury such as use of intraoperative imaging and approaches to the difficult gallbladder that include proper bail-out techniques (7). An effective and easy method of photodocumentation of CVS is now available for surgeons who wish to record CVS visually (18). It is called doublet photography (18).

Doublet photography allows scoring of the degree to which the three elements of CVS are attained on a 6 point scale. Doublet photodocumentation may be used to perform studies regarding the adoption of CVS as a safety quality measure. Recently, the combination of focused education using doublet photography to measure improvement of CVS scores along with intraoperative time-out was shown to significantly improve attainment of all three elements of CVS by surgical residents (17). For those who wish to record it in operative notes, it is important to know that CVS cannot be said to have been achieved without attainment of all three elements of this method of target identification. We dictate these three elements into operative notes and recommend it as an excellent practice.

In summary, CVS is an excellent method of anatomical identification in laparoscopic cholecystectomy. However, it has only partially penetrated surgical practice. Coaching and photodocumentation are potential solutions of the future.

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