

Research article

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Results of laparoscopic cholecystectomy using the critical view of safety technique

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Abstract

Background: The aim of this study was to assess the safety of laparoscopic cholecystectomy using “The Critical View of Safety” (CVS) technique for the management of gallbladder stone disease.

Subjects and methods: Prospective study, describing a series of cases of patients undergoing laparoscopic cholecystectomy with CVS applied to treat gallbladder stones at Binh Dan Hospital from August 2020 to October 2022.

Results We enrolled 185 patients and recorded the following outcomes: the success rate was high, at 98.3%. The failure cases were due to large stones blocking the gallbladder neck and severe adhesions in the hepatocystic triangle in necrotizing cholecystitis. The overall bleeding complication rate was 8.6% (16 cases) and during CVS was 5.9% (11 cases). The overall gallbladder perforation complication rate was 8.1% (15 cases) and during CVS was 4.3% (8 cases), with no biliary tract injuries. The postoperative complications included fluid collection in the gallbladder bed in 16.2% of cases and surgical wound infection in 2.7% of cases. All were successfully treated with conservative measures.

Conclusion: We concluded that CVS is a necessary, safe, and effective diagnostic method in laparoscopic cholecystectomy for gallbladder stone disease.

Keywords: The critical view of safety, Gallbladder stones, Laparoscopic cholecystectomy.

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1. INTRODUCTION

Nowadays, laparoscopic cholecystectomy has gradually replaced the traditional open cholecystectomy. Although it has many advantages over open cholecystectomy, laparoscopic cholecystectomy has a significantly higher rate of biliary tract injury compared to the open approach [1]. The results of several studies have shown that misidentification of anatomical structures is the primary cause of biliary tract injuries

in laparoscopic cholecystectomy [1,2]. As a result, various studies have proposed safe approaches to prevent biliary tract injuries during laparoscopic cholecystectomy, among which “The Critical View of Safety” (CVS) is noteworthy. Since its first introduction by Steven M. Strasberg and colleagues in 1995, the application of CVS has been considered a reliable and safe method for identifying the cystic duct and cystic artery [2].

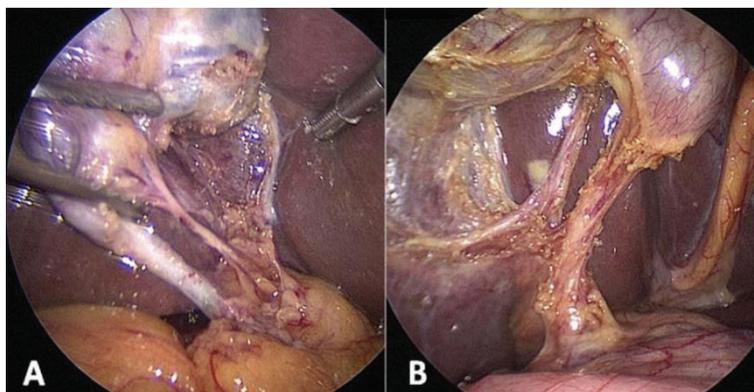


Figure 1. (A) Anterior view of CVS, commonly seen in thin cystic plate.

(B) Posterior view of CVS. cystic plate is thick and slightly white.

Both anterior and posterior aspects meet all three criteria for CVS.

•The hepatocystic triangle must be completely clear of tissue allowing proper visibility of all cystic structures

• The lower one third of the gallbladder is separated from the liver to expose the cystic plate.

• Only two structures can be clearly seen connected to the gallbladder.

There is currently no research on CVS in laparoscopic cholecystectomy in Vietnam. Therefore, we conducted the study “Results of LC with the application of “CVS” at Binh Dan Hospital” to evaluate the safety of LC with the application of “VCS” and evaluate the rate of intraoperative complications and postoperative complications when performing this method.

2. MATERIALS AND METHODS

Research subjects

All patients had LC due to gallbladder stones at Binh Dan Hospital

Inclusion criteria

The patient was diagnosed with gallbladder stones based on ultrasound. The patient was diagnosed with acute cholecystitis (AC) due to stones according to Tokyo Guideline 2018.

The patient was operated on using the laparoscopic surgery method, with CVS performed which was recorded in the sample medical record.

Exclusion criteria

Patients with acute cholecystitis have

common bile duct stones, liver stones, biliary tract tumors, pancreatic head tumors, common bile duct cysts, stomach tumors... accompanied.

Research Methods

Study design and sample size

Study design: prospective, describing a series of cases.

Maximum number of samples taken from possible patients.

Sampling time and location

Research period: From August 2020 to the end of October 2022 at Binh Dan hospital.

3. RESULTS

There were 185 cases of LC surgery applying the essential safety perspective that met the selection criteria for research subjects. Of these, there were 182 successful cases.

General features

Age

There were 185 cases with an average age of 53.2 ± 13.1 years. The youngest case was 17 years old and the oldest case was 90 years old. The most common age group is 40- 60 years old, accounting for 50.6%, two

age groups from 17-39 years old have a rate of 21.3%, and 60-90 years old have a rate of 28.1%.

Sex

In the study sample there were 125 females (67.6%) and 60 males (32.4%). Thus, there are more women than men, the female:male ratio is approximately 2:1

Group of surgeons

There were 145 surgical cases (accounting for 78.3%) performed by surgical teams with experience of 30 or more surgical procedures.

Of these, 40 cases were performed by surgeons with less than 30 cases of experience, 57 cases were performed by surgeons with 30-50 cases of experience, and 88 cases were performed by surgeons with more than 50 cases of experience.

Results of LC with the application of CVS

Intraoperative findings

We combine ultrasound images, We combine ultrasound images, computed

tomography, abdominal magnetic resonance imaging, and intraoperative damage to determine the condition of the gallbladder.

In this study cohort, 112 gallbladders exhibited no signs of inflammation (non-distended, with no wall thickening). Eight cases presented with gallbladder necrosis. Cystic duct impaction was observed in 5 cases. The remaining cases displayed gallbladder enlargement and wall thickening. Concerning the degree of hepatobiliary triangle adhesions: 125 cases demonstrated no adhesions (representing 67.6% of the cohort), 19 cases exhibited mild adhesions, and 41 cases showed severe adhesions.

Rate of achieving CVS

A total of 185 cases of LC applied CVS. The success rate is 98.3% (182 cases).

There were 3 cases of failure during surgery to achieve CVS. These cases include a case of large stones blocking the neck of the gallbladder and a case of necrotizing gallbladder. Both failed cases were performed by 2 surgeons with over 50 cases of experience.

Table 3.1 Describing the success rate of achieving CVS by lesion group and surgeon group

Lesion	CVS achieved	Did not meet CVS	p
Gallbladder status			
Normal gallbladder	112	0	p=0.02 (Fisher's test)
Enlarged gallbladder with thickened wall	60	0	
Gallbladder necrosis	7	1	
Impacted stone in the gallbladder neck	3	2	
Degree of adhesive inflammation of the Hepatocystic triangle			
Not adhesive	125	0	p=0.039 (Fisher's test)
Mild adhesion	19	0	
Severe adhesion	38	3	
Surgeon group			
Surgeons with less than 30 cases of experience	40	0	p=0.502 (Fisher's test)
Surgeons with 30-50 cases of experience	57	0	
Surgeons with over 50 cases of experience	85	3	

Time to achieve CVS

Table 3.2. Describing the time to achieve CVS by lesion group and surgeon group

	Time to reach CVS (minutes)	p
Degree of hepatocystic triangle adhesion inflammation		
No inflammation	25.5±11.8	p<0.01 (Kruskal Wallis test)
Mild inflammation	39.2±11.0	
Servere inflammation	65.3±15.6	
GALLBLADDER status		
Normal gallbladder	24.2±13.4	p=0.001 (Kruskal Wallis test)
Enlarged gallbladder with thickened wall	35.4±14.3	
Gallbladder necrosis	62.7±18.2	
Impacted stone in the gallbladder neck	55.5±17.4	
Group of surgeons		
Surgeons with less than 30 cases of experiance	38.3±10.3	p=0.004 (Kruskal Wallis test)
Surgeons with 30-50 cases of experiance	43.3±24.2	
Surgeons with over 50 cases of experiance	28.4±16.4	

The average time to reach CVS was 35.8 ± 19.5 minutes. Recorded the shortest time to reach CVS is 10 minutes, the longest time to reach CVS is 90 minutes.

Duration of surgery

Table 3.3. Describing the surgical duration by lesion group and surgeon group

	Duration of surgery (minutes)	p
Degree of hepatocystic triangle adhesion inflammation		
No inflammation	54,4±14,9	p<0.01 (Kruskal Wallis test)
Mild inflammation	71,7±15,7	
Servere inflammation	108,8±25,8	
GALLBLADDER status		
Normal gallbladder	53,2±12,4	p<0.01 (Kruskal Wallis test)
Enlarged gallbladder with thickened wall	65,5±15,3	
Gallbladder necrosis	85,7±17,8	
Impacted stone in the gallbladder neck	74,5±19,2	
Group of surgeons		
Surgeons with less than 30 cases of experiance	71,5±15,1	p=0.001 (Kruskal Wallis test)
Surgeons with 30-50 cases of experiance	77,7±33,8	
Surgeons with over 50 cases of experiance	58,7±22,6	

The mean operative time was 68.2 ± 26.9 minutes. The shortest operative time recorded was 40 minutes, and the longest was 180 minutes.

Complications during surgery

There were only two types of complications were encountered during surgery: bleeding and gallbladder perforation.

Regarding bleeding complications, a total of 16 cases (8.6%) experienced intraoperative bleeding. Of these, 11 cases bled during dissection to achieve CVS: 5 cases involved tears in small branches of the cystic artery, 2 cases had bleeding in the gallbladder bed, and 4 cases had both tears in small branches of the cystic artery and bleeding in the gallbladder bed. The remaining 5 bleeding cases occurred in the gallbladder bed after achieving CVS. All bleeding cases were managed with monopolar cauterization and packing. Bleeding complications were most common in cases of gallbladder necrosis (7 cases), with 5 cases occurring in non-inflamed gallbladders, 3 cases in enlarged, thickened gallbladders, and 1 case with cystic duct impaction. Results showed that 12 bleeding cases occurred when the hepatobiliary triangle had severe adhesions, and 4 cases had no adhesions.

Among the 15 cases of gallbladder perforation (8.1%), 7 were due to clamping, and the remaining 8 occurred during the liberation of the gallbladder from the gallbladder bed. All cases of gallbladder perforation were managed by cleaning and irrigating the subhepatic space and removing any spilled stones from the abdominal cavity. Of these, 7 cases occurred in necrotic gallbladders, 5 cases in non-inflamed gallbladders, 3 cases in enlarged, thickened gallbladders, and 1 case with cystic duct impaction. According to the degree of hepatobiliary triangle adhesions, 4 cases of gallbladder perforation occurred when the hepatobiliary triangle had severe adhesions, 2 cases had mild adhesions, and 9 cases had

no adhesions. No other complications such as bile duct injury or damage to adjacent organs were observed.

Complications after surgery

All patients were monitored from the first day after surgery until discharge, with follow-up visits 14 days and 30 days after discharge. All patients after surgery receive routine ultrasound. Ultrasound results on the first day after surgery revealed that 30 patients (16.2%) had fluid collection in the gallbladder bed. Assessing the size of the seroma, there were 21 cases with seroma size smaller than 30 mm and 9 cases with seroma larger than 30 mm.

4. DISCUSSION

General characteristics

Age and gender

Research results showed that the average age of patients was 53.2 ± 13.1 years; The youngest age is 17 years old, the oldest age is 90 years old. The most common age group from 40-60 accounts for 50.6%. As well as Nassar's research [3], has an average age of 53.2 years. The cases successfully achieving CVS were distributed in many different age groups, so we believe that age does not affect the success rate of achieving CVS.

The study showed that there were 125 cases (67.6%) female and 60 cases (32.4%) male, the female to male ratio was approximately 2:1. Research by Do Trong Hai [4] : the female to male ratio is 3:1. This is consistent with the literature. Almost all cases achieved CVS, so we found that gender did not affect the rate of achieving CVS.

Group of surgeons

There were 3 groups of surgeons classified based on the number of LC cases they had ever performed, a group of surgeons who had performed less than 30 cases, a group of surgeons who had performed 30-50 cases,

and a group of surgeons who had performed surgery on less than 30 cases. performed over 50 cases. both cases of stone stuck in the neck and necrotizing gallbladder failed in performing CVS were performed by doctors with extensive experience with more than 50 gallbladder cutting cases. All young doctors with less than 30 cases of experience and the group of doctors with 30-50 cases of gallbladder cutting experience successfully performed CVS. In this study, we found that the success rate of achieving CVS is not affected by the surgeon's experience

Intraoperative characteristics

Gallbladder condition and degree of adhesion inflammation in the hepatocystic triangle

In this study, there were 112 cases of gallbladder without signs of inflammation. 60 cases of large gallbladder with thick walls; this is one of the factors that causes many difficulties for the operation. There were 8 cases of necrotizing gallbladder. of these, there were 7 successful cases achieving cvs, accounting for 87.5%. in necrotizing gallbladder, endoscopically removing the gallbladder is a challenge for the surgeon because the gallbladder is highly inflamed, pus-filled, necrotic, difficult to handle, and difficult to identify the anatomical structure. today, laparoscopic surgery is still performed safely and effectively on patients with necrotizing gallbladder [3].

There were 5 cases of stones stuck in the gallbladder neck. According to Nassar [3], the rate of achieving CVS was only 60% for the gallbladder group with stones stuck in Hartmann's pocket. However, this author's study had 175 cases in the group of stones stuck in the gallbladder neck, much larger than ours. We believe that most cases of stones stuck in the neck of the gallbladder have moderate to severe inflammation and

the larger the stone, the more difficult it will be to clearly dissect the biliary triangle and expose the lower 1/3 of the gallbladder bed, so it is possible that failure increases when performing CVS in these cases.

There were 41 cases (22.2%) of a lot of adhesive inflammation, 19 cases (10.3%) of a little adhesive inflammation and 125 cases (67.5%) of no adhesive inflammation.

Success rate of achieving CVS

The rate of achieving CVS was 98.3%. There were 3 cases of failure during surgery to achieve CVS. The failed cases include 2 case that did not achieve CVS due to large stones stuck in the neck of the gallbladder, narrowing and obscuring the hepatocystic triangle, and 1 case of necrotizing gallbladder, the hepatocystic triangle was so inflamed and adhesive that they had to be treated. I cut the gallbladder from the base, dissecting the gallbladder wall closely to the funnel and canal. Then the forceps cut the gallbladder tube and gallbladder artery. Complete surgery safely. There were no cases requiring conversion to open surgery.

We found that the success rate of achieving CVS is not affected by the surgeon's experience, the time of surgery in cases of AC as well as some other factors such as age and gender. Besides, the following factors: high level of hepatocystic triangle adhesion inflammation, state of stones stuck in the neck of the gallbladder, and necrosis of the gallbladder reduce the success rate of achieving CVS. When the inflammation of the gallbladder is more severe and the hepatocystic triangle is difficult to dissect, the likelihood of successfully achieving CVS decreases. In those cases, the surgeon can choose other techniques such as: taking pictures of the bile ducts during surgery, cutting gallbladder from the bottom, converting to

open surgery. According to P. Sanjay [6], he had 447 cases of LC with 40% of AC cases, 58% of chronic gallbladder inflammation and 2% of symptomatic gallbladder stones. There were 388 (87%) cases achieving CVS, 59 (13%) cases not achieving CVS. due to inflammation in many areas of the hepatocystic triangle, preventing clear delineation of the anatomy of this area. Among them, 12 cases that did not achieve CVS were converted to partial retrograde gallbladder resection. The remainder were converted to open surgery.

The CVS achievement rate aligns with findings from previous research. C. Avgerinos' study [7] of 1046 cholecystectomies reported that 39% of cases involved moderately to severely inflamed gallbladders (chronic cholecystitis, hydrops, jaundice, empyema), while 61% involved non-inflamed or mildly inflamed gallbladders (biliary colic, non-specific dyspepsia, incidental gallstones). The CVS success rate was 95.4% (998/1046). In 2.5% of cases (26/1046), alternative identification techniques such as the infundibular approach or cholangiography were employed. In 22 cases, open conversion was necessary prior to any surgical or identification maneuver. The author concluded that CVS was a simple, precise, and highly suitable technique for all gallbladder pathologies in laparoscopic cholecystectomy.

Time to achieve CVS

The average time to reach CVS was 35.8 ± 19.5 minutes. When compared with JK Koong's research [8], the time to reach CVS (average 22.8 ± 14.3 minutes) was shorter. This difference we think is due to many different factors between the 2 studies. We found that the time to reach CVS in different surgeons groups was statistically significant ($p=0.004$). with our group of experienced

surgeons in research, the average time to achieve CVS is 28.4 ± 16.4 minutes, which is longer than Koong's results.

Duration operation

The average surgery duration was 68.2 minutes, ranging from 40 to 180 minutes. Operative time was significantly influenced by gallbladder condition, degree of Calot's triangle adhesions, and surgeon experience. Surgeons encountered longer operative times in cases with gangrenous and impacted gallstones compared to those with non-inflamed gallbladders ($p<0.01$). Additionally, cases with severe Calot's triangle adhesions required significantly longer operative times compared to those with mild or no adhesions ($p<0.01$). Surgeon experience also played a significant role, with less experienced surgeons having longer operative times ($p=0.001$). These findings align with Urquij's study [9], which demonstrated a significant difference in operative times between resident and experienced surgeons."

Complications during surgery

Bleeding

Bleeding is the leading complication in laparoscopic surgery. This complication often puts pressure on the surgeons and is one of the main reasons for conversion to open surgery. We encountered 16 cases of bleeding (8.6%), including 11 cases during surgery to achieve CVS, the amount of blood loss was from 50-100ml, no case required blood transfusion or open surgery. The cases of necrotic gallbladder, bleeding during surgery was statistically significantly more than other conditions ($p<0.01$). Bleeding occurs more frequently in the group with a lot of adhesion to the surrounding structures and a lot of adhesions in the hepatocystic triangle. These differences are statistically significant ($p<0.01$). However, this

complication was not significantly different between the 3 groups of surgeons ($p=0.61$). Research by Nguyen Van Hai and Nguyen Tuan [10] in 66 cases, there were 4 cases of heavy bleeding during surgery but did not require blood transfusion.

Gallbladder perforation

There were 15 cases of gallbladder perforation, of which 8 cases of gallbladder perforation occurred during surgery to get out of the gallbladder bed, the remaining 7 cases were perforation due to handling. The rate of complications of gallbladder perforation had a statistically significant difference between groups of gallbladder conditions ($p<0.001$), in which the necrotic gallbladder group had the highest perforation rate of 6 out of 8 cases. It is almost rare for studies that apply CVS in LC to mention gallbladder perforation during surgery. Gallbladder perforation rate of Vu Bich Hanh [5] is 11.6%.

Biliary tract injured

185 patients with varying degrees of gallbladder inflammation and hepatobiliary triangle adhesions, operated on by 3 surgical groups. There were no cases of biliary tract injured. This result shows that less experienced doctors who are properly trained in performing CVS can avoid complications of biliary tract injured.

Complications after surgery

When applying CVS, postoperative complications including gallbladder bed fluid collection were 16.2%, surgical wound infection was 2.3%. Postoperative ultrasound examination results (performed on the first day after surgery) recorded 30 cases (16.2%) with gallbladder bed fluid collection. Of these, 21 cases had seroma size $<30\text{mm}$, 9 cases had seroma size $>30\text{mm}$. The inflamed and necrotic gallbladder group had a higher rate of fluid

collection than the non-inflamed gallbladder group and had neck stones stuck in the neck with statistical significance ($p<0.01$). The rate of seroma according to surgeons group was not significantly different ($p=0.147$). In cases of post-operative seroma, we closely monitor the clinical situation and the size of the seroma through ultrasounds and then note that the size of the seroma has decreased, so we discharge the hospital like other cases and do not need intervention any more. Our results do not differ much from previous studies. Vu Bich Hanh [11] encountered 3 cases (5%), Nguyen Van Hai [10] had 2 cases (3.0%) of fluid collection under the liver.

The above complications do not greatly affect the quality of treatment and the rate is not high. This shows that applying CVS in LC is safe, especially for groups of resident doctors and young doctors with little experience. And this technique should be thoroughly applied to the group of less inflamed gallbladder and is very practical for teaching and training general surgeons.

5. CONCLUSION

Applying CVS in LC Surgery at Binh Dan Hospital is completely feasible. High success rate, reaching 98.3%. General complications during surgery and complications after surgery are small and not serious. We find that CVS is a necessary, safe, and effective assessment technique.

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