

Adoption of Critical View of Safety versus Infundibular Technique in Laparoscopic Cholecystectomy: A comparative study

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Abstract

Background	Laparoscopic cholecystectomy (LC) is the most common elective surgery performed by a general surgeon. Although being a routine procedure, classical pitfalls as misperception of intraoperative anatomy is one of the leading causes of bile duct injuries (BDI). The critical view of safety (CVS) in LC can be a new safe technique for identification of anatomy to reduce such a risk.
Objective	To assess the efficacy of CVS in LC compared with the traditional infundibular technique.
Methods	This comparative study included 344 patients who suffered from symptomatic gall stones. Patients have been grouped into two groups: group A (172 patients) operated utilizing the traditional infundibular technique and group B (172 patients) by CVS technique. Preoperative patient assessment, operating time and intraoperative and postoperative events including hospital stay, were recorded. Those patients who were unfit and or with bleeding disorders were excluded from the study. Postoperatively, patients were assessed using clinical examination for the possible complications.
Results	The main perioperative complications bleeding and bile leak were significantly reported in infundibular group 6.98% and 9.88% respectively compared to 0.58% and 1.74% in CVS group respectively. Postoperatively, both intra-abdominal collection and bile leak were significantly lower in CVS group (1.16% and 1.74%, respectively) than in infundibular group (7.58% and 6.98%, respectively). Furthermore, hospital stay was significantly less in CVS group (1.8±2.7 days) compared to infundibular group (3.14±2.8 days).
Conclusion	Using the CVS is associated with shorter operative time, less frequent peri- and postoperative complications and shorter hospital stay compared with infundibular technique.
Keywords	Laparoscopic cholecystectomy, critical view of safety (CVS)
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List of abbreviations: BDI = Bile duct injury, CVS = Critical view of safety, HC = hepatocytic, LC = Laparoscopic cholecystectomy

Introduction

Laparoscopic cholecystectomy (LC) is one of the most commonly executed general surgical procedures worldwide. It is associated with an overall complication rate of

nearly 10% with a higher risk of biliary injury (0.1-1.5%), when matched to the open method (0.1-0.2%)⁽¹⁾. This complication, if persist, largely equipoises the benefit of the minimally invasive approach. Recent data suggest a decreasing trend in the bile duct injury (BDI), vascular-biliary injury (VBI) rate (0.32-0.52%)

without any significant change in the morbidity or mortality after LC ⁽²⁾.

A common source of biliary injury during LC is misidentification of structures in the hepatocystic (HC) triangle. Several procedures have been used to improve the identification of these structures. In the infundibular view error, cystic duct identification is established according to the appearance of the infundibulum-cystic duct junction as a funnel ⁽³⁾. In certain conditions, this procedure can be misleading. When the cystic duct is merged with common hepatic duct (CHD) due to acute or chronic inflammation, when the cystic duct is too short or obliterated by a large stone impacted in the infundibulum, or when there is difficulty in uncovering the HC triangle due to insufficient retraction (e.g., due to fibrosis), the CBD may be misidentified as the cystic duct ⁽⁴⁾.

Many authors worldwide explored other techniques to overcome the problem of misidentification. Flum et al. used intraoperative cholangiography (IOC) and reported a significant decline in BDI ⁽⁵⁾. Huang et al. adapted fundus-down LC and found it to be associated with lower complication rate and shorter postoperative hospital stay ⁽⁶⁾. Al-Helfy et al. used intraoperative methylene blue in 98 Iraqi patients with symptomatic cholelithiasis and recorded a significant success in bile duct anatomical identification ⁽⁷⁾. However, some cases of BDI/VBI (even accounting for very small percent) do occur in all these techniques. The concept of the critical view of safety (CVS) was introduced in an attempt to decrease the misidentification injury ⁽⁸⁾. The aim of the CVS is conclusive identification of the cystic duct and cystic artery (two targets) to avoid misidentification injury ⁽⁹⁾. CVS is the final view that is achieved after a thorough dissection of the HC triangle to demarcate the cystic duct and the cystic artery before they are clipped and divided ⁽³⁾.

This study aimed to evaluate the efficiency of CVS in reducing the intraoperative complications compared with the traditional infundibular technique.

Methods

This was a comparative study conducted on patients who attended Surgical Department at Al-Imamein Al-Kadhimein Medical City during the period from January 2019 to December 2021. Those patients were suffering from symptomatic gall stones confirmed by clinical examination and ultrasonography. Patients unfit for pneumoperitoneum due to cardiac or pulmonary causes, suspicion of gall bladder tumor or having bleeding disorders, combined gall bladder and common bile duct stones, patients who have suspicion of gall bladder mass and patients in whom both techniques of dissection had failed to applied intraoperatively due to difficult anatomy secondary to inflammatory adhesion and fibrosis were excluded from the study.

Eligible patients provided written informed consent acknowledging all possible complications, and the study was approved by the Institutional Review Board, College of Medicine, Al-Nahrain University.

A total of 344 patients were qualified for the study. Patients given admission number. Group A (172 patients) who were operated by routine LC using infundibular technique and group B (172 patients) were operated by CVS technique.

For group A the older common method found in texts for ductal identification in laparoscopy has been used; the "infundibular" or "infundibular-cystic" technique. This method entails dissecting the gallbladder from its neck upward, the cystic duct is isolated by dissection on the front and the back of the triangle of Calot (cystic artery forms cephalad boundary instead of the liver surface) once isolated it is traced on to the gallbladder. Conclusive identification, i.e., the anatomic rationale for identification, occurs as a result of seeing the characteristic flare (funnel shape) as the cystic duct widens to become the gallbladder infundibulum.

In group B, the CVS was achieved by clearance of the HC triangle (CHD on the left, cystic duct on the right, and liver under surface superiorly). The triangle has been cleared of all the soft areolar tissue. Then exposure of the

lower cystic plate and the gallbladder been separated from its liver bed with the exposure of the lower third of the cystic plate. When two and only two tubular structures have been

entering the gallbladder, the cystic duct and the cystic artery, clips are applied as shown in figure 1. Sub hepatic drain in both groups inserted when needed.



Figure 1. Dissection of the hepatocystic triangle exposing the critical view of safety

Preoperative patient characteristics, operating time and intraoperative and postoperative factors including hospital stay, were recorded. Postoperatively, patients were assessed using clinical examination for signs and symptoms of biliary leakage such as drainage bag content, abdominal distention, fever, jaundice, while sometimes, liver function test and abdominal US were needed to detect any bile collection. All the patients received adequate analgesia and were discharged once stable. The patients were called for follow up after 10 days for stitches removal and to look for any jaundice due to biliary strictures.

Results were statistically analyzed. Comparisons between the two groups were done by using T test and Chi square test. A p value of less than 0.05 was considered to represent a significant.

Results

The mean age of the patients in group A and B was (36.9±6.21), (37.84±4.11) years subsequently. Stratifying of age in to classes

revealed the age class 30-39 years was the most prevalent among patient both groups (109 patients, 63.37%, group A) and (101 patients, 58.72%, group B). Female preponderance was obvious in both groups. In group A the male:female ratio was 1:1.57 and 1:1.32 in group B with no significant difference. The mean operative time for infundibular group was 67.8±20.9 minutes (range 45-112 min), which is significantly higher than that reported for CVS group (46.71±12.6 minutes, range 30-78 minutes) (p= 0.016).

In regard to perioperative complications, bleeding was encountered in 12 patients (6.98%) of infundibular group while only 2 patients (0.58%) of CVS group. Bile leak was reported in 17 patients (9.88%) in infundibular group versus 3 patients (1.74%) in CVS group. Subhepatic drain insertion was required in 25% and 2.33% of patients in infundibular and CVS group respectively, the details and P values are shown in table 1.

Table 1. Perioperative complications in infundibular and critical view of safety groups

Complications	Infundibular (N=172) N (%)	CVS (N=172) N (%)	P value
Bleeding	12 (6.98)	1 (0.58)	<0.001
Bile leak	17 (9.88)	3 (1.74)	0.001
Drain insertion	43 (25)	4 (2.33)	<0.001

Port site infection was reported in 3.49% among patients in infundibular group while 0.58% in CVS group, however, the difference did not reach a significant level. Thirteen patients (7.58%) in infundibular group developed intra-abdominal collection compared to only 2 patients (1.16%) among CVS group, with a highly significant difference.

The frequency of bile leak in infundibular and CVS groups was 12 (6.98%), 3 (1.74%) respectively with a significant difference. Although chest infection was more frequent among patients in infundibular group (6.98%) compared to CVS group (1.74%), the difference was not a significant as shown in table 2.

Table 2. Postoperative complications in infundibular and critical view of safety groups

Complications	Infundibular (N=172) N (%)	CVS (N=172) N (%)	P value
Port site infection	6 (3.49)	1 (0.58)	0.056
Intra-abdominal collection	13 (7.58)	2 (1.16)	0.004
Bile leak	12 (6.98)	3 (1.74)	0.017
Chest infection	11 (6.4)	5 (2.91)	0.125

The mean hospital stay in infundibular group was (3.14±2.8) days (range 1-14 days), which was significantly higher than that reported for CVS group (1.8±2.7) days, range 1-8 days). In the same context, 16 patients (9.3%) among

infundibular group required prolonged hospital stay compared to only 2 patients (1.16%) in CVS group who needed such period, with a highly significant difference (Table 3).

Table 3. Hospital stay in infundibular and CVS groups

Hospital stay (Days)		Infundibular (n=172) N (%)	CVS (n=172) N (%)	P vale
Mean±SD		3.14 ± 2.8	1.8 ± 2.7	0.011
Range		1-14	1-8	
		N (%)	N (%)	
Prolonged hospital stay	No	156 (90.7)	170 (98.84)	0.001
	Yes	16 (9.3)	2 (1.16)	

Discussion

The present study aimed to assess the CVS technique in relation to classical infundibular technique for LC. The criteria used for this assessment were operative time, perioperative and postoperative complications and hospital stay.

Mean operative time for infundibular group was 67.8 ± 20.9 minutes, which is significantly higher than that reported for CVS group (46.71 ± 12.6 minutes). In accordance with this result is a retrospective study conducted by Vettoretto et al., in which the authors reported a mean operation time for CVS as (51.5 versus 69.7 minutes) for infundibular approach⁽¹⁰⁾. However, there were no significant differences between the two approaches regarding complications. Almost similar results were reported by Viswanathan et al. among Indian patients, they found a mean operation time in CVS and infundibular approaches of (55.7 and 74 minute) respectively with a significant difference⁽¹¹⁾. In another study, Zarin et al. reported that the operative time was significantly reduced in CVS technique compared with infundibular technique (50 versus 73 minutes)⁽¹²⁾.

The reduced operation time in CVS compared to the traditional method even in less experienced surgeons can be attributed to the principle of CVS, which allows the ability to identify adequate anatomical structure with safe dissection as well as make operative decisions easier without risking patients⁽¹³⁾.

In the current series, each of bleeding, bile leak and sub hepatic drain insertion were reported more frequently in infundibular approach compared with CVS with highly significant differences, all these add more operative time. Compared with local and international studies, these results seemed very reasonable. In a retrospective local study, Hamad et al. indicated high incidence of BDI among patients undergoing open or LC utilizing classical infundibular technique. The most common presentations of those patients were biliary fistula (36%) and jaundice (28%)⁽¹⁴⁾. Singh and Brunt conducted a prospective study including 1340 patients (CVS - 700, Infundibular technique -640). There was no bile leak or BDI

among patients operated with CVS. Whereas in traditional method, 32 operations were converted to open surgery, due to BDIs, out of which, 3 were major BDIs. The authors concluded that no doubt of CVS being safe, feasible and superior to infundibular technique in preventing BDI⁽¹⁵⁾. In Egypt, Safwat et al. conducted a small prospective study on 30 patients with chronic cholecystitis treated surgically with either CVS or infundibular technique. Despite the small number of patients, the study revealed a significant difference in drain insertion between the two techniques in favor of CVS⁽¹⁶⁾.

However, some studies did not report such variation between the two approaches. For example, Vettoretto et al. concluded that CVS technique has a similar rate of biliary and hemorrhagic complications⁽¹⁰⁾.

Generally, studies which did not found such advantages for CVS may be questioned regarding their attaining of this technique. In this regard, a Dutch study involving video reviewing for 1108 consecutive patients who had claimed to be undergone a LC with CVS technique. The study showed that 8.8% of patients developed complications and 1.7% had bile duct injuries. Reviewers of video found that CVS was really achieved in only 10.8% of the cases, and CVS was not performed in any of the patients who had biliary injuries⁽¹⁷⁾. These findings suggest that although a surgeon may have stated or believed that CVS was reached, as documented in the operative note, this was not the case, and even those who claimed to perform CVS may actually not apply all criteria of technique properly.

The main postoperative complications in the present study were intra-abdominal collection, bile leak and chest infection, which were more frequent among patients in infundibular group compared with CVS group. These results agree with most literatures. In a local prospective study, Al-Saffar and Al-Khaqany found that CBD injury was reported in only one patient (0.2%), while bile leak was reported in only 2.4%⁽¹⁸⁾.

In the present study, mean hospital stay in infundibular group was (3.14 ± 2.8) days, which was significantly higher than that reported for CVS group (Table 3). Furthermore, 9.3% and

1.16% of patients in infundibular and CVS group respectively required prolonged hospital with a highly significant difference. In a similar study, Kaya et al. found that all their patients who were operated with CVS were discharged on first, second or third day post-operative day⁽¹⁹⁾. However, in the Egyptian study, there was no significant difference in the hospital stay between the two techniques, may be because the small number of patients in each group⁽¹⁶⁾. The remarkable decrease in hospital stay in patients operated with CVS compared with those operated with the traditional method can be explained on the basis of postoperative complications, which have been more frequently among patients in infundibular group.

Collectively, the present data suggest that practicing the CVS method of identification of vital anatomical structure during LC remarkably decrease the incidence of complications, operative time because of the safe accurate dissection at hepaticocystic triangle that allow the surgeon to proceed without fear of misidentification. Furthermore, the CVS technique associated with shorter hospital stay compared with infundibular technique. The CVS builds self-confidence, and is a simple standardized method both for complicated and uncomplicated gallbladder stone. Accordingly, the CVS approach should be made the standard method of identification of anatomical structures at the HC triangle for all LC operations. This is particularly important when considering trainees or young surgeons, who have scarce experience in biliary anatomical variance and are at risk of causing a major injury.

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Author contribution

Dr. Noman: data collection and writing the manuscript. Dr. Abdulhassan: Patient examination and supervision of data collection. Dr. Hamdawi: Data analysis.

Conflict of interest

The authors declare that they have no competing interests.

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