# Original Article

## Comparison of the critical view of safety versus infundibular techniques in laparoscopic cholecystectomy

**[1]Rukhsana Ghulam Nabi, [2]Dr Sarmad Latif Awan, [3]Bilal Ahmad, [4]Misbah**

*[1]CMH Muzaffarabad*

*[2]Consultant Professor, CMH Muzaffarabad*

*[3]Aims Muzaffarabad*

*[4]CMH Muzaffarabad*

**Abstract**

**Objective:** To compare critical view of safety and infundibular techniques in laparoscopic cholecystectomy regarding surgery duration and bile duct injury.

**Study Design:** A randomised controlled trial. **Place and Duration of the Study:** Department of General Surgery SKBZ CMH Muzaffarabad, for 6 months after approval of synopsis.

**Methodology:** A total of 282 patients aged 18 to 50 years, of both genders and American Society of Anesthesiologists grade I or II undergoing laparoscopic cholecystectomy were included. Patients were randomly allocated into critical view of safety group (n=141) and infundibular technique group (n=141). Surgery duration and bile duct injury were recorded. Data were analysed using SPSS 26. Independent t test was used for surgery duration and chi-square or Fisher exact test for bile duct injury. A p-value of ≤0.05 was considered significant.

**Results:** The mean age was 39.08 ± 6.41 years in the critical view of safety group and 38.48 ± 6.80 years in the infundibular group. Females were 97 (68.8%) and 94 (66.7%), respectively. Mean surgery duration was significantly shorter with critical view of safety (34.34 ± 9.20 minutes) than infundibular technique (42.22 ± 11.50 minutes; p<0.001). This difference remained significant across age, gender and body mass index subgroups. Bile duct injury occurred in 1 (0.7%) patient in each group, with no significant difference (p=1.000). **Conclusion:** Critical view of safety provided shorter surgery duration, while both techniques showed similarly low bile duct injury rates in selected patient.

**Keywords:** Bile duct injury, Infundibular technique, Laparoscopic cholecystectomy, Operative duration, Surgical safety.

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## INTRODUCTION

Laparoscopic cholecystectomy is a commonly done surgery for the management of symptomatic gallstones and other benign gallbladder disorders.[1] It is done by removal of the gallbladder through small incisions made in the abdomen through the use of a laparoscope and special equipment.[2] In comparison with open cholecystectomy, the laparoscopic method is less painful after the operation, and the recovery period is shorter.[3] There are some risks connected with the operation that may be life-threatening such as biliary and vascular injuries and biliary fistulas.[4]

Various techniques have been suggested for the identification and dissection of the structures around the gallbladder neck in laparoscopic cholecystectomy. The importance of the selection of the technique is in the fact that sometimes unclear anatomy, acute inflammation, adhesions and distortion of anatomical planes might increase the probability of common bile duct and other biliary structures injury.[5] Two most popular among other methods, critical view of safety technique and infundibular technique have been widely used as the technique for ensuring the proper identification of anatomy prior to clipping and cutting cystic duct and cystic artery.[6] Infundibular technique consists of the dissection in the direction of the gallbladder infundibulum with identification of the cystic duct in relation to the gallbladder neck.[7]

The critical safety technique involves clearance of the hepatocystic triangle, dissection of the lower portion of the gallbladder off the liver bed and making sure that there are only two things entering the gallbladder, namely the cystic duct and cystic artery before cutting the gallbladder.[8] This technique is meant to prevent wrong identification of the common bile duct and is thus very useful for the prevention of bile duct injury.[9] The infundibular technique involves tracing the cystic duct along the gallbladder infundibulum to the cystic duct. However, this can be misleading especially where there is intense inflammation or where the common bile duct is very close to the gallbladder neck.

The comparison between the critical view of safety and infundibular technique for laparoscopic cholecystectomy is necessary because both these methods are popular for the identification of cystic duct and cystic artery, however, the safety of the two methods may differ depending on the anatomical and operative complexity. The injury of bile ducts is a potential complication of laparoscopic cholecystectomy and the proper identification of the biliary structures is necessary in order to avoid such complication.

## METHODOLOGY

This randomized controlled trial was conducted in the Department of General Surgery, SKBZ CMH Muzaffarabad for a period of 6 months after approval of synopsis. A total of 282 patients

undergoing laparoscopic cholecystectomy were included in the study. The sample size was calculated by using WHO sample size calculator with 5% level of significance and 80% power, taking mean surgery duration as 33.04±13.74 minutes with critical view of safety and 38.58±18.96 minutes with infundibular technique.[11] A sample of 282 patients was obtained, with 141 patients allocated to critical view of safety group (A) and 141 patients to infundibular technique group (B). Patients were selected through non-probability consecutive sampling.

Patients aged 18 to 50 years of both genders who were undergoing laparoscopic cholecystectomy and belonged to ASA grade I or II were included. Patients were excluded if they had history of suspected or confirmed gallbladder cancer, acute cholecystitis, previous upper abdominal surgery, severe liver disease of Child-Pugh class C, coagulopathy with INR >1.5 or platelet count <50,000/μL, anatomical variations of the biliary tract such as accessory ducts or Mirizzi syndrome, or pregnancy confirmed by HCG testing.

After approval from the ethical committee and CPSP informed consent was obtained from all patients before their participation in the study. The patients were informed about the study procedure, confidentiality of their information and that participation would not cause additional risk to them. Baseline demographic information including age, gender, BMI, socioeconomic status, education level, residential status and duration of complaints was recorded.

Randomisation was carried out by blocked randomization with 141 patients assigned to critical view of safety group (A) and 141 patients to infundibular technique group (B). All patients underwent laparoscopic cholecystectomy under general anaesthesia using a three-port technique, while a fourth or fifth port was inserted when difficult dissection was encountered. Preoperative prophylactic antibiotics were administered at the time of induction. In critical view of safety group (A) the hepatocystic triangle was cleared from fat and fibrous tissue, the lower third of the gallbladder was separated from the liver to expose the cystic plate, and only two structures entering the gallbladder were identified before their division. Direct exposure of the common bile duct and common hepatic duct was not required. In infundibular technique group (B), the continuity between the cystic duct and gallbladder infundibulum was identified first, following which the cystic duct was clipped and transected. Surgery duration was recorded in both groups from insertion of the first port until retrieval of the gallbladder. After surgery, patients were clinically assessed for signs and symptoms suggestive of bile duct injury and MRI was performed. Adequate postoperative analgesia was provided and patients were discharged after becoming clinically stable.

Surgery duration was recorded in minutes from insertion of the first port until extraction of the gallbladder. Bile duct injury was considered present when MRI after the procedure showed at least 2 of the following findings: a visible gap or interruption in bile duct continuity measuring >2 mm in length; focal narrowing of the bile duct lumen by >50% of the normal duct diameter; dilated common bile duct >8 mm or intrahepatic duct dilatation >2 mm proximal to the site of injury; visible leakage of bile or contrast material outside the normal biliary tree; biloma >2 cm in diameter; bile duct wall thickness >3 mm; or increased T2 signal intensity within 5 mm of the duct wall indicating periductal oedema. Surgery durations and bile duct injury were recorded in both groups according to these criteria by the researcher.

The collected data were analysed using IBM SPSS version 26. Categorical variables including gender, education, socioeconomic status, residential status and bile duct injury were presented as frequencies and percentages. Quantitative variables including age, BMI, duration of complaints and surgery duration were expressed as mean ± standard deviation. The independent t test was used for comparison of surgery duration between both groups while chi-square test was applied for comparison of bile duct injury. Surgery duration and bile duct injury were further stratified according to age, gender, BMI. Post-stratification analysis was performed using independent t test or chi-square test as appropriate. A $p \leq 0.05$ was considered statistically significant.

## RESULTS

The baseline characteristics were generally comparable between the two groups. The mean age was 39.08 ± 6.41 years in the CVS group and 38.48 ± 6.80 years in the infundibular group, while mean BMI was 26.09 ± 2.66 and 26.55 ± 2.76 kg/m², respectively. Females predominated in both groups (68.8% vs. 66.7%). Most patients were from rural areas, particularly in the CVS group (64.5% vs. 51.1%). Low socioeconomic status was the most common category in both groups (46.1% vs. 46.8%) (Table-I).

**Table I: Patient Demographics in Both Groups. n=182**

| **Variables** | **Critical View of Safety n=141** | **Infundibular Technique n=141** |
|---|---|---|
| | **Mean ± SD** | **Mean ± SD** |
| Age (years) | 39.08 ± 6.41 | 38.48 ± 6.80 |
| BMI (Kg/m²) | 26.09 ± 2.66 | 26.55 ± 2.76 |

| | | |
|---|---|---|
| Duration of Complaints (months) | 7.75 ± 5.85 | 7.11 ± 4.40 |
| Surgery Duration (minutes) | 34.34 ± 9.20 | 42.22 ± 11.50 |
| | **n (%)** | **n (%)** |
| **Gender** | | |
| Male | 44 (31.2%) | 47 (33.3%) |
| Female | 97 (68.8%) | 94 (66.7%) |
| **Residential Status** | | |
| Rural | 91 (64.5%) | 72 (51.1%) |
| Urban | 50 (35.5%) | 69 (48.9%) |
| **Education Level** | | |
| Uneducated | 35 (24.8%) | 39 (27.7%) |
| Primary | 50 (35.5%) | 27 (19.1%) |
| Secondary | 35 (24.8%) | 48 (34.0%) |
| Higher | 21 (14.9%) | 27 (19.1%) |
| **Socioeconomic Status** | | |
| Low | 65 (46.1%) | 66 (46.8%) |
| Middle | 62 (44.0%) | 52 (36.9%) |
| High | 14 (9.9%) | 23 (16.3%) |

The mean surgery duration was significantly shorter in the CVS group at 34.34 ± 9.20 minutes as compared to 42.22 ± 11.50 minutes in the infundibular technique group, and this difference were found to be statistically significant ($t = -6.359$, $p < 0.001$) (Table-II).

**Table II: Comparison of Mean Surgery Duration Between the Two Groups.**

**n=182**

| | **Critical View of Safety (CVS) n=141** | **Infundibular Technique n=141** | **t** | **p value*** |
|---|---|---|---|---|
| **Surgery Duration (minutes)** | 34.34 ± 9.20 | 42.22 ± 11.50 | -6.359 | <0.001 |

*Independent Sample t test

Surgery duration was significantly shorter with the CVS technique across all demographic subgroups. The difference remained significant in patients aged ≤35 years and >35 years ($p=0.001$ and $p<0.001$,

respectively), as well as in both males and females (p<0.001). Similarly, CVS resulted in significantly shorter surgery duration in patients with BMI ≤25 kg/m² (p=0.002) and >25 kg/m² (p<0.001) (Table-III).

**Table III: Stratification of Mean Surgery Duration with Respect to Demographic Factors in Both Groups.**

**n=182**

| **Demographic Factors** | **Group** | | **Mean Surgery Duration (minutes)** | | **p value*** |
|---|---|---|---|---|---|
| | | | **Mean** | **SD** | |
| **Age (years)** | ≤35 | CVS (n=42) | 33.93 | 8.25 | 0.001 |
| | | Infundibular (n=47) | 41.13 | 11.78 | |
| | >35 | CVS (n=99) | 34.51 | 9.6 | <0.001 |
| | | Infundibular (n=94) | 42.77 | 11.38 | |
| **Gender** | Male | CVS (n=44) | 33.3 | 8.88 | <0.001 |
| | | Infundibular (n=47) | 42.68 | 10.56 | |
| | Female | CVS (n=97) | 34.81 | 9.34 | <0.001 |
| | | Infundibular (n=94) | 41.99 | 11.98 | |
| **BMI (Kg/m²)** | ≤25 | CVS (n=48) | 33.13 | 7.96 | 0.002 |
| | | Infundibular (n=47) | 39.24 | 10.55 | |
| | >25 | CVS (n=93) | 34.96 | 9.75 | <0.001 |
| | | Infundibular (n=94) | 43.71 | 11.71 | |

*Independent Sample t test

Bile duct injury were observed in 1 (0.7%) patient in each of the two groups, with no statistically significant difference noted between the CVS and infundibular technique groups (p=1.000) (Table-IV).

**Table IV: Comparison of Bile Duct Injury Between the Two Groups.**

**n=282**

| Bile Duct Injury | CVS n=141 n (%) | Infundibular Technique n=141 n (%) | P value |
|---|---|---|---|
| **Yes** | 1 (0.7%) | 1 (0.7%) | 1.000* |
| **No** | 140 (99.3%) | 140 (99.3%) | |

*Fisher Exact Test

Bile duct injury was rare and showed no significant difference between the CVS and infundibular groups across age, gender, or BMI subgroups. Overall, injury occurred in 1 (0.7%) patient in each group (p=1.000) (Table-V).

**Table V: Association of Bile Duct Injury with Demographic Variables.**

**n=282**

| Demographic Variables | Group | | Bile Duct Injury | | P-value |
|---|---|---|---|---|---|
| | | | Yes n (%) | No n (%) | |
| **Age (years)** | ≤35 | CVS (n=42) | 1 (2.4%) | 41 (97.6%) | 0.472* |
| | | Infundibular (n=47) | 0 (0.0%) | 47 (100.0%) | |
| | >35 | CVS (n=99) | 0 (0.0%) | 99 (100.0%) | 0.487* |
| | | Infundibular (n=94) | 1 (1.1%) | 93 (98.9%) | |
| **Gender** | Male | CVS (n=44) | 0 (0.0%) | 44 (100.0%) | N/A |
| | | Infundibular (n=47) | 0 (0.0%) | 47 (100.0%) | |
| | Female | CVS (n=97) | 1 (1.0%) | 96 (99.0%) | 1.000* |
| | | Infundibular (n=94) | 1 (1.1%) | 93 (98.9%) | |
| **BMI (Kg/m²)** | ≤25 | CVS (n=48) | 1 (2.1%) | 47 (97.9%) | 1.000* |
| | | Infundibular (n=47) | 0 (0.0%) | 47 (100.0%) | |
| | >25 | CVS (n=93) | 0 (0.0%) | 93 (100.0%) | 1.000* |
| | | Infundibular (n=94) | 1 (1.1%) | 93 (98.9%) | |

*Fisher Exact Test

**DISCUSSION**

The present study was conducted to compare the critical view of safety (CVS) technique with the infundibular technique in laparoscopic cholecystectomy with respect to surgery duration and bile duct injury. The finding of this study demonstrated that the CVS technique were associated with a significantly shorter surgery duration as compared to the infundibular technique, with mean operative times of 34.34 ± 9.20 minutes and 42.22 ± 11.50 minute respectively. With regard to bile duct injury the rate was equally low in both group with only 1 (0.7%) patient affected in each group and no statistically significant difference were observed between the two technique.

The present study compared the CVS and infundibular techniques in laparoscopic cholecystectomy with specific focus on surgery duration and bile duct injury. The findings demonstrated that the CVS technique were associated with a significantly shorter mean operative time of 34.34 ± 9.20 minutes as compared to 42.22 ± 11.50 minutes in the infundibular group ($p<0.001$). These findings were in agreement with Zarin et al.[12] who reported a shorter mean operative time with CVS (50±1.5 minutes) versus the infundibular technique (73±2.3 minutes) in a comparative study of 438 patients, and Ismaeil et al.[13] similarly reported mean operative times of 33.04±13.74 versus 38.58±18.96 minutes favouring CVS ($p=0.013$) in 245 patients. Iftikhar et al.[14] also reported a significantly shorter mean operative time with CVS (35.07 minutes) versus the infundibular technique (40.58 minutes, $p=0.013$) among 220 patients, further corroborating the operative efficiency of CVS. The shorter operative time with CVS across these studies may be explained by the fact that CVS provides a clear and defined anatomical endpoint for dissection within the hepatocystic triangle, which reduces the surgeon's uncertainty during identification of cystic structures and thus avoids unnecessary and prolonged blind dissection. In contrast, Wafa et al.[15] reported a longer mean operative time with CVS (57 minutes) as compared to the infundibular technique (43 minutes) in 1,021 laparoscopic cholecystectomies, and Yousfani et al.[16] similarly reported mean operative times of 75±12 minutes with CVS versus 85±14 minutes with the infundibular technique in 60 patients; the relatively longer CVS times in these studies may be attributed to the learning curve associated with the technique, wherein surgeons less familiar with the two-structure criterion required additional time for safe dissection, particularly in cases involving inflamed or fibrosed hepatocystic triangles. Dubhashi et al.[17] further highlighted this relationship by demonstrating a significant association between operative difficulty and CVS demonstration ($\chi^2=23.580$, $p<0.001$) in 50 patients, wherein CVS were successfully achieved in only 34 (68%) patients, with 28 (82.3%) of these belonging to the easy operative

group, suggesting that operative difficulty remains a key determinant of both CVS feasibility and operative duration.

With regard to bile duct injury, the present study recorded an equally low rate of 1 (0.7%) in both the CVS and infundibular groups, with no statistically significant difference between the two techniques (p=1.000). This finding were consistent with Zarin et al.,[12] where minor leaks occurred in 1 (0.5%) CVS and 2 (0.9%) infundibular patients and major leakage in 1 (0.5%) and 3 (1.4%), respectively, with overall fewer biliary complications in the CVS group. Ismaeil et al.[13] reported no bile duct injury in the CVS group, while one male patient in the infundibular group developed a common bile duct injury requiring Roux-en-Y hepaticojejunostomy, further supporting the safety advantage of CVS. Yousfani et al.[16] reported bile duct injury in 1.7% of CVS patients versus 6.7% in the infundibular group, suggesting a more favourable safety profile with CVS in higher-risk populations. Sgaramella et al.[18] demonstrated in a large multicentre study of 604 patients that non-use of CVS were substantially more common among the 11 (1.8%) patients who developed bile duct injury or perioperative bleeding, with 4 out of 5 isolated bile duct injuries occurring without CVS application, which further support the protective role of CVS in heterogeneous surgical settings. Shahzad et al.[19] similarly reported no major biliary duct injury in 300 patients when CVS were applied before clipping the cystic duct and artery, with only one bile leak attributed to a slipped cystic duct ligature, reinforcing that consistent CVS application serves as an effective safeguard against major biliary complications. The comparable bile duct injury rates between the two groups in the present study may be related to strict patient selection, exclusion of complex or acutely inflamed cases, and standardised surgical experience, which collectively minimised biliary risk regardless of technique. Blitzkow et al.[20] demonstrated in 309 consecutive laparoscopic cholecystectomies that no surgical complications occurred among the 247 (79.9%) patients in whom satisfactory CVS were achieved, whereas failure to achieve CVS were significantly associated with acute cholecystitis (p=0.007), male sex (p=0.014) and previous abdominal surgery (p=0.021), highlighting that patient-related factors rather than technique alone determines the rate of biliary injury.

There are a number of limitations associated with the current study that need to be considered. Firstly, the research was conducted using a single-center approach, with an average sample size of 282 patients, and it may limit the applicability of results to larger cohorts of surgical patients. Secondly, experience of surgeons was not controlled for in the study, even though this variable is known to impact on operative time and complication rates after

laparoscopic cholecystectomy procedures. Finally, it is likely that patients who had acute cholecystitis, previous abdominal surgeries, and complicated anatomy of their biliary system were excluded from the study.

## CONCLUSION

This study finds that the critical view of safety approach to be more time efficient than the infundibular approach in laparoscopic cholecystectomy, as it has been noted to have lower operative times for all age, sex and body mass index groups.

### Ethical Approval

Approval for conducting this research was taken from the Institutional Ethical Committee of the concerned hospital before starting the study.

### Patients' Consent

All enrolled participant were informed about the study and written consent was taken from them before participation.

### Competing Interests

The authors declared that there was no conflict of interest associated with the present research.

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