Association of preoperative ultrasonography findings with intraoperative surgical findings in patients undergoing laparoscopic cholecystectomy for gallstone disease

Nabin Pokhrel,[1] Shraddha Paudyal,[2] Santosh Mishra,[1] Divas Thapa,[1] Shreeyanshu Parajuli,[3] Raushan kumar Sah[1]

ABSTRACT

INTRODUCTION

Gallstone disease is a common cause of hospital admission worldwide, including in Nepal. While many cases are asymptomatic, some develop complications requiring surgery. Laparoscopic cholecystectomy is the standard treatment. Ultrasonography is the main diagnostic tool, but discrepancies with intraoperative findings may occur. This study evaluated its ability to predict operative findings.

MATERIAL AND METHODS

An analytical cross-sectional study was conducted over six months in the Department of General Surgery at Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Nepal. Although the minimum sample size was 93, a total of 150 patients with symptomatic cholelithiasis undergoing laparoscopic cholecystectomy were included. Data were analyzed using Microsoft Excel and SPSS version 20. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequency and percentage. Chi-square and concordance analysis were applied and $p< 0.05$ was considered significant.

RESULTS

Among 150 patients, 125 (83.3%) were females and 25 (16.7%) were males. The mean age was 45.44 ± 13.51 years, with most patients aged 41–60 years (47.3%). Preoperative USG showed a distended gallbladder in 49.3% and multiple stones in 54.7%, with the largest stone ≥1 cm in 72% of patients. Intraoperatively, the gallbladder appeared normal in 81.3% of cases, and multiple stones were found in 60.7%. Adhesions were present in 28.7% of patients, and conversion to open surgery occurred in 1.3%. Significant concordance was observed between USG and intraoperative findings for the number and size of stones ($p<0.001$), while gallbladder wall thickness and pericholecystic collection showed no significant association.

CONCLUSION

Preoperative ultrasonography predicts gallstone number and size but less accurately assesses gallbladder wall thickness and pericholecystic fluid; intraoperative evaluation remains essential.

KEYWORDS

Cholelithiasis; Laparoscopic cholecystectomy; Ultrasonography; Preoperative assessment; Intraoperative findings

AUTHORS' AFFILIATIONS

1. Department of Surgery, Universal College of Medical Sciences, Bhairahawa, Nepal.
   Nabin Pokhrel : https://orcid.org/0009-0000-1758-6069
2. Bhim Hospital, Bhairahawa, Nepal.
3. Department of Surgery, College of Medical Sciences, Bharatpur, Nepal.

https://doi.org/10.3126/jucms.v14i02.99281

For Correspondence
Dr. Nabin Pokhrel
Department of Surgery
Universal College of Medical Sciences
Bhairahawa, Nepal
E-mail:drnabinpokhrel17@gmail.com

INTRODUCTION

Gallbladder stone, also known as cholelithiasis, is a very common condition worldwide. About 6% of men and 9% of women in the United States have gallstones.[1] As per Nepal Government, Department of Health Services annual report of 2018–19, the 10th most common condition resulting in hospital admissions in Nepal was cholelithiasis.[2] Clinically silent GB stones account for about 80% of case.[3] They are detected incidentally in imaging studies done for other symptoms, 10% people experiencing symptoms after 5 years of this accidental discovery, and 20% within 20 years.[4]

Laparoscopic cholecystectomy (LC) is a common and preferred technique for symptomatic cholelithiasis, with a mortality and morbidity rate of approximately 0.5% and 10%, respectively.[5] Laparoscopic procedures are popular for cholecystectomies due to reduced pain, shorter hospital stays, improved cosmetics, and early recovery, with a conversion rate to open surgery of 1-13%.[6] The size and quantity of gallstones significantly influence their pathology, with larger and more numerous stones causing higher symptoms.[7,8]

Ultrasonography (USG) is the gold standard for diagnosing gallstone disease, surpassing CT scans, making it the preferred imaging method for gallstone identification.USG is a quick, cost-effective, and radiation-free method for detecting gallbladder stones, its number and size. It also provides information on the GB's volume, sludge presence, biliary tree diameter, dilatation, GB wall thickness, and inflammatory signs, including pericholecystic fluid accumulation.[9] USG's biggest disadvantage is reliance on operator expertise, it is also affected by patient factors like obesity, ascites, severe pain, uncooperative patients, time constraints, environment in which USG was conducted, and observers' conditions.[10,11] The USG's information may differ from LC's findings, necessitating evaluation to remove confounding variables and ensure accurate planning for surgeons.

As a result, we will undertake this study considering all of the above-mentioned parameters to determine whether preoperative USG can predict intraoperative findings and be helpful in preoperative LC planning.

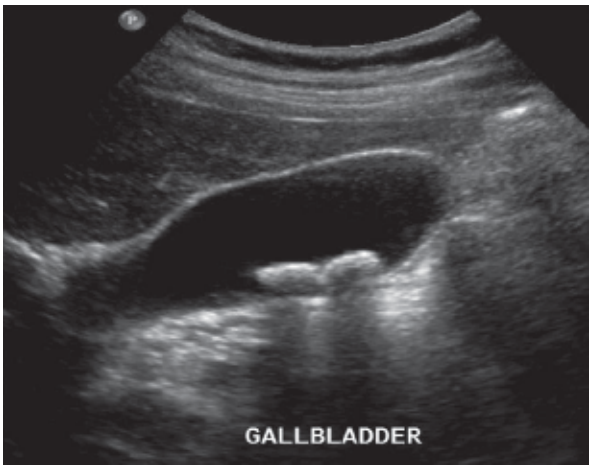

Figure 1.USG of GB showing two gallstones

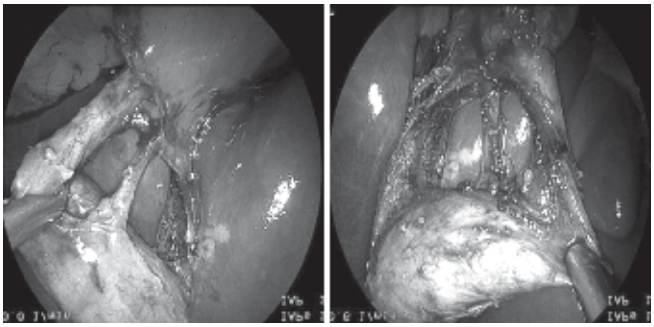

Figure 2. Visualization of doublet view anterior Visualization of doublet view posterior

MATERIAL AND METHODS

Ananalytical cross-sectional study was conducted over six months from 12th May 2025 to 11th November 2025 in the Department of General Surgery at Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Nepal, after taking an ethical clearance from IRC (UCMS/IRC/074/25). A total of 93 patients were included in the study. The inclusion criteria were all patients aged >18 years with symptomatic gallstone disease and ultrasonographic evidence of gallstones, whether diagnosed at UCMS-TH or elsewhere, undergoing laparoscopic cholecystectomy at UCMS-TH and patient not willing to participate were excluded.

Patient who met the inclusion criteria were informed about the study and written consent was obtained. Patients were admitted through the OPD, and data were collected by the researcher.

The calculated sample size was 93 using the formula $n=Z^2pq/d^2$. However, 150 patients undergoing laparoscopic cholecystectomy over 6 months who met the inclusion criteria were enrolled using purposive sampling. The reported prevalence of cholelithiasis in Nepal ranges from 2.44% to 6.45%.[12]

Primary data were collected using a preformed proforma from preoperative USG and intraoperative findings. After ethical approval and informed consent, patients underwent clinical evaluation, fasting USG, routine investigations, and laparoscopic cholecystectomy by a single surgeon. Outside USG scans were repeated at UCMS-TH by an experienced radiologist using a GE LOGIQ P6 PRO with a 3–5 MHz probe. Data were analyzed using Microsoft Excel and SPSS 20 with descriptive statistics, Chi-square test, and kappa agreement; $p < 0.05$ was considered significant.

RESULTS

A total of 150 patients had undergone laparoscopic cholecystectomy for gallstone disease during the study period. Among them 25 (16.7%) were males and 125 (83.3%) were females so the results showed that majority of the patients were female (table 1). Among them the average age

of the patients were 45.44 ± 13.51 years. Similarly, the results also showed that most of the patients were from the age group 41-60 years (47.3%) followed by 21-40 years (35.3%) and least were from the age groups ≤20 years (2%) (table1).

Table1. Frequency distribution of sex and age groups

Variable	Category	Frequency (n)	Percentage
Sex	**Female**	125	83.3
	Male	25	16.7
Age group (years)	≤ 20	3	2.0
	21-40	53	35.3
	41-60	71	47.3
	>60	23	15.3
Mean ± SD = 45.44 ± 13.51 years			

Among 150 cases, majority of the appearance of GB was distended (49.3%) followed by normal (38%) and contracted (12.7%). Likewise, GB wall thickness more than 3 mm was found only in 2% of cases, rest 98% had GB wall thickness less than 3 mm. Multiple stone were found in 82(54.7%) cases while single stone were found in 68 (45.3%) and the size of the largest stone that is ≥1 cm was found in 72% cases. Pericholecystic collection was found only in 0.7% of total cases in pre-operative findings in ultrasonography, rest 99.3% had no pericholecystic collection (table 2).

Table 2. Frequency distribution of ultrasonography findings of preoperatively

Ultrasonography findings	Category	Frequency (n)	Percentage (%)
Appearance of GB (n=150)	Distended	74	49.3
	Normal	57	38
	Contracted	19	12.7
GB Wall (n=150)	>3mm	3	2
	<3mm	147	98
No of Stones (n=150)	Multiple	82	54.7
	Single	68	45.3
Size of Largest Stone (n=150)	<1 cm	42	28
	≥1 cm	108	72
Pericholecystic Collection (n=150)	No	149	99.3
	Yes	1	0.7

Among 150 cases, majority of the appearance of GB was normal looking (81.3%) followed by distended (12%), contracted (6%) and least was intra-hepatic (0.7%). Likewise, GB wall thickness more than 3 mm was found only in 3.3% of cases and majority of cases that is 96.7% had GB wall thickness less than 3 mm. Multiple stone were found in 91 (60.7%) cases whereas no stone was found in 1 (0.7%) case and sludge was found in 3 (2%) cases. Size of the largest stone that is ≥1 cm was found in 133 (88.7%) cases, remaining 13 (8.7%) were found to be <1cm. Pericholecystic collection was found only in 1 (0.7%) of total cases, remaining 149 (99.3%) had no pericholecystic collection and impacted stone was found in 6 (4%) of the total cases in intraoperative findings, rest 144 (96%) had no impacted stone in GB. Similarly, in 43 (28.7%) of the cases adhesion was found and rest 107 (71.3%) of the cases had no adhesions (table 3).

Tabl 3. Frequency distribution of intraoperative findings

Ultrasonography findings	Category	Frequency (n)	Percentage (%)
Appearance of GB (n=150)	Contracted	9	6.0
	Distended	18	12.0
	Intra-hepatic	1	0.7
	Normal looking	122	81.3
GB wall (n=150)	>3mm	5	3.3
	<3mm	145	96.7
No of stones (n=150)	No Stone	1	0.7
	Sludge	3	2.0
	Multiple	91	60.7
	Single	56	37.3
Size of stone (n=146)	<1 cm	13	8.7
	≥1 cm	133	88.7
Impacted stone (n=150)	No	144	96.0
	Yes	6	4.0
Pericholecystic collection (n=150)	No	149	99.3
	Yes	1	0.7
Adhesion (n=150)	No	107	71.3
	Yes	43	28.7

The result showed that only 2 (1.3%) cases underwent conversion to open surgery while rest 148 (98.70%) were conducted laparoscopically.

Association between preoperative and intraoperative findings was analyzed using Chi-square and Kappa tests. Concordance for GB wall thickness >3 mm was 66.7%, while 98% concordance was observed for thickness <3 mm. However, the association and kappa agreement between preoperative and intraoperative findings were statistically insignificant ($p = 0.625$) **(Table 4).**

Table 4. Association between pre-operative and intraoperative findings of GB wall

Pre-operative assessment by USG	Intraoperative assessment >3 mm wall thickness	Intraoperative assessment <3 mm wall thickness	Total	Kappa	*p*-value
>3mm wall thickness	2 66.7	1 (33.3)	3	0.487	0.625
<3mm wall thickness	3 (2)	144 (98)	147		
Total	5	145	150		

The results demonstrated a 21.1% concordance for contracted gallbladder (GB) and 24.3% concordance for distended GB between preoperative ultrasonography and intraoperative findings. In contrast, normal-looking GB showed a high concordance of 94.7%. The overall agreement between preoperative and intraoperative findings, assessed by kappa, was statistically significant ($p< 0.001$).

However, there was no concordance for pericholecystic fluid between preoperative and intraoperative findings, and the kappa agreement for this parameter was not statistically significant (p=0.97). Study showed a 92.7% concordance for multiple stones and approximately 75% concordance for a single stone between preoperative ultrasonography and intraoperative findings. The association and kappa agreement for the number of stones were statistically significant (p< 0.001) (table 5).

Table 5. Association between pre-operative and intraoperative findings of number of the stone

Pre-Operative	Intraoperative assessment				Total	Kappa	*p*-value
Assessment by USG	(no stone)	(sludge)	Multiple	Single			
Multiple	1 (1.2)	0 (0)	76 (92.7)	5 (6.1)	82	0.002	<0.001
Single	0 (0)	2 (2.9)	15 (22.1)	51 (75)	68		
Total	1	2	91	56	150		

Moreover, there was 31% concordance of size of the largest stone <1 cm between pre-operative and intraoperative findings. Likewise, there was about 97.2% concordance of size of the largest stone ≥1 cm between pre-operative and intraoperative findings. The association and kappa agreement between pre-operative and intraoperative findings of size of the largest stone was found to be statistically significant (p<0.001).

DISCUSSION

Cholelithiasis is commonly diagnosed by USG, and laparoscopic cholecystectomy is the standard treatment.[13] However, some procedures are difficult and may cause complications. This study compared preoperative USG with intraoperative findings to aid surgical planning.

This study supports the classic cholelithiasis dictum "fat, forty, fertile, female." The mean age was 45.44 ± 13.51 years. Of 150 patients, 25 (16.7%) were males and 125 (83.3%) females (sex ratio 0.2). Similar findings were reported by Sahai et al (2019) and other studies.[14–16] A 2020 study by Bansal et al reported 65.3% females, with most patients aged 30–40 years. The higher incidence was related to age-related biliary dysmotility and prolonged risk exposure, while estrogen, pregnancy, oral contraceptives, and hormone therapy have contributed to female predominance.[17,18]

Preoperatively, 19 cases were reported as contracted GB, but intraoperatively only 4 were contracted and 15 appeared normal. Of 74 distended GB cases preoperatively, only 18 were distended intraoperatively, 3 were contracted, and 53 were normal. Among 57 preoperatively normal GB, 54 remained normal, 2 were contracted, and 1 was intrahepatic.

Kreimer F et al found that when contracted GB was reported, the appearance of GB in USG and intraoperative were statistically different. When the scans are performed on a recently fed state, one such problem may occur.[19] The typical GB wall thickness resembles a single-stroke pencil line with a mean wall thickness of 2.6 ± 1.6 mm.[20] In this study, GB wall thickness >3 mm was considered thickened and <3 mm not thickened. It was measured preoperatively by USG and intraoperatively with a caliper. No statistically significant difference was found between the two measurements.

In a study conducted by Bouarfa et al which revealed no differences in measures supported their study. Thus, they proposed that since surgery has already been performed, it is very difficult to assess wall thickness intraoperatively. They suggested using wall thickness measured by USG for risk scoring.[21]

In the present study, there was no statistical difference between preoperative and intraoperative findings of pericholecystic collection. Among two cases converted to open surgery, one had intraoperative pericholecystic collection and dense adhesions, which were not detected preoperatively. This was supported by a similar study conducted by Fatih Ciftci et al which concluded that pericholecystic collection determined via ultrasound, male gender, gangrenous cholecystitis, and gallbladder wall thickness >1 cm is associated with a higher risk of conversion to open surgery.[22]

In our study there was statistical difference in number and size of stones compared pre-operatively and intraoperatively. Pre-operatively among 82 multiple stones, there were 76 multiple stone, 5 single stone and in 1 case there was no stone which was observed intraoperatively. Also, preoperatively among 68 single stone, there were 51 single stone, 15 multiple stone, 2 cases of GB sludge observed intraoperatively.

When comparing the largest stone size, among 42 cases with stones <1 cm on preoperative diagnosis, only 13 were <1 cm intraoperatively, 26 were >1 cm, and 1 had GB sludge. Of 108 cases diagnosed with stones >1 cm preoperatively, 105 were confirmed intraoperatively, 2 had GB sludge, and 1 had no stone. Bret P. M et al discovered a statistical disparity in the size measurements of stones obtained from USG and intraoperative procedures.[23]

In our study, impacted stones were found intraoperatively in 6 of 150 cases (4%), while 144 (96%) had none. Adhesions were present in 5 of these cases. All were completed laparoscopically without conversion to open surgery.This study was supported by Karim et al and Kulkarni et al in which they also found impacted stone to be significant factors for difficult LC and increased conversion rate.[24,25]

Among 150 cases, adhesions were absent in 107 (71.3%) and present in 43 (28.7%). Conversion to open surgery occurred in 2 cases (1.3%): one with a distended GB, wall >3 mm, adhesions, and undetected collection; the other had a normal GB on USG but dense intraoperative adhesions that aligns with study done by Sahai et al.[15] Bansal et al concluded that if adhesion were found around the Calot's both contracted and distended GB were the contributing factors.[16]

The main limitations of the present study were that our study was a cross-sectional study conducted in a single centre. Other limitations were operator dependency of ultrasonography, observer bias and lack of comparison with other imaging modalities.

CONCLUSION

Preoperative ultrasonography predicts gallstone number and size but less accurately assesses gallbladder wall thickness and pericholecystic fluid; intraoperative evaluation remains essential.

FINANCIAL SUPPORT

None

CONFLICT OF INTEREST

None

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