

ORIGINAL ARTICLE

DIAGNOSTIC ACCURACY OF ULTRASOUND IN DETECTING PERICHOLECYSTIC ADHESIONS IN CHOLELITHIASIS PATIENTS KEEPING PER-OPERATIVE FINDINGS AS THE GOLD STANDARD**Rimsha Khan, Sarah Anwar, Sadia Mehmood***

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Background: Laparoscopic cholecystectomy is a standard technique for surgical management of cholelithiasis. Dense pericholecystic adhesions pose a primary challenge during the procedure, underscoring the importance of their pre-surgical detection. While ultrasonography remains the gold standard tool for diagnosing cholelithiasis, there is limited data available regarding its diagnostic accuracy in detecting pericholecystic adhesions. This study aimed to assess the diagnostic precision of ultrasound in identifying pericholecystic adhesions. **Methods:** This study was carried out in the Radiology Department of DHQ Hospital, Narowal, spanning from Jul 2023, to Mar 2024. With a sample size of 138, all patients enrolled in the study underwent fasting abdominal ultrasound to identify the sonographic features of pericholecystic adhesions, including pericholecystic stranding, pericholecystic fluid/exudates, contracted gallbladder lumen, and loss of gall bladder wall/hepatic parenchyma interface. Operative findings were gathered from the Surgery Department for subsequent analysis. **Results:** Out of the total 138 patients, 53 (38.4%) patients were true positive, 16 (11.6%) were false positive, 49 (35.5%) were true negative and 20 (14.5%) were false negative. Ultrasonography had 72.6% sensitivity, 75.3% specificity, 76.8% positive predictive value, 71.0% negative predictive value, and 73.9% diagnostic accuracy in preoperative prediction of pericholecystic adhesions. **Conclusions:** Ultrasound remains an accessible and cost-effective imaging tool for identifying pericholecystic adhesions in patients with cholelithiasis. It is a valuable and reliable tool in aiding the selection of most suitable operative technique for cholecystectomy.

Keywords: cholelithiasis, pericholecystic adhesions, ultrasound, sonography, Laparoscopy

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INTRODUCTION

Laparoscopic cholecystectomy stands as the gold standard procedure for addressing symptomatic gallstones.¹ While it demands greater technical proficiency than open cholecystectomy, laparoscopic cholecystectomy offers numerous advantages to patients, such as minimal scarring of the abdominal wall, shorter hospital stays, faster recuperation, and reduced risk of complications.² Numerous factors can contribute to challenges during laparoscopic cholecystectomy, potentially necessitating a switch to an open procedure.³ This transition prolongs the duration of anesthesia. A common intraoperative challenge often arises from pericholecystic adhesions, complicating both the dissection of the gall bladder bed and the retrieval of the gall bladder through laparoscopic ports. This can lead to complications such as significant haemorrhage, gall bladder perforation, and the potential for slipped calculi.⁴ These serious complications can be prevented by carefully selecting the appropriate operative technique based on thorough patient history and preoperative imaging.

Advanced age, male gender, obesity, diabetes, active inflammation, and prior upper abdominal surgeries all pose increased risks for challenging laparoscopic procedures.^{5,6} Ultrasound serves as a primary diagnostic modality for cholelithiasis, and it can

also predict the likelihood of difficult laparoscopic cholecystectomy by identifying certain factors.⁷ Pericholecystic adhesions serve as the most crucial predictor of challenging laparoscopy. Sonographic indicators of pericholecystic adhesions encompass pericholecystic stranding, the presence of pericholecystic fluid or exudates, a contracted gall bladder lumen, and the loss of the interface between the gall bladder wall and hepatic parenchyma.⁸ These findings guide the surgeon in considering open cholecystectomy over laparoscopic cholecystectomy.^{9,10} Ultrasound is also capable of revealing sonographic manifestations of acute cholecystitis, such as a thickened or oedematous gall bladder wall, an over-distended lumen, pericholecystic fluid or strands, and the presence of a sonographic Murphy's sign.¹¹

A comprehensive pre-operative evaluation is essential for the surgeon to determine whether the patient is suitable for laparoscopic or open surgery. Variations in the biliary tract anatomy can also lead to complications during cholecystectomy. However, assessing these variations typically necessitates Magnetic Resonance Cholangiopancreatography.¹²

The primary aim of this study was to assess the diagnostic precision of ultrasound in identifying pericholecystic adhesions among patients with cholelithiasis, using per-operative findings as the

benchmark. The outcomes of this research are anticipated to provide evidence-based insights for radiologists/sonographers facilitating improved accuracy in their diagnoses. This information would assist surgeons in devising optimal management strategies for patients.

MATERIAL AND METHODS

This cross-sectional validation study involved 138 patients diagnosed with cholelithiasis, who sought treatment at the Surgery Department of DHQ Hospital, Narowal, from 1st July 2023 to 1st March 2024. These patients were referred by the Surgery Department to the Radiology Department for ultrasonographic evaluation. All cholelithiasis patients who presented to the ultrasound department in an 8-hour fasting state and were considered candidates for cholecystectomy were eligible for inclusion in the study. Patients who were terminally ill and not suitable for general anesthesia were excluded. Patients with history of previous surgery, gall bladder malignancy, and not willing were also excluded from the study.

The sample size was determined using a sensitivity/specificity calculator, with a confidence interval of 90%, a margin of error of 10%, and prevalence of cholelithiasis in Pakistan as 14.2%.¹³ Internationally studied sensitivity of ultrasound in predicting difficult laparoscopic cholecystectomy was considered to be 91.8%, while the specificity was 76.7%.¹⁴ Consecutive non-probability sampling technique was employed for participant selection.

After receiving approval from the hospital Ethical Review Committee, patients who met the inclusion criteria were enrolled for the study after their written informed consent. After pertinent medical history, a 3.75 MHz conventional curvilinear transducer was used for transabdominal scans with patients positioned both supine and in the left lateral position. Ultrasonographic results were recorded. Operative findings from cholecystectomy procedures were gathered from the Surgery Department.

The data was analysed using SPSS-25. Mean and standard deviation were computed for quantitative variables, whereas frequency and percentages were calculated for qualitative variables. To ascertain the sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of transabdominal ultrasound in diagnosing pericholecystic adhesions, a 2×2 contingency table was employed, with per-operative findings serving as the gold standard.

RESULTS

The mean age of the patients was 43.6±13.8 years. The included patients were predominantly female (n=116, 84.1%) with fewer (n=22, 15.9%) male patients. Ultrasonography reported pericholecystic adhesions in

69 patients (50%), out of a total of 138 patients. Sonographic findings that indicated pericholecystic adhesions were stranding, fluid/exudates, contracted gall bladder lumen, and non-visualization of gall bladder wall/hepatic parenchyma interface (Table-1).

Out of the total 138 patients, 41 (29.7%) underwent an open cholecystectomy, while the rest 97 (70.3%) patients were managed uneventfully by laparoscopic cholecystectomy. A 2×2 table was constructed to compare the ultrasound results with the per-operative findings (Table-2).

Ultrasonography had 72.6% sensitivity, 75.3% specificity, 76.8% positive predictive value, 71% negative predictive value, and 73.9% diagnostic accuracy in preoperative prediction of pericholecystic adhesions (Table-3).

Out of a total of 69 ultrasound-positive patients, 7 patients had all four features of pericholecystic adhesions (pericholecystic strands, pericholecystic fluid/exudates, contracted gall bladder lumen, and loss of gall bladder wall/hepatic parenchyma interface). Others had two or three of the abovementioned features. Out of these 7 patients, 6 had pericholecystic adhesions confirmed on operative findings. So, the positive predictive value of ultrasound approached 85.7% in these cases. Positive predictive values of ultrasound were calculated separately for cases with two or three sonographic features of pericholecystic adhesions, which were 74.3%, and 78.2%, respectively (Table-4).

Table-1: Descriptive statistics of sonographic findings of pericholecystic adhesions [n (%)]

Sonographic features	Present	Absent
Non-visualization of the gall bladder wall/hepatic parenchyma interface	7 (5.1)	131 (94.9)
Pericholecystic strands	20 (14.5)	118 (85.5)
Contracted lumen	43 (31.2)	95 (68.8)
Pericholecystic fluid/exudates	51 (36.9)	87 (63.1)

Table-2: 2×2 table comparing the ultrasound results with per-operative findings [n (%)]

Intra-operative findings	Adhesions reported on ultrasound	Adhesions not reported on ultrasound
Adhesions identified intra-operatively	TP 53 (38.4)	FN 20 (14.5)
Adhesions not identified intra-operatively	FP 16 (11.6)	TN 49 (35.5)

TP=true positive, FP=false positive, TN=true negative, FN=false negative

Table-3: Performance indicators of efficacy of ultrasound in detecting pericholecystic adhesions keeping per-operative findings as the gold standard

Performance indicator	Percentage
Sensitivity	72.6%
Specificity	75.3%
Positive predictive value	76.8%
Negative predictive value	71.0%
Diagnostic accuracy	73.9%

Table-4: Effect of number of detected sonographic features of pericholecystic adhesions on calculated positive predictive values

Number of features	Calculated positive predictive value
Two	74.3%
Three	78.2%
Four	85.7%

DISCUSSION

Our study exhibits a commendable capability of ultrasonography in detecting pericholecystic adhesions. Ultrasound remains an accessible and cost-effective imaging tool for identifying pericholecystic adhesions in patients with cholelithiasis. An Indian study⁸ demonstrated that ultrasound exhibited a sensitivity of 70.4%, specificity of 82.1%, positive predictive value of 79.2%, negative predictive value of 74.2%, and diagnostic accuracy of 76.4% in detection of pericholecystic adhesions.⁸ In comparison, based on our findings, ultrasonography displayed a sensitivity of 72.6%, specificity of 75.3%, positive predictive value of 76.8%, negative predictive value of 71%, and diagnostic accuracy of 73.9% in preoperatively predicting adhesions. The average age of patients in our study was 43.6±13.8 years, which closely mirrors the mean age of patients in the study mentioned above⁸ (42.9±14.7 years), indicating a substantial similarity.

Another study¹⁵ revealed significantly improved diagnostic accuracy (96.0%) of ultrasound. This system exhibited a sensitivity of 91%, specificity of 100%, and negative predictive value of 93.1%. Our study results suggest that positive predictive value was 85.7% in cases that demonstrated all four sonographic features of pericholecystic adhesions.

A study investigating the Global Epidemiology of Gallstones, revealed that among Asian women the prevalence of cholelithiasis is 11.2%, whereas among Asian men it is 5.1%.¹⁶ In our study, out of the total 138 patients, majority were female, while a smaller proportion were male. In our study, among the 138 cholelithiasis patients, 58.7% individuals had a BMI exceeding 30. This underscores the heightened prevalence of gallstones among obese patients.¹⁷

A study conducted in 2022 found a significant association between the presence of pericholecystic fluid and difficult laparoscopic cholecystectomy.¹⁸ Our study revealed that among the total of 69 ultrasound-positive patients, 51 exhibited pericholecystic fluid or exudates, making it the most commonly identified sonographic feature of pericholecystic adhesions on ultrasound.

Our research had certain limitations. While it examined the overall diagnostic accuracy of ultrasound in predicting pericholecystic adhesions, it did not develop a scoring system based on individual sonographic features of pericholecystic adhesions. Further research is needed to establish a point-scoring

system for detecting pericholecystic adhesions. Our study concentrated solely on pericholecystic adhesions. Future studies in our region should explore other predictors of difficult laparoscopic cholecystectomies, such as variant bile duct anatomy.

CONCLUSION

Ultrasound exhibits a commendable capability in detecting pericholecystic adhesions with 72.6% Sensitivity, 75.3% Specificity, and 73.9% Diagnostic accuracy.

RECOMMENDATIONS

Ultrasound should be routinely employed for pre-operative assessment of cholelithiasis patients. This practice would aid in selecting suitable operative techniques for patients. If ultrasound indicates a notable likelihood of pericholecystic adhesions, opting for open cholecystectomy instead of laparoscopic approach would be prudent to mitigate intra-operative risks to patient.

REFERENCES

1. Bhat SA, Gorski BA, Peer JA. Pre-operative predictors of difficult laparoscopic cholecystectomy. *Ann Romanian Soc Cell Biol* 2020;24(2):2149–58.
2. Kurtulus I, Culcu OD, Degerli MS. Which is more effective: laparoscopic or open partial cholecystectomy? *J Laparoendoscopic Adv Surg Tech* 2022;32(5):476–84.
3. Warchalowski Ł, Łuszczki E, Bartosiewicz A, Dereń K, Warchalowska M, Oleksy Ł, *et al.* The analysis of risk factors in the conversion from laparoscopic to open cholecystectomy. *Int J Environ Res Public Health* 2020;17(20):7571.
4. Al-Hayali M. Gallbladder perforation during elective laparoscopic cholecystectomy incidence, risk factors and outcomes. *Indian J Public Health Res Dev* 2021;12(4):319–28.
5. Christina NM, Wijaya JH. A systematic review and meta-analysis of the impact of obesity on postoperative outcomes for patients undergoing laparoscopic cholecystectomy. *Bali Med J* 2023;12(1):946–53.
6. Riaz S, Khan NA, Khaliq A, Ramzan R, Aziz MA. Validation of a Pre-existing scoring system for preoperative prediction of difficulty in laparoscopic cholecystectomy. *Pak J Med Health Sci* 2023;17(4):405–7.
7. Abdelhamid MS, Gharib AZ, Mohammed MA, Negida M. Anticipation of difficulty during laparoscopic cholecystectomy. *Arch Surg Clin Res* 2020;4:24–8.
8. Wani AM, Rastogi R, Pratap V, Joon P, Gupta Y. Role of ultrasonography (USG) in evaluation of pericholecystic adhesions in gallstone disease (GSD). *Ann Int Med Dental Res* 2017;3(4):28–33.
9. Nassar AHM, Hodson J, Ng HJ, Vohra RS, Katbeh T, *et al.* Predicting the difficult laparoscopic cholecystectomy: development and validation of a pre-operative risk score using an objective operative difficulty grading system. *Surg Endosc* 2020;34(10):4549–61.
10. Chhaparia S, Dewangan KP, Geddam SR. Prediction of difficult laparoscopic cholecystectomy on the basis of preoperative ultrasonography assessment. *Int Surg J* 2024;11(1):75–87.
11. Joyce A, Snelling PJ, Elsayed T, Keijzers G. Point-of-care ultrasound to diagnose acute cholecystitis in the emergency department: A scoping review. *Australas J Ultrasound Med* 2023;27(1):26–41.
12. Goldfinger MH, Ridgway GR, Ferreira C, Langford CR, Cheng L, Kazimianec A, *et al.* Quantitative MRCP imaging: accuracy, repeatability, reproducibility, and cohort-derived normative ranges. *J Magn Reson Imaging* 2020;52(3):807–20.

13. Amin A, Haider MI, Aamir IS, Khan MS, Khalid Choudry U, Amir M, *et al.* Preoperative and operative risk factors for conversion of laparoscopic cholecystectomy to open cholecystectomy in Pakistan. *Cureus* 2019;11(8):e5446.
14. Carbotta G, Panebianco A, Laforgia R, Pascazio B, Balducci G, Bianchi FP, *et al.* A new clinical-ultrasound score to predict difficult videolaparocholecystectomies: A prospective study. *Ann Med Surg* 2018;35:59–63.
15. Kapoor A, Sidhu BS, Singh J, Brar N, Singh P, Kapur A. Adhesions detection and staging classification for preoperative assessment of difficult laparoscopic cholecystectomies: A prospective case-control study. *J Med Ultrasound* 2023;31(2):137–43.
16. Wang X, Yu W, Jiang G, Li H, Li S, Xie L, *et al.* Global epidemiology of gallstones in the 21st century: a systematic review and meta-analysis. *Clin Gastroenterol Hepatol* 2024;(Suppl):S1542–3565.
17. Parra-Landazury NM, Cordova-Gallardo J, Méndez-Sánchez N. Obesity and gallstones. *Visc Med* 2021;37(5):394–402.
18. Raheem M, Shah SA, Waqar SH. Accuracy of ultrasonography in predicting factors for difficult laparoscopic cholecystectomy: accuracy of ultrasonography in difficult laparoscopic cholecystectomy. *J Aziz Fatima Med Dent Coll* 2022;4(1):1–5.

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