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Vascular Anomalies During Laparoscopic Cholecystectomy and Their Impact on Outcome

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A B S T R A C T

Objective: To compare the early postoperative pain at 24 hours between laparoscopic and open unilateral inguinal hernia repair.

Methodology: Cohort study conducted at the Department of Surgery, Islamabad Medical Complex, Islamabad from 1st January 2025 to 31st May 2025. A total of 60 patients with unilateral inguinal hernia were divided equally into laparoscopic and open Lichtenstein repair groups. Postoperative pain was assessed using a Visual Analog Scale (VAS) at 24 hours. Secondary outcomes included operative time, length of hospital stay, postoperative analgesia use and complications based on patient fitness and surgeon discretion.

Results: The median (IQR) VAS pain score at 24 hours was significantly lower in the laparoscopic group [4.0 (3.0–4.0)] than in the open repair group [5.0 (5.0–6.0); p<0.001]. Median (IQR) operative time was longer in the laparoscopic group [46.5 min (45.0–50.0)] than in the open group [31.0 min (27.0–35.0); p<0.005], whereas median (IQR) hospital stay was shorter [1.0 day (1.0–2.0) versus 2.0 days (2.0–3.0); p<0.005]. Additional postoperative analgesia was used by 5 (16.67%) in laparoscopic and 9 (30.0%) in open-repair patients and no postoperative complication occurred in the laparoscopic group, while 1 (3.33%) superficial surgical site infection occurred in the open group.

Conclusion: Laparoscopic inguinal hernia repair is associated with significantly reduced early postoperative pain compared to open Lichtenstein repair, despite longer operative times. These findings support the feasibility and patient centered advantages of minimally invasive hernia repair in the local population, highlighting its potential to improve early recovery and postoperative comfort

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Introduction

Laparoscopic cholecystectomy (LC), a revolutionary and minimally invasive surgical management for symptomatic gallstone disease and benign gallbladder conditions, is regarded as gold standard, due to reduced postoperative pain and shorter hospital stays, compared to open cholecystectomy. [1-3] However, LC is associated with risks of Iatrogenic or intraoperative complications, despite improved perioperative care are surgical management techniques. These risks are more prominent when unexpected anatomical variations are encountered in hepatobiliary system.[1,4] Among these anatomical variants, anomalies of cystic artery and related arterial structures are the most challenging variants, which can potentially complicate surgical procedure carried out within the hepatocystic triangle. These complicated surgical procedures have increased likelihood of hemorrhage along with prolong operative time, with negative impact on not only surgical outcomes but patient morbidity also. [4,5]

The anatomical pattern and position of cystic artery and adjacent biliary structures are inherently variable, with unusual origins, accessory or multiple arteries, and uncommon paths. These clinically relevant anomalies must be considered during LC, as these anomalies mostly remain unidentified preoperatively and are first recognized intraoperatively. The major reason behind late recognition of most unidentified vascular anomalies is the limited sensitivity of routine imaging modalities. Awareness of these anatomical patterns is of prime importance to avoiding accidental vascular injuries in surgical procedures.[6] Recent studies reveal a considerable impact of vascular variations in routine laparoscopic practice. A cross-sectional study reported that anatomical variants of the cystic and biliary structures in a significant proportion of 19.04% of patients, with complication rates of 7.7%, and cystic artery was the most frequently observed anatomical anomaly among the patients undergoing LC. Cystic and biliary anatomical variants were significantly associated

with increased rates of complications, such as bile leak and intraoperative hemorrhage. [7]

These anatomical complexities can extend operative duration along with additional dissection, leading to higher risk of accidental injury to vascular as well as biliary structures. A prospective study also documented biliary and vascular anatomical variants among even higher proportion of 25% cholecystitis patients, with biliary variants in 18.75% and vascular variants in 7.14% of patients who were managed with laparoscopic cholecystectomy. Among those with anatomical variants, a significant proportion of 3.75% patients developed complications and 7.5% of patients were converted to open cholecystectomy because of frozen hepatocystic triangle, suggesting higher rates of surgical complications and greater operative attention among patients with anatomical anomalies.[9]

Complications associate with vascular anomalies can extend beyond hemorrhagic complications to major arterial injuries. In this context, damage to right hepatic artery or aberrant branches can lead to critical outcomes, such as ischemic liver injury, bile duct ischemia, and prolonged hospital stay. The vascular anomalies, when coexisting with biliary duct variations can further complicate a surgical procedure leading to challenging intraoperative scenarios, where conversion for a Laparoscopy to open cholecystectomy becomes essential for patient safety. [10] The surgical management of vascular anomalies is further complicated by the unpredictable nature of these variants. Since, intraoperative identification of anomalies relies on the surgeon's ability to achieve a critical view of safety, which is essential to minimize bile duct injury. While achieving this critical view may be more difficult in the presence of these variants and failure to recognize an abnormal vascular progression can increase the risk of vascular and biliary injuries. Consequently, surgical strategies relevant to hepatocystic triangle are necessary to effectively manage unexpected vascular anatomy.[11] A considerable spectrum of vascular anomalies has been reported to encounter during LC across previous documented studies, which significantly impact operative parameters and clinical outcomes. Thus, pre-operative or intraoperative recognition of these vascular variants is essential for patient safety, reduced risk of intraoperative complications, and improved outcome measures.[12] However, the limited local evidence exists regarding their frequency and impact on surgical outcomes and a higher burden of operative and post-operative complication, present study is therefore significant in improving anatomical understanding, decreasing the complications rate and to enhance the safety pattern of patients during laparoscopic cholecystectomies.

Methodology

A cohort study was conducted over a period of 5 months starting from 1st January 2025 to 31st May 2025 at the Department of Surgery, Islamabad Medical Complex, Islamabad. Ethical approval was obtained from the Institutional Review Board as *NESCOM-44(33)/2025-IMC* and written informed consent was collected from each participant.

Sample size was calculated using the "Sample Size for Comparing Two Means" in the OpenEpi sample size calculator. The calculation used the difference between the mean 24 hours postoperative VAS pain scores reported by Garg el al[6] with mean $\pm$ SD of 2.5 $\pm$ 1.1 in the laparoscopic group and 3.8 $\pm$ 1.3 in the open group (mean difference of 1.3). At a confidence level of 95%, 5% margin of error, 80% power of study and 1:1 group ratio, the estimated sample size came out to be 28 being 14 participants in each group. It was conservatively increased to 60 participants to meet the minimum requirement of sample size. Non-probability convenient sampling technique was used to enroll the participants.

Participants were then divided into two groups with each group containing 30 participants. Group A was set to undergo laparoscopic hernia repair whereas group B was to undergo open inguinal surgical repair. All the patients aged 10-65 years, having unilateral inguinal hernia confirmed on physical examination were included whereas those patients who were previously diagnosed with any severe uncontrolled systemic illness, end stage malignancies and poor candidates of surgery were excluded from the study. Those patients who met the inclusion criteria were admitted in the surgical ward a day prior to the surgery.

This Prospective observational study was conducted at department of surgery & Minimal invasive surgical center (MISC), Liaquat University Hospital Hyderabad. The study was performed after the permission approval of ethical committee of LUMHS and duration was one year from December 2020 to November 2021. The overall sample size of 125 patients was calculated taking the prevalence for vascular anomalies during laparoscopic cholecystectomy 20%,[3] with 95% confidential level and 5% margin of error. All the adult patients aged ≥18 years, diagnosed with gallbladder disease including cholelithiasis, chronic cholecystitis, or biliary colic, were scheduled for elective laparoscopic cholecystectomy (first time), whom intraoperative assessment of vascular anatomy in the hepatocystic triangle was feasible off either gender, were included. The patient with acute cholecystitis, empyema, gall bladder, pancreatitis, obstructive jaundice and carcinoma of gall bladder were excluded from study because in these cases it would have been difficult to identify the anomalies due to obscured biliary anatomy. Base line investigation along with ultrasound abdomen

were carried out in all cases and no other special investigation was done to evaluate the patient because the purpose was not assessing these anomalies pre-operatively by any conventional or special investigation. All cases undergoing routine laparoscopic cholecystectomy were assessed for different vascular anomalies accessible during the procedure and their importance in relation to operative difficulties and post-operative complication / outcome particularly due to these anomalies. Structure mainly assessed was cystic artery and hepatic artery which was easily handled during laparoscopic cholecystectomy. During the study the confidentiality was maintained and the informed consent was taken in clearly understandable national or regional (if required) languages. The whole information of patients was kept confidential, and access was restricted to authorized personnel and regulatory authorities.

Furthermore, the intraoperatively, the operating surgeon recorded the presence or absence of the vascular anomalies and linked operative findings immediately after the surgeries. The operative duration, loss of blood, and any intraoperative complications were noted and the patients were followed daily postoperatively to evaluate the complications like leak of bile, infection, bleeding and outcomes during Hospital stay. The data of all patients were entered, saved and analyzed in spss version 20.

Results

In this study total 125 patients were studied and most common age group was 31-45 years 56.0%, followed by 46-60 years 26.4% and 15-30 years 17.6%. Females were most common 72.0% and males were 28.0%. According to the presenting symptoms right hypochondrium pain was most common among 50.4% patients; epigastrium pain was among 19.2% patients, dyspepsia was in 16.05 patients, vomiting 6.4% and nausea was among 8.0% patients. Table I.

Table I: Demographic distribution of the patients. (n=125)

Demographic variables	Frequency	(%)
Age groups		
15-30 years	22	17.6
31-45 years	70	56.0
46-60 years	33	26.4
Gender		
Male	35	28.0
Females	90	72.0
Symptoms		
Right Hypochondrium pain	63	50.4
Epigastrium pain	24	19.2
Dyspepsia	20	16.0
Vomiting	8	6.4
Nausea	10	8.0

According to the vascular anomalies Moynihan's hump anomaly was among 4.0% patients, artery aInterior to cystic duct was among 4 patients, Short cystic duct in 3 patients, Artery posterior to cystic duct in 2 patients, Common hepatic artery in 2 patients, Long cystic duct, while Parallel to CBD, Cystic artery anomalies, Aberrant cystic artery, Short cystic artery and Double cystic artery were found in one patients respectively. Table II

Table II: Vascular anomalies of the patients. (n=125)

Vascular anomalies	N	(%)
Long cystic duct	1	0.8
Parallel to CBD	1	0.8
Short cystic duct	3	2.4
Moynihan's hump anomaly	5	4.0
Cystic artery anomalies	1	0.8
Common hepatic artery	2	1.6
Artery anterior to cystic duct	4	3.2
Artery posterior to cystic duct	2	1.6
Artery right to cystic duct	1	0.8
Aberrant cystic artery	1	0.8
Short cystic artery	1	0.8
Double cystic artery	1	0.8

According to the post-operative complications bleeding was in 8.0% patients, followed by prolonged Hospital stay, biliary leakage, infection and others with percentage of 9.6%, 6.4%, 3.25 and 8.0% respectively. Table III

Table III: Post-operative complications. (n=125)

Complications	Frequency	(%)
Bleeding	10	8.0
Biliary leakage	04	3.2
Infection	08	6.4
Others	10	8.0
Prolonged Hospital stay	12	9.6

Discussion

Laparoscopic cholecystectomy (LC) remains a treatment of choice for cholelithiasis and other gallbladder conditions, surpassing open surgery in surgical benefits because of marginally invasive nature and faster recovery, with lower postoperative morbidity. Despite its widespread application, LC is challenging when anatomical variations are encountered within the hepatocystic triangle, significantly complicating surgical dissections, increasing the likelihood of intraoperative hemorrhage, and causing iatrogenic injuries.[13] In this study total 125 patients were studied and most common age group was 31-45 years (56.0%), with female gender predominance (72.0%), suggesting higher incidence of gallbladder disease among middle-aged patients and female patients. Comparable demographic characteristics were presented in the study of Talpur et al[14] with female gender predominance (85%) and mean and median age of 39.85 and 41 years respectively.

Similar statistics were documented in the study conducted by Radunovic et al[15] who observed majority of females (67.8%), while median age of 51 years in their study suggests that gallstone diseases leading to laparoscopic cholecystectomy become more prevalent as the age increases. Additionally, in our cohort, according to the presenting symptoms right hypochondrium pain was most common among 50.4% patients; epigastrium pain was among 19.2% patients, dyspepsia was in 16.05 patients, vomiting 6.4% and nausea was among 8.0% patients. In line with our findings, in the study of Dhamnetiya et al[16] right upper quadrant/ hypochondriac pain (31.67%) was the predominant presenting symptom, followed by a high proportion patient presenting with epigastrium pain (26.67%), nausea (17.5%), and vomiting (13.3%). Comparable pattern of presenting symptoms was documented by Talpur et al[14] who reported higher proportion of right hypochondrial pain in 71.67% of patients, Nausea & Vomiting in 18.67% and Dyspepsia in 11.67% of patient compared to our findings, while epigastric pain among 9.33% of their patients was lower than those of our cohort.

In current study, the Moynihan's hump anomaly was among 4.0% patients, artery anterior to cystic duct was among 3.2% patients, short cystic duct in 2.4% patients, artery posterior to cystic duct in 1.6% patients, common hepatic artery in 1.6% patients, while, each of the Long cystic duct, Parallel to CBD, cystic artery anomalies, aberrant cystic artery, Short cystic artery, and Double cystic artery were found in 0.8% of patients respectively. In agreement with these findings, in the study carried out by Singh et al[17] reported anterior/posterior positional variations, with double/accessory cystic arteries and single short cystic artery among 2.3%-3.8% of patients. Higher overall rates of arterial variations in their study can possibly be attributed to large sample size. Consistent pattern of vascular anomalies, were stated in the study of Talpur et al[14] They found that moynihan's hump and Short cystic duct anomalies were the most common anomalies in 2.67% of patients respectively, followed by Aberrant cystic artery among 2.33%, Short cystic artery in 1.67%, and Artery posterior to cystic duct in 1.33% of patients, while other anomalies were less frequent similar to our findings.

In this study, according to the post-operative complications bleeding was in 8.0% patients, followed by biliary leakage, infection and others with percentages of 6.4%, 3.25% and 8.0% respectively. However, prolonged Hospital stay was found in 9.6% of patients. Aligning with these findings, in the study of Radunovic et al[18] postoperative complications (POC), the most common ones were bleeding (3.64%) and biliary leakage (1.89%) were the most frequent postoperative complications, while surgical site infection were present in only 0.94% of the patients.

Consistently, in the study of Talpur et al[14] major postoperative complications were sepsis in 7.33% of patients, followed by pain in right shoulder among 2.33%, bleeding among 3.67% and biliary leak among 1.67% of the patients. However, mean hospital stay in their study was 2.75 ± 1.95 days, with prolonged hospital stay (5 or more days) was among 9.67% of patients. Similarly, in the study by Radunovic et al[15] bleeding (3.64%) was the mostly frequent postoperative complication, followed by bile leaks (1.89%). In aligns to this series Tiwari S et al[8] reported higher rate of complication among cases with anatomical variations around 19.04% in contrast to cases found with normal anatomy around 3.64%, while overall intraoperative and postoperative complications were reported in 5.2% and 3.9% of patients, correspondingly. Moreover, few other studies also found comparable findings.[7,9.19] Based on findings, careful preoperative assessment and meticulous intraoperative identification of vascular and biliary anatomical variations are strongly recommended to minimize the risk of bleeding and other complications during laparoscopic cholecystectomy. The surgeons should maintain a critical view of safety before clipping or dividing any structures. However further large scale multicenter studies also are recommended to establish the impact of these anatomical variations on surgical outcomes.

Conclusion

This study revealed the alterable anatomy of the cystic duct and the cystic artery, including Moynihan's hump anomaly, aberrant or short cystic ducts. Such anatomical variations pose potential challenges during laparoscopic cholecystectomy surgeries, while overall incidence of postoperative complications was relatively lower, with the bleeding being the most prevalent, subsequently biliary leakage and prolonged hospital stay. The findings emphasize the significance of careful intraoperative concern of regrading vascular and biliary anatomy to reduce the risks during surgery and improve the outcome of patients, even in the absence of statistically significant relationships.

References

1. Fernicola A, Palomba G, Capuano M, De Palma GD, Aprea G. Artificial intelligence applied to laparoscopic cholecystectomy: what is the next step? A narrative review. Updates Surg. 2024;76(5):1655-67. https://doi.org/10.1007/s13304-024-01892-6

2. Delgado LM, Pompeu BF, Pasqualotto E, Magalhães CM, Oliveira AF, Kato BK, et al. Robotic-assisted cholecystectomy versus conventional laparoscopic cholecystectomy for benign gallbladder disease: a systematic review and meta-analysis. J Robot Surg. 2024;18(1):242. https://doi.org/10.1007/s11701-024-01989-5
3. Morcos RK, Lima SR, Bokhari SF, Almadhoun MK, Patel M, Hlyan NP, et al. A comprehensive analysis of single-incision laparoscopic cholecystectomy: trends, challenges, and future directions. Cureus. 2024;16(2):e54493. https://doi.org/10.7759/cureus.54493
4. Adrales G, Ardito F, Chowbey P, Morales-Conde S, Ferreres AR, Hensman C, et al. Laparoscopic cholecystectomy critical view of safety (LC-CVS): a multi-national validation study of an objective, procedure-specific assessment using video-based assessment (VBA). Surg Endosc. 2024;38(2):922-30. https://doi.org/10.1007/s00464-023-10479-y
5. Pesce A, Fabbri N, Feo CV. Vascular injury during laparoscopic cholecystectomy: an often-overlooked complication. World J Gastrointest Surg. 2023;15(3):338. https://doi.org/10.4240/wjgs.v15.i3.338
6. Fateh O, Wasi MS, Bukhari SA. Anatomical variability in the position of cystic artery during laparoscopic visualization. BMC Surg. 2021;21(1):263. https://doi.org/10.1186/s12893-021-01270-8
7. Gupta R, Kumar A, Hariprasad CP, Kumar M. Anatomical variations of cystic artery, cystic duct, and gall bladder and their associated intraoperative and postoperative complications: an observational study. Ann Med Surg (Lond). 2023;85(8):3880-6. https://doi.org/10.1097/MS9.0000000000001079
8. Tiwari S, Sharma OK, Seth S, Rathore AS. Complications of laparoscopic cholecystectomy in relation to the normal anatomy and variations in the extrahepatic biliary tree and vascular anatomy: a cross-sectional study. Int J Pharm Clin Res. 2024;16(8):26-30. Available from: https://impactfactor.org/PDF/IJPCR/16/IJPCR,Vol16,Issue8,Article5.pdf
9. Katti SC, Dwivedi S, Nagula BP. Study on variations of the vascular and extrahepatic biliary system in laparoscopic cholecystectomy and its associated outcomes. Eur J Cardiovasc Med. 2023;13(3).
10. La Vaccara V, Coppola A, Cammarata R, Olivieri L, Farolfi T, Coppola R, et al. Right hepatic artery anomalies in pancreatoduodenectomy—a risk for arterial resection but not for postoperative outcomes. J Gastrointest Oncol. 2023;14(5):2158. https://doi.org/10.21037/jgo-23-191
11. Chooklin SM, Chuklin SS. How to prevent complications in laparoscopic cholecystectomy: a critical view of safety. Emerg Med. 2024;20(5):376-87. https://doi.org/10.22141/2224-0586.20.5.2024.1737
12. Katti SC, Dwivedi S, Nagula BP. Study on variations of the vascular and extrahepatic biliary system in laparoscopic cholecystectomy and its associated outcomes. Eur J Cardiovasc Med. 2023;13(3).
13. Perdikakis M, Liapi A, Kiriakopoulos A, Schizas D, Menenakos E, Lyros O. Anatomical variations of the cystic artery and laparoscopic cholecystectomy: a persisting surgical challenge. Cureus. 2024;16(8). https://doi.org/10.7759/cureus.67948
14. Talpur KA, Laghari AA, Yousfani SA, Malik AM, Memon AI, Khan SA. Anatomical variations and congenital anomalies of extrahepatic biliary system encountered during laparoscopic cholecystectomy. J Pak Med Assoc. 2010;60(2):89.
15. Radunovic M, Lazovic R, Popovic N, Magdelinic M, Bulajic M, Radunovic L, et al. Complications of laparoscopic cholecystectomy: our experience from a retrospective analysis. Open Access Maced J Med Sci. 2016;4(4):641. https://doi.org/10.3889/oamjms.2016.128
16. Dhamnetiya D, Goel MK, Dhiman B, Pathania OP, Usman BO, Oyewole FA, et al. Clinical presentation of gallstone disease: evidence from a case-control study. Arch Int Surg. 2019;9:1-4. https://doi.org/10.4103/ais.ais_26_19
17. Singh K, Singh R, Kaur M. Clinical reappraisal of vasculobiliary anatomy relevant to laparoscopic cholecystectomy. J Minim Access Surg. 2017;13(4):273-9. https://doi.org/10.4103/jmas.JMAS_268_16
18. Radunovic M, Lazovic R, Popovic N, Magdelinic M, Bulajic M, Radunovic L, et al. Complications of laparoscopic cholecystectomy: our experience from a retrospective analysis. Open Access Maced J Med Sci. 2016;4(4):641. https://doi.org/10.3889/oamjms.2016.128
19. Alyan A, Mohamed H, Musa HA, Ahmed T, Answer D, Awadlseid KMF. Anatomical variations and congenital anomalies of the gallbladder observed during laparoscopic cholecystectomy. Int J Biomed. 2024;14(4):719-22. https://doi.org/10.21103/Article14(4)_ShC
20. Shaik K, Babu BA. Incidence of vascular and biliary anomalies found during laparoscopic cholecystectomy and their outcomes. Int J Community Med Public Health. 2025;12:4461-5. https://doi.org/10.18203/2394-6040.ijcmph20253239