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Original Research Article

A study on preoperative clinico-radiological factors in predicting intraoperative difficulties in laparoscopic cholecystectomy

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ABSTRACT

Background: Gallstones, or cholelithiasis, are common conditions causing patients to seek surgery. They can result from chronic or acute disorders in the biliary, pancreatic, gastrointestinal, and hepatic systems. The main pathways for gallstone formation are excessive bilirubin, cholesterol supersaturation, and impaired gall bladder contractility. Surgeons need to establish criteria for difficult laparoscopic cholecystectomy (LC) and conversion, but there's no consensus among them.
Methods: Observational analytical prospective cohort study, conducted in general surgery, People's hospital, Bhopal from November 2022 to February 2024, patients diagnosed with cholelithiasis scheduled for LC in the study area during the study period.
Results: LC is the gold standard treatment for symptomatic cholelithiasis. Preoperative prediction of conversion risk is crucial for planning surgery. Predicting difficult LC allows experienced surgeons to be present during surgery, preventing complications. Early decision-making can prevent unnecessary surgery prolongation. Despite attempts to develop scoring systems for difficult LC, they are complex, difficult to use in daily practice, and often cannot be applied preoperatively.
Conclusions: LC is a common surgery for symptomatic cholecystectomy. A detailed clinical assessment and preoperative ultrasound are important to identify potential challenges and complications. Factors like recurrent acute cholecystitis, pancreatitis, chronic liver disease, and past hospitalizations can predict difficulties. Intraoperative issues may include bile spillage and bleeding. Difficult cases may require conversion to open surgery, extending operation time and hospital stays.

Keywords: Acute cholecystitis, Laparoscopic cholecystectomy, Liver function tests, Open cholecystectomy

INTRODUCTION

Gallstones, or cholelithiasis, are common conditions causing patients to seek surgery. They can result from chronic diseases or acute disorders of the biliary, pancreatic, gastrointestinal, and hepatic systems.[1] The three main pathways associated with gall stone formation are excessive bilirubin, cholesterol supersaturation, and hypomotility or impaired contractility of the gall bladder. Cholelithiasis is a prevalent condition, with a prevalence estimated to be 60-70% in American Indians and 10-15% in the US population.[2] Most cases are symptomatic, with symptoms presenting with sharp, intermittent, and episodic pain in the right upper quadrant of the abdomen with nausea and vomiting.[3] Ultrasonography is the gold standard for diagnosing gallstones, with a sensitivity and specificity of 84% and 99% respectively. Treatment depends on underlying symptoms, patient condition, and presentation mode. Some LC procedures require an open surgery, with factors such as acute cholecystitis, anatomical abnormalities, severe fibrosis, aging, male gender, history of upper abdominal surgeries,

pancreatitis, lack of appropriate laparoscopic instruments, gallbladder wall thickening, fluid surrounding the gallbladder, and intraoperative complications contributing to the conversion.[4]

The need of this study to predict intraoperative difficulties in elective LC on the basis of preoperative clinico-radiological factors (USG) and reduce the conversion rates of LC to open cholecystectomy.[5]

The aim of this study is to predict intraoperative difficulties in elective LC on the basis of preoperative clinico-radiological factors.

METHODS

Study type

It was a descriptive study.

Tool used was SPSS.

Inclusion criteria

All patients of both sexes having symptomatic gall stones disease undergoing LC giving consent to be the part of study will be included in the study.

Exclusion criteria

Patients not giving consent, patients unfit for general anaesthesia, patients having coagulation disorders, laparoscopic to open conversion due to equipment failure and acute cholecystitis, carcinoma gall bladder, CBD stone, obstructive jaundice were excluded.

This study will include all the patients who will be diagnosed as cholelithiasis, meeting the inclusion criteria and are willing to participate in study and are going to be admit in department of surgery of people's hospital, Bhopal associated with people's college medical sciences and research centre Bhopal over a period from November 2022 to April 2024.

Sampling technique

The ideal sampling technique for this study would be stratified random sampling, as it ensures representation across key clinico-radiological factors while allowing subgroup analyses. Simple random sampling could also be considered for simplicity.[6]

Ethical approval information

Ethical approval information for this study has been confirm[7] Approval by an institutional ethics committee or equivalent, with the reference number and date. Compliance with ethical guidelines (e.g., Declaration of Helsinki, ICMR guidelines). Confirmation of informed consent for prospective participants or waiver for retrospective data. Assurance of participant confidentiality and data protection measures.

Surgery technique

LC: The surgery is performed under general anaesthesia, with controlled ventilation and monitoring of end tidal carbon dioxide and pulse oximetry.[8] The patient is placed in supine position with 150 head tilt and right up position, and a pneumoperitoneum is created. Two 5 mm and two 10 mm ports are inserted, with 10mm ports in the umbilical and epigastric regions and 5 mm ports in the right subcostal region. Calot's triangle is identified and skeletonized, and the Rouviere's sulcus is visualized. Strasberg's critical view of safety is identified to prevent bile duct injury.[9] Clops are applied over the cystic artery and duct, and the gallbladder is dissected off the liver bed for hemostasis. Analgesic infiltration is given at post-operative sites for postoperative pain relief.

Open cholecystectomy: The patient undergoes a right subcostal incision to remove the gallbladder, ensuring adequate exposure and visualization of the gallbladder, triangle of Calot, and bile ducts.[10] The surgeon then removes the gallbladder from the liver using electrocautery or a harmonic scalpel. The gallbladder bed is examined for bleeding or bile leaks, and cholangiogram or common bile duct exploration is performed based on factors like elevated bilirubin and dilated common bile duct. The abdomen is closed in a multilayer fashion. If the gallbladder is tense due to inflammation, decompression needle may be needed.[11]

RESULTS

Mean age of patients who underwent laparoscopic cholecystectomy in our study was 44±12.78 years and majority i.e. 29.3% cases belonged to age range of 41 to 50 years, followed by 26.7% cases belonging to 31 to 40 years of age. Only 9.3% cases belonged to elderly age group.

We documented slight female predominance in our study, i.e. about 54.7% cases were females whereas only 45.3% of the cases were males (Table 2).

Previous history of acute cholecystitis and hospitalization for gall bladder related complaints was reported in 1.73% and 13.3% cases respectively. History of upper abdominal surgery reported in 12% cases whereas history of chronic liver disease was documented in 9.3% cases. History of pancreatitis present in 5.3% cases (Table 3).

Gall bladder wall thickness and CBD diameter were more than 4 mm and 6 mm respectively in 8% and 13.3% cases respectively. About 82.7%had single stones and the size of stone was more than 1 cm in 85.3% cases. Gall bladder was distended in 97.3% cases. Stone was found impacted in neck of gall bladder in 9.3% cases. Features of chronic liver disease was noted in 13.3% cases (Table 4).

Table 1: Age group-wise distribution of study subjects among two groups, (n=75).

Age (in years)	N	Percentage (%)
≤30	12	16
31-40	20	26.7
41-50	22	29.3
51-60	14	18.7
>60	7	9.3
Mean	44±12.78	

Table 2: Distribution of cases according to sex, (n=75).

Sex	N	Percentage (%)
Male	34	45.3
Female	41	54.7

Table 3: Distribution of cases with association of previous medical of surgical history, (n=75).

Previous history	N	Percentage (%)
Upper abdominal surgery	9	12
Pancreatitis	4	5.3
Acute cholecystitis	13	17.3
Chronic liver disease	7	9.3
Hospitalization for GB complaints	10	13.3

Intra operative complications revealed bile spillage in 18.7% cases. Calot's dissection and gall bladder bed dissections were difficult in 17.3% and 24% cases respectively. Diffuse oozing of blood or cystic artery injury was present in 10.7% cases and 5.3% cases had injury to CBD (Table 5).

Cholecystectomy was easy in 61.3% cases whereas it was difficult in 38.7% cases. Of them, cholecystectomy was difficult, moderately difficult and very difficult in 4%, 25.3% and 9.3% cases respectively (Table 6).

Laparoscopic cholecystectomy was converted to open cholecystectomy in 9.3% cases out of 75 cases enrolled in our study. The procedure was abandoned in none of the cases (Table 7).

Majority i.e. 63% and 66.7% cases with easy and difficult laparoscopic cholecystectomy were females respectively whereas 57.9% cases with moderately difficult laparoscopic cholecystectomy and 71.4% cases with very difficult cholecystectomy were males. However, the observed association of sex with level of difficulty was statistically insignificant (p>0.05) (Table 8).

As observed from the Table 9, history of pancreatitis, acute cholecystitis, chronic liver disease and previous hospitalization for GB complaints was found to be significantly higher in cases with very difficult laparoscopic cholecystectomy as compared to cases with easy, difficult and moderately difficult procedure (p<0.05).

Table 4: Ultrasound parameters among the study participants, (n=75).

Ultrasound findings		N	Percentage (%)
Gall bladder wall thickness	<4 mm	69	92
	>4 mm	6	8
CBD diameter	<6 mm	65	86.7
	>6 mm	10	13.3
No. of stone	Multiple	13	17.3
	Single	62	82.7
Size of stone	<1 cm	11	14.7
	>1 cm	64	85.3
Shape of GB	Contracted	2	2.7
	Distended	73	97.3
Impacted stone at neck of GB	Absent	68	90.7
	Present	7	9.3
CLD	Absent	65	86.7
	Present	10	13.3

Table 5: Distribution according to intra operative complications, (n=75).

Intra operative complications	N	Percentage (%)
Bile spillage	14	18.7
Injury to CBD	4	5.3
Cystic artery injury/diffuse oozing of blood	8	10.7
Difficult Calot's dissection	13	17.3
Difficult gall bladder bed dissection	18	24

Table 6: Distribution of cases according to ease of cholecystectomy, (n=75).

Cholecystectomy		N	Percentage (%)
Easy		46	61.3
Difficult	Total	29	38.7
	Difficult	3	4
	Moderately difficult	19	25.3
	Very difficult	7	9.3

Table 7: Distribution of cases according to need to convert to open cholecystectomy, (n=75).

Procedure converted to open cholecystectomy	N	Percentage (%)
No	68	90.7
Yes	7	9.3

Table 8: Association of sex with difficult cholecystectomy.

Sex	Easy, (n=46)		Difficult, (n=3)		Moderately difficult, (n=19)		Very difficult, (n=7)	
	N	%	N	%	N	%	N	%
Male	17	37	1	33.3	11	57.9	5	71.4
Female	29	63	2	66.7	8	42.1	2	28.6
χ^2	4.61							
P value	0.203							

Table 9: Association of previous history with difficult cholecystectomy.

Previous history	Easy, (n=46)		Difficult, (n=3)		Moderately difficult, (n=19)		Very difficult, (n=7)		χ^2	P value
	N	%	N	%	N	%	N	%		
Upper abdominal surgery	3	6.5	0	0	4	21.1	2	28.6	5.01	0.171
Pancreatitis	1	2.2	0	0	1	5.3	2	28.6	8.57	0.036
Acute cholecystitis	1	2.2	2	66.7	5	26.3	5	71.4	27.84	0.001
Chronic liver disease	0	0	0	0	4	21.1	3	42.9	17.42	0.001
Hospitalization for GB complaints	1	2.2	0	0	4	21.1	5	71.4	26.84	0.001

Table 10: Association of USG findings with difficult cholecystectomy.

USG findings		Easy, (n=46)		Difficult, (n=3)		Moderately difficult, (n=19)		Very difficult, (n=7)		χ^2	P value
		N	%	N	%	N	%	N	%		
Gall bladder wall thickness	<4 mm	46	100	2	66.7	16	84.2	5	71.4	12.21	0.007
	>4 mm	0	0	1	33.3	3	15.8	2	28.6		
CBD diameter	<6 mm	44	95.7	3	100	15	78.9	3	42.9	16.28	0.001
	>6 mm	2	4.3	0	0	4	21.1	4	57.1		
Number of stone	Multiple	5	10.9	0	0	3	15.8	5	71.4	16.29	0.001
	Single	41	89.1	3	100	16	84.2	2	28.6		
Size of stone	<1 cm	5	10.9	0	0	2	10.5	4	57.1	11.39	0.01
	>1 cm	41	89.1	3	100	17	89.5	3	42.9		
Shape of GB	Contracted	1	2.2	0	0	1	5.3	0	0	0.81	0.847
	Distended	45	97.8	3	100	18	94.7	7	100		
Impacted stone at neck of GB	No	46	100	3	100	17	89.5	2	28.6	36.97	0.001
	Yes	0	0	0	0	2	10.5	5	71.4		
CLD	No	43	93.5	3	100	15	78.9	4	57.1	8.57	0.036
	Yes	3	6.5	0	0	4	21.1	3	42.9		

Gall bladder wall thickness was found to be more than 4 mm in 33.3%, 28.6% and 15.8% cases with difficult, very difficult and moderately difficult laparoscopic cholecystectomy whereas it was less than 4 mm in 100% cases with easy cholecystectomy. We found a significant association of difficult laparoscopic cholecystectomy with gall bladder wall thickness of more than 4 mm, CBD diameter of more than 6 mm, multiple stones, size of stones or more than 1 cm, presence of impacted stone in gall bladder neck and presence of chronic liver disease ($p<0.05$).

DISCUSSION

Though laparoscopic cholecystectomy is one of the commonly performed surgical procedure for underlying symptomatic cholelithiasis, some cholecystectomies may be difficult and complicated, requiring conversion to open cholecystectomy.[11] Approximately 3 to 10% of the laparoscopic cholecystectomies require conversion to open cholecystectomies across the globe.[12] The underlying factors associated with conversion to open cholecystectomies include anatomical abnormalities, advanced age, male gender, previous upper abdominal surgeries, severe fibrosis, acute cholecystitis, acute pancreatitis, thickening of gall bladder wall of more than 3 mm, presence of fluid surrounding the gall bladder, lack of appropriate laparoscopic instruments and intraoperative complications.[13] The present study conducted on a total of 75 cases who underwent laparoscopic cholecystectomy at our hospital during the study period to study and identify preoperative clinical and radiological factors predictive of difficult Laparoscopic Cholecystectomy.[14,15]

Limitations

First, the cost of laparoscopic surgery was not taken into consideration. Second, the classification of surgery into easy and difficult procedure was determined based upon the clinical, radiological and intraoperative parameters, there is no standard classification system for grading the surgery into various level of difficulties. Third, the sample size of the study was small and thus the findings could not be generalized.

CONCLUSION

Laparoscopic cholecystectomy is a common surgical procedure for symptomatic cholelithiasis. Prior to surgery, a thorough clinical assessment, including history, examination, and ultrasound (USG), is crucial. Preoperative ultrasound can identify cases likely to be challenging and anticipate potential complications. Significant predictors of difficult laparoscopic cholecystectomies include a history of recurrent acute cholecystitis, pancreatitis, chronic liver disease, and previous gallbladder-related hospitalizations. Specific USG findings, such as gallbladder wall thickness, common bile duct (CBD) diameter, number and size of gallstones, presence of impacted stones, and signs of chronic liver disease, further inform risk assessment.

Intraoperative challenges may arise from bile spillage, common bile duct injury, diffuse bleeding, and complications during dissection at Calot's triangle and the gallbladder bed.

Although not all difficult procedures necessitate conversion to open surgery, those deemed very difficult typically do. Such difficulties can significantly extend both the duration of the operation and the patient's length of hospital stay.

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