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Original Research Article

Assessment of clinical, hematological, radiological parameters for prediction of difficult laparoscopic cholecystectomy at a tertiary health care centre

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ABSTRACT

Background: Since its introduction in the mid 1980's, laparoscopic cholecystectomy (LC) has been widely used for symptomatic cholelithiasis. In recent years it has been considered as a gold standard for treatment of symptomatic cholelithiasis. Recent studies have reported that the rate of conversion of LC to open cholecystectomy (OC) is 1.5-19%. The aim of the present study was to predict the difficulties of performing laparoscopic cholecystectomy in symptomatic cholelithiasis. Further, the possibility of converting LC to open cholecystectomy was also investigated using various haematological, clinical, and radiological tool such as USG.
Methods: The present prospective study was conducted in in Nehru Hospital of BRD Medical College, Gorakhpur, India over a period of 12 months on in-patients from various surgical wards undergoing LC. The patients were primarily divided into two groups consisting of those undergoing LC and those converted to OC respectively. Parameters like gender, age, body mass index, associated complains, total leukocyte count (TLC) and levels of alkaline phosphatase (ALP) were assessed as potential risk factors for conversion.
Results: 50 patients were considered for this study. Results indicated that rate of conversion of LC to OC was found to be maximum for patients belonging to male gender, 31-40 years old, were obese, had previous history of upper abdominal surgery and had raised levels of TLC and ALP. Patients having multiple stones and contracted gall bladder also had a higher incidence of conversion to OC.
Conclusions: From results obtained in this study, it could be concluded that parameters like age, gender, obesity, history of upper abdominal surgery, raised levels of TLC and ALP, incidences of multiple stones and contracted gall bladder posed significant risk for LC and acted as predictors for conversion to OC.

Keywords: Cholelithiasis, Haematology, Laparoscopic cholecystectomy, Ultrasonography

INTRODUCTION

Laparoscopic cholecystectomy (LC) is considered as a gold standard procedure for treatment of symptomatic gallstones and benign gall bladder disease in patients having elective or emergency conditions.[1,2] In comparison to open cholecystectomy (OC), LC facilitates earlier restoration of bowel activities, lower post-operative pain and infection, improved cosmesis, shorter duration of hospitalization, earlier restoration of complete activity and an overall reduction of cost.[2]

According to a recent study, the rate of conversion of LC to OC was found to be 1.5-19%.[2] Process safety and efficiency is dependent upon the underlying pathology as well as the experience and expertise of the surgeon.[1] It is

even performed in small community hospitals with limited resources.[1]

However, in smaller regional hospitals, presence of fewer experienced surgeons makes achievement of definitive successful treatment difficult. Therefore, protection of bile ducts and vascular structures from injury becomes a major priority during LC.[1]

Acquiring information regarding potential risk factors causing difficulties in different phases of LC prior to execution of the same is highly important for ensuring patient safety as well as for critical analysis of the competency of the surgical team performing the LC.[1,2]

Identification of these risk factors prior to operation is specifically important for non-referential LC centers as well as hospitals where OC is rarely performed for protection of bile ducts and vascular structures from intraoperative injuries.[1] Besides, accurate identification of these risk factors also facilitate more significant and precise preoperative counselling, improved scheduling and efficiency of operating room as well as classification of risks posing technical challenges.[2]

Identification of risks also aid in suitable assignment of resident assistance which in turn improves patient safety by reducing time required for conversion.[2] Furthermore, risk identification helps determine patients indicated for planned OC.[3] In scenarios where only few experienced surgeons are available, the surgeon about to perform a difficult operation should be aware of his competencies and operate only in presence of an experienced surgeon.[1]

The present study aims to predict the difficulties of laparoscopic cholecystectomy and the possibility of converting this to open cholecystectomy using various haematological, clinical, and radiological (such as ultrasonographic; USG) tool.

METHODS

Prospective study of all patients admitted over 12 months as in-patient in various surgical wards in Nehru Hospital of BRD Medical College, Gorakhpur, India for undergoing LC was used.

Detailed history of every patient was recorded, and all patients were clinically examined as per proforma. Investigations were carried out after receiving written informed consent. Duration of the procedure, complications encountered during procedure (if any) and whether in any case LC was converted to OC and the reason for doing so was carefully noted during the operation. Application of drain removal (if required), duration of hospital stay post-surgery and other complications (if any), time taken for restoration of full function as well as patient satisfaction were also recorded. Post-operative follow up of each patients was performed for 3 months.

Symptomatic Cholelithiasis/ cholecystitis and diagnosed by ultrasonography of abdomen was considered as the sole criteria for patient inclusion. Bleeding diathesis, proven carcinoma gall bladder, unfitness for general anaesthesia, cholangitis, dialated common bile duct and presence of common bile duct stone were considered as criteria for patient exclusion.

RESULTS

Patient demographics

This study was performed with 50 patients. Patient demographics have been shown in Table 1. 5 Patients of LC and 5 patients of LC converted to OC (50%) were males. Among females, 37 patients were subjected to LC group while in case of 3 patients (7.5%) LC was converted to OC.

Table 1: Patient demographics.

Sex	Laparoscopic cholecystectomy		Converted to open cholecystectomy		Total	
	No.	%	No.	%	No.	%
Male	5	10	5	10	10	20
Female	37	74	3	6	40	80

Age distribution in patients

Classification of patients on the basis of their age has been shown in Table 2. 32% of the patients were found to be less than 30 years old and none of them were converted to OC.

Rate of conversion of LC to OC was found to be 23.1%, 10% and 25% for patients belonging to age groups 31-40 years, 41-50 years and 51-60 years respectively. Incidence of cholecystectomy was less in patient over 60 years of age but in these cases 67% of patients were converted to OC.

Table 2: Age distribution of patients.

Age (years)	Laparoscopic cholecystectomy		Converted to open cholecystectomy		Total	
	No.	%	No.	%	No.	%
< 30	16	32	0	0	16	32
31 -40	10	20	3	6	13	26
41-50	9	18	1	2	10	20
51-60	6	12	2	4	8	16
61-70	1	2	2	4	3	6

Body mass index (BMI)

BMI of patients considered for this study has been shown in Table 3. 21 patients were found to have BMI less than 30 kgm^{-2} while 29 patients were obese and had BMI higher than 30 kgm^{-2}. It is difficult to perform LC in case of overweight and obese patients and therefore rate of

conversion to OC was higher (17.2%) than patients with lower BMI (14.3%).

Table 3: Body mass index in patients.

BMI (kg/m^2)	Laparoscopic cholecystectomy		Converted to open cholecystectomy		Total	
	No.	%	No.	%	No.	%
<30	18	36	3	6	21	42
>30	24	48	5	10	29	58

Complaints presented by patients

Different complaints presented by patients considered in this study have been shown in Table 4. 34 patients complained of pain in right upper abdomen of which 5 were converted to OC. Other complaints like dyspepsia, fever, vomiting, were reported by 14, 7 and 9 patients respectively. Of these 3, 4 and 2 patients were converted to OC respectively. Eleven patients had complained of multiple episode of acute cholecystitis. 2 of 3 patients having jaundice and hyperbilirubinemia were converted to OC. Of all patients, 5 have had abdominal surgeries previously and 1 had a history of upper abdominal surgery being converted to OC. Most of the patients had presented multiple complaints.

Hematological findings

Different hematological findings recorded in patients considered for this study have been shown in Table 5. Results indicated that 5 out of 14 patients having total leukocyte count (TLC) higher than 11000 cells mm^{-3} and 3 out of 36 patients with a total leukocyte count lower than 11000 cells mm^{-3} were converted to OC. 2 out of 4 patients having high alkaline phosphatase were also converted to OC.

Table 4: Complaints presented by patients.

Presenting complaints		Laparoscopic cholecystectomy		Converted to open cholecystectomy		Total	
		No.	%	No.	%	No.	%
Pain in right upper abdomen		29	58	5	10	34	68
Dyspepsia		11	22	3	6	14	28
Fever		3	6	4	8	7	14
Vomiting		7	14	2	4	9	18
Hyper bilirubinemia		1	2	2	4	3	6
Multiple epidose of cholecystitis		7	14	4	8	11	22
History of previous surgery	upper abdomen	0	0	1	2	1	2
	lower abdomen	3	6	0	0	3	6

Table 5: Hematological findings.

Hematological findings		Laparoscopic cholecystectomy		Converted to open cholecystectomy		Total	
		No.	%	No.	%	No.	%
TLC	<11000	33	66	3	6	36	72
	>11000	9	18	5	10	14	28
ALP	≤N	40	80	6	12	46	92
	>N	2	4	2	4	4	8

Table 6: Ultrasonographic findings.

USG findings	Laparoscopic cholecystectomy		Converted to open cholecystectomy		Total	
	No.	%	No.	%	No.	%
Solitary stone	19	38	3	6	22	44
Multiple stones	23	46	5	10	28	56
Contracted GB	5	10	5	10	10	20
Thickened wall GB (≥5mm)	3	6	3	6	6	12
Pericholecystic fluid collection	4	8	2	4	6	12

Ultrasonographic findings

Ultrasonographic findings of patients considered for this study have been shown in Table 6. All patients were subjected to abdominal sonography. 13.6% (3 out of 22) patients having a solitary stone were converted to OC. Five out of 28 (18%) patients having multiple stones were also converted to OC. 10 patients were found to have had contracted gallbladder and 5 (50%) of them were converted to OC. 4 and 2 of all patients subjected to LC and converted to OC respectively had pericholecystic fluid collection suggestive of acute cholecystitis. 3 out of 6 (50%) patients having a thickened gallbladder (more than 5 mm) were also converted to OC.

Operative findings

Operative findings of patients considered for this study have been shown in Table 7. Duration of performing LC (45-90 min) was lesser than that required for patients being converted to OC (75 - 120 min). 33 patients undergoing LC and 3 converted to OC experienced loss of blood lesser than 50 ml while 9 patients undergoing LC and 5 converted to OC lost more than 50 ml of blood during the surgery. Drains were put in 38 patients of which 30 patients were undergoing LC and 8 patients had been converted to OC.

Table 7: Operative findings.

Operative Findings		Laparoscopic cholecystectomy		Converted to open cholecystectomy		Total	
		No.	%	No.	%	No.	%
Operative time	<45min	14	28	2	4	16	32
	>45min	28	56	6	12	34	68
	Range	45-90 min		75-120 min			
Blood loss	<50 ml	33	66	3	6	36	72
	>50 ml	9	18	5	10	14	28
Drain used		30	60	8	16	38	76

Complications observed in patients

Details of intraoperative complications recorded in patients considered for this study have been shown in Table 8. Multiple complications were encountered in many patients. 5 out of 10 patients having bile leak also had stone spillage. Bleeding at port site and at Calot's triangle was observed in 1 and 7 of all patients respectively. 3 out of 6 patients having frozen Calot's triangle was converted to OC. However, none of the patients revealed vascular injury (due to Trocar and Veress needle) and common bile duct injury.

Table 8: Complications observed in patients.

Complications	Laparoscopic cholecystectomy		Converted to open cholecystectomy		Total	
	No.	%	No.	%	No.	%
Port site bleeding	1	2	0	0	1	2
Bleeding at Calot's	5	10	2	4	7	14
Frozen Calot's	3	6	3	6	6	12
Bile leak	10	20	0	0	10	20
Stone spillage	5	10	0	0	5	10
Vascular injury D/T Trocar and Veress needle	0	0	0	0	0	0
CBD injury	0	0	0	0	0	0

Table 9: Post OP recovery.

Post OP recovery	Laparoscopic cholecystectomy	Converted to open cholecystectomy
Time taken to return of bowel sound (range)	6-15 hours	18-30 hours
Time to resumption of oral feeds (range)	8-18 hours	24-36 hours
Duration of hospital stays (range)	1-3 days	3-5 days
Time taken to return to normal work (range)	6 -8 days	12-15 days

Post-operative recovery

Details of post-operative recovery of all patients have been shown in Table 9. Bowel sound was found to return earlier (less than 6-15 hours) in patients undergoing LC than those converted to OC (18-30 hours). Time taken for resumption of oral feeds was also lesser (8-18 hours) in patients undergoing LC than those converted to OC (24-36 hours). Duration of hospital stay was also less for patients undergoing LC (1-3 days) in comparison to those converted to OC (3-5 days). Patients treated with LC were also found to resume normal work earlier (in 6- 8 days) than those converted to OC (12-15 days).

DISCUSSION

In comparison to OC, LC is a more technically challenging procedure that poses a higher risk of damage of biliovascular structure in course of the process. The present study aimed to identify regular preoperative clinical parameters for prediction of operational complications that may arise while performing LC.

In this study, out of a total of 50 patients admitted over 12 months at the Nehru Hospital, BRD Medical College, Gorakhpur, India, 8 (16%) were converted to OC. As reported by Kumar et al, conversion of LC to OC is usually required for 2-15% of all patients considered for a study.[4] In their own study, Kumar et al and Beksacet et al reported that 7.8% and 7.7% of patients undergoing LC had been converted to OC.[4,5] In a more recent study by Coccolini et al, the average rate of conversion was reportedly 20.87%.[6]

Many studies have also reported a higher incidence of difficult LC and higher rate of conversion to OC in male patients.[7-9] Similar gender bias was also evident in results obtained in this study inspite of the smaller sample size considered. This may be due to the fact that males more frequently suffer from acute and chronic cholecystitis and have higher quantities of intra-abdominal and visceral adipose tissues in comparison to females.[10] According to Goyal et al males are less likely to seek medical attention in comparison to women.[10]

Age is another risk factor widely considered in similar studies.[9,11-13] Few studies have also reported that age above 50, 60 and 65 years act as a risk factor for conversion of LC to OC.[10] Similar results were also found in this study where rates of conversion declined in patients above 40 years of age. This may have had occurred due to prolonged occurrence of gallstones as well as higher incidences of cholecystitis and associated morbidities in patients of older age groups.[10]

Many studies have also reported morbid obesity to pose increased risk of conversion.[10,14-18] Similar results were also reported in this study. Obesity induced thickening of abdominal wall, displacement of canula, deposition of fat in omentum, formation of falciform ligament and heavy liver reportedly causes significant increase of technical difficulty in gaining access to the abdominal cavity and hence necessitating conversion to OC.[10]

Analysis of complaints presented by patients included in this study revealed that 34 out of 50 patients had a past history of biliary colic and occurrence of this factor was accompanied by the highest rate of conversion 14.7% (5 out of 34 patients).

In patients who had experienced pain within 2 to 4 months prior to hospitalization, this could have been due to pericholecystic inflammation causing dense adhesion and subsequent conversion.[19] Results obtained in this study also indicated that 4 out of 11 patients (36.4%) experiencing multiple episodes of acute cholecystitis were converted to OC.

Though acute cholecystitis is usually treated conservatively in the host institute of this study and surgery is postponed till the acute condition is resolved, planning for cholecystectomy is carried out when the patients had revealed subtle features of acute cholecystitis. History of previous surgery especially upper abdominal regions may pose difficulty due to unwanted adhesion around the umbilicus and peri gallbladder area.[10]

One patient considered for this study had a history of previous upper abdominal surgery and was converted to OC due to the presence of dense adhesions. 3 other patients considered for this study had history of lower abdominal surgery, but no conversion was performed.

Many studies have identified raised total leukocyte count (TLC) as a risk factor for predicting conversion.[10] An increase of total leukocyte count may be attributed to acute inflammation of the gall bladder along with oedema which in turn causes difficulties for performing surgery.[10]

Besides, patients having increased TLC in conditions of acute cholecystitis are often found to have a problematical gall bladder.[10] In the present study, 35.7% of patients having a raised TLC (>11000 cells mm^{-3}) had a significantly higher risk of conversion in comparison to 8.33% of patients having TLC lower than 11000 cells mm^{-3}. Previous studies have also reported increased levels of serum alkaline phosphatase (ALP) as a potential risk factor for conversion.[20-23] Similar results were reported in this study. This may be due to the fact that elevated levels of ALP reportedly indicate severe inflammations in the gall bladder.[10]

Results obtained in this study revealed that rates of conversion were higher (18%) in case of 56% of patients having multiple stones in comparison to 13.6% of patients detected with single stone. Impacted stones present at Hartmann's pouch make dissection difficult because of difficulty in holding gall bladder at Hartmann's pouch. Furthermore, thick-walled gallbladder

was also strongly associated with higher conversion rate during LC. Results obtained in this study indicated that thickness of gall bladder exceeding 5 mm lead to difficult grasping of the same due to dense adhesions.

Pre-operative USG had revealed that 10 out of 50 patients considered in this study had contracted gall bladder associated with dense adhesions around the surrounding structures and frozen Calot's triangle of which 5 were converted to OC. Patients with a small contracted or trabeculated gall bladder resulting from heavy stone load and multiple crisscross strictures in the gall bladder lumen, are also candidates at risk where the surgeon would have difficulty in holding the gallbladder.

Edematous, friable or thin walled gall bladders resulting from occurrence of multiple calculi are also difficult to grasp with forceps.[24] However, according to previous studies, maximum difficulty in performing LC was faced in patients having abnormal Calot's anatomy in turn resulting in maximum rates of conversion.[24]

LC has been considered as the ideal treatment for acute cholecystitis. While most of the previous studies were conducted retrospectively and evaluated various risk factors in terms of conversion to OC, this prospective study analyzed various risk factors as pre-operative predictors on the basis of clinical evaluation and ultrasonographic parameters.

Patients undergoing successful LC have reportedly experienced less postoperative pain, shorter operating time and reduced post-operative complications. They are also able to ambulate earlier, allowed earlier oral ingestion and have shorter hospital stay.

However, the sample size considered in this study was too small for drawing final conclusions. Assessment of larger study groups will enable evaluation of these predictors of conversion in acute cholecystitis more accurately.

CONCLUSION

In conclusion, results obtained in this study indicated that advanced age, elevated total white blood cell count and levels of alkaline phosphatase were independent factors associated with higher rates of conversion.

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