

Learning Curve of Laparoscopic Cholecystectomy

Dr. Chetan Sharma¹, Dr. Latika Sharma², Dr. Harsh Bagla*³,
Dr. Amir Hussain Usmani⁴, Dr. Anupam Bhargava⁵, Dr Amit Soni⁶

¹Ex Professor & Unit Head, Department of General Surgery, Dr. Sampurnanad Medical College, Jodhpur, RUHS, India

²Professor & Unit Head, Department of General Surgery, Dr. Sampurnanad Medical College, Jodhpur, RUHS, India

^{3,4,5,6}Resident, Department of General Surgery, Dr. Sampurnanad Medical College, Jodhpur, RUHS, India

ABSTRACT

Background: laparoscopic cholecystectomy can be performed with lower mortality and morbidity, compared with the traditional open surgery. Nevertheless conversion to open surgery may occasionally be obligatory for patients in whom laparoscopic cholecystectomy cannot be performed safely and /or because of technical difficulties or intra operative complications. Preoperative estimation of the risk probability for requirement of conversion to open surgery is important.

Methods: Study was a retrospective type which includes all patients admitted for elective cholecystectomy in single surgical unit over a period of ten year (2004-2013) in department of Surgery, Mahatma Gandhi Hospital, attached to Dr. S.N. Medical College and associated group of hospital Jodhpur.

Results: The conversion rate was 33% in 2005 which fell down to 8% in 2013. The learning curves shows rapid fall in the conversion rate in the initial phase of learning followed by gradual rate of improvement finally leading to a plateau phase.

Conclusions: The conversion rate of laparoscopic cholecystectomy decreased with experience years showing the learning curve with increasing surgical experience.

Keywords: Laparoscopic Cholecystectomy, Learning Curve, Conversion to Open.

INTRODUCTION

Since 1985 lap cholecystectomy has developed rapidly and become the gold standard treatment of various gallbladder diseases. Contrary to the early reports of increased complication rates, recent studies suggest that laparoscopic cholecystectomy can be performed with lower mortality and morbidity, compared with the traditional open surgery. Its benefits over open cholecystectomy include less patient discomfort, better cosmetic results, shorter hospitalization and more rapid return to full activities postoperatively. Nevertheless conversion to open surgery may occasionally be obligatory for patients in whom laparoscopic cholecystectomy cannot be performed safely and /or because of technical difficulties or intra operative complications.

The most common reported reasons for conversion have been inability to perform a safe dissection due to obscure anatomy, inflammation, or adhesion, bleeding and bile duct injuries. Other infrequent factors to result in conversion include unexpected malignancies, inability to create pneumoperitoneum, instrument failure multiple tears in the gall bladder, and common bile duct stones. Conversion from laparoscopic cholecystectomy to open surgery should not be considered as a failure or a complication of laparoscopic operation rather it should be accepted as a step towards safer surgery when completion of laparoscopic cholecystectomy is not possible.

Preoperative estimation of the risk probability for requirement of conversion to open surgery is important.

AIMS AND OBJECTIVES

Aim of the study was:

- To study the learning curve of laparoscopic cholecystectomy in form of changing trend of rate of conversion of laparoscopic surgery into open cholecystectomy with surgical experience.

- To determine the risk factors for conversion of laparoscopic cholecystectomy into open surgery.
- To find causes leading to conversion of laparoscopic cholecystectomy into open cholecystectomy.

MATERIALS AND METHODS

Study was a retrospective type which includes all patients admitted for elective cholecystectomy in single surgical unit over a period of ten year (2004-2013) in department of Surgery, Mahatma Gandhi Hospital, attached to Dr. S.N. Medical College and associated group of hospital Jodhpur.

Patients of all age and both sexes were included.

- Inclusion Criteria :
 - ✓ Patients with symptomatic gallbladder diseases
 - Symptomatic gallstones /GB polyp
 - Acute or Chronic cholecystitis
 - Mucocele/Pyocele of gallbladder
- Exclusion Criteria :
 - ✓ CBD Stone.
 - ✓ Jaundice or abnormal liver function test .
 - ✓ Cholangitis or biliary enteric fistula.
 - ✓ Pregnancy.
 - ✓ Morbid Obesity.
 - ✓ Major bleeding disorder.
 - ✓ Cirrhosis with portal hypertension
 - ✓ Generalized peritonitis.
 - ✓ Patient not fit for general anesthesia.
 - ✓ Preoperative suspicion of gall bladder malignancy.
 - ✓ Patient not willing for laparoscopic surgery.

OBSERVATION

Table: 1 Age Distribution

AGE	SEX		TOTAL
	F	M	
0-30	46	12	58
31-50	109	21	130
51-70	62	23	85
71-90	5	6	11
TOTAL	222	62	284

Of the 284 cases attempted for laparoscopic cholecystectomy 222 were female which was statistically significant (F:M::3.6:1). The most common age group affected was from the 30 years to 50 years(48.77%)

Table: 2: Rate of Conversion

CONVERSION	Frequency	Percent
NO	250	88.03%
YES	34	11.97%
TOTAL	284	100.00%

Of the total 284 cases in 34 cases (11.97%) required conversion. This is the cumulative conversion rate over 10 years.

Table: 3 Cause of Conversion

CAUSE OF CONVERSION	Frequency	Percent
Abnormal Anatomy	6	17.65%
Bleeding	1	2.94%

CBD Injury	0	-
Dense Adhesions	24	70.59%
Suspicious of Malignancy	2	5.88%
Technical Problem	1	2.94%
TOTAL	34	100%

The most common cause of conversion of laparoscopic cholecystectomy into open cholecystectomy was dense adhesion (70.59%), followed by abnormal anatomy (17.65%), suspicion of malignancy (5.88%), bleeding and technical problem (2.94%). None of the cases was converted due to bile duct injury.

Table 4: Conversion Rate in Relation to Previous Surgery

PREVIOUS SURGERY	CONVERSION		TOTAL
	YES	NO	
NO	17	199	216
YES	17	51	68
Total	34	250	284

25% of patient who had history of previous abdominal surgery were converted to open procedure while it was 7.87% in previously non operated patient. The result is extremely statistically significant.

Chi-square = 14.3999 P value = 0.000148

Table 5: Sex Wise Conversion Rate

SEX	CONVERSION		TOTAL
	YES	NO	
F	24	198	222
M	10	52	62
Total	34	250	284

The conversion rate in males was 16.13% in comparison to females in whom patient was 10.81%. The result is statistically not significant.

Chi-square = 1.3007

P value = 0.254086

Table 6: Conversion Rate in Acute V/S Chronic Cholecystitis

DIAGNOSIS	CONVERSION		TOTAL
	YES	NO	
ACUTE CHOLECYSTITIS	13	18	31
CHRONIC CHOLECYSTITIS	16	224	240
Total	29	242	271

13 (42%) of the 31 cases of acute Cholecystitis were complete by open procedure while it was only in 16(7.14%) out of 224 cases for chronic Cholecystitis. The result is statistically significant.

Chi-square=35.7364P Value=0.0001

Table 7: Year Wise Conversion Rate

YEAR	CONVERSION		TOTAL	CONVERSION RATE (%)
	NO	YES		
2004	1	1	1	-
2005	6	3	9	33.33
2006	12	3	15	20.00
2007	23	4	27	14.81
2008	21	3	24	12.50
2009	30	4	34	11.76

2010	36	4	40	10.00
2011	18	2	20	10.00
2012	44	6	50	12.00
2013	59	5	64	7.81
TOTAL	250	34	284	-

The conversion rate for successive years decreased through year 2005 to year 2013 with exception being in 2012 in which it was more than in years 2010 and 2011. Since only 1 case was done laparoscopically in year 2004, it has not been considered. The conversion rate was 33.33% in 2005 which fell swiftly to 12.5% in 2008, Thereafter it had minimal variation till year 2012(12%). Least conversion rate was seen in year 2013 when it was 8%.

DISCUSSION

Of the 284 cases attempted for laparoscopic cholecystectomy in our study, 222 were females (F:M::3,6,1). This observation is also supported by Cholecystectomy **Shaffer EA et al** study which shows that female gender has a most compelling association with gallstone disease, especially during the fertile years.

Of the total 284 cases included in this study over 10 years, 34 years(11.97%) required conversion which is a bit higher than seen in previous studies. The conversion rates decreased with increasing surgical experience. In **Sujit Vijay Sakpal et al** study retrospectively analyzed 2205 Laparoscopic cholecystectomies performed at a large tertiary community hospital over a 52 month period (May 2004 through October 2008) and found conversion occurred in ~5% of all laparoscopic cholecystectomy. In the study of 2284 patients done by **Livingston EH et al** conversion rate to open cholecystectomy was 4.9% in **Sultan Am et al** study conversion to open cholecystectomy was 5.3%.

Notably elderly patients have a higher incidence of severe, acute, and gangrenous cholecystitis as well as an increased incidence of comorbid cardiopulmonary disease, choledocholithiasis, and prior abdominal surgery. This may contribute to the higher conversion rate.

The conversion rate for attempted laparoscopic cholecystectomies in male patients in our study was 16.13% in comparison to female patients with conversion rate of 10.81%. The result is statistically not significant ($P=0.2707$). **Lein HH et al¹** in their study interpreted a conversion rate of 6.4 percent in men and 5.9 percent in women ($P=0.843$). The male gender is associated with a higher likelihood of conversion, which may be due to the more frequent association of pathologically severe disease. Data derived from the National Hospital Discharge database by **Livingston EH et al** revealed that males with acute Cholecystitis incurred a higher risk of conversion (2.5%) than their female counterparts(1.5%). Further. **Tang B et al** and **Ibrahim S et al²** also support higher conversion rate among males.

The most common cause of conversion of laparoscopic cholecystectomy into open cholecystectomy in our study was dense adhesions (70.59%), followed by abnormal anatomy(17.65%), suspicion of malignancy (5.88%), bleeding and technical problem (2.94%). None of the cases in our study was converted due to bile duct injury. Dense adhesion has also been associated with a higher likelihood of conversion in numerous studies as well. **Sujit Vijay Sakpal et al** in their study of 2205 laparoscopic cholecystectomies found dense adhesion as most common reason for conversion to open procedure(40.4%) followed by technical difficulty (22.9%) iatrogenic injury (11%). haemorrhage (6.4%), anomalous biliary anatomy(2.8%), bile leak (2.8%). Usually as a result of prior surgery, especially in the upper abdomen, adhesions occur around the gallbladder, limiting visualization, retraction, and dissection eventually leading to conversion of laparoscopic procedure to open. Similarly in **Sultan AT et al** study the main cause for conversion was dense adhesions (54.7%) as also in our study.

The present study shows conversion to open procedure in 25% of patients who has history of previous abdominal surgery while it was only 7.87% in patients with no history of previous abdominal surgery. The result is extremely statistically significant ($P=0.0004$). The result is supported by many other studies performed earlier like the studies done by **Bouasker et al** **Tang B et al** and **Sujit Vijay Sakpal et al** In our study 13(42%) of the 31 cases of acute cholecystitis were completed by open procedure while it was only in 16(7.14%) out of 224 cases of chronic cholecystitis in this study. The result is statistically significant ($P<0.0001$). Similar result were found in **Ibrahim S et al⁸** study which concluded that the patients who had conversion were mostly men($P=0.0001$), were heavier ($P<0.05$), had acute cholecystitis ($P<0.0001$), and had a history of upper abdominal surgery ($P=0.001$).

In our study over a period of 10 year the conversion rate for successive years decreased through year 2005 to year 2013 with exception being in 2012 in which it was more than in years 2010 and 2011. since only 1 case was done laparoscopically in year 2004, it has not been considered. The conversion rate was 33.33% in 2005 which fell swiftly to

12.5% in 2008. Thereafter it had minimal variation till year 2012(12%) least conversion rate was seen in year 2013 when it was 8%. This depicts the learning curve of laparoscopic cholecystectomy over 10 years which shows rapid fall in the conversion rate in the initial years of learning followed by gradual rate of improvement finally leading to a plateau phase. In the **Livingston EH et al** study over the 52 month study period, 2284 patients underwent cholecystectomy. The annual rate of attempted laparoscopic cholecystectomy ranged from 94.8% (457 of 482 total cholecystectomies) in 2005 which fell to 3.7% (19 of 515 attempted laparoscopic cholecystectomies) in 2006. **Moore MJ et al** described learning curve in form of falling rate of bile duct injuries over time with surgeon's experience. In this study fifty-five surgeon performed 8,839 procedures. Fifteen bile duct injuries (by 13 surgeon) occurred with 90% of the injuries occurring within the first 30 cases performed by an individual surgeon. Multivariate analyses indicated that the only significant factor associated with an adverse outcome was the surgeon's experience with the procedure. A regression model predicted that a surgeon had a 1.7% chance of a bile duct injury occurring in the first case a 0.17% chance of a bile duct injury at the 50th case. **Andrus J. Voitek et al** studied learning curve in form of decreasing operation time with increasing surgical experience. Their results were that there is a 40% decrease ($P < 0.05$) in average operative time over the first 200 operations. Our study is a retrospective study and we had no time records of the surgeries, so cannot analyze our study in this regard.

CONCLUSION

- Of the attempted laparoscopic cholecystectomy cases gall bladder diseases were more common in females than males (3.6:1).
- Incidence of gallbladder diseases was more in age group of 31-50 years.
- The commonest diagnosis was chronic cholecystitis.
- The cumulative conversion rate of laparoscopic cholecystectomy into open cholecystectomy over 10 years was 11.97%
- Conversion rate of laparoscopic cholecystectomy to open cholecystectomy was higher in males (16.13%) than in females (10.81%) but the difference was statistically not significant.
- The most common cause of conversion of laparoscopic cholecystectomy into open cholecystectomy was dense adhesion (70.59%), followed by abnormal anatomy (17.65%), suspicion of malignancy (5.88%), bleeding and technical problem (2.94%). None of the cases was converted due to bile duct injury.
- 25% of patients who had history of previous abdominal surgery were converted to open procedure while it was 7.87% in previously non operated patients. The result was extremely statistically significant.
- 13 (42%) of the 31 cases of acute cholecystitis were completed by open procedure while it was only 16 (7.14%) out of 224 cases for chronic cholecystitis. The result is statistically significant.
- The conversion rate of laparoscopic cholecystectomy decreased with experience years showing the learning curve with increasing surgical experience. The conversion rate was 33% in 2005 which fell down to 8% in 2013. The learning curves shows rapid fall in the conversion rate in the initial phase of learning followed by gradual rate of improvement finally leading to a plateau phase.

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