ORIGINAL ARTICLE

Ten-point Strategy for Safe Laparoscopic Cholecystectomy: A Prospective Study

Ashok K Yadav[1], Jeevan Kankaria[2]

Abstract

Aims/objectives: To devise a 10-point strategy for performing safe laparoscopic cholecystectomy (LC), share experience of 8,000 patients without any conversion to open procedure by adopting the strategy, and assess its effectiveness.

Materials and methods: A total of 8,000 patients were prospectively analyzed during 2007 to 2017. A point was assigned to a specific finding intraoperatively. Patients were divided into three groups based on the points. Anatomical variations, time of surgery, intraoperative/postoperative complications were plotted for three groups, and statistical significance was calculated.

Results: In this study, 63.5% of patients were female. No case of conversion to open cholecystectomy (OC) was found. The youngest and oldest patients were 2 and 109 years old, respectively. Mortality, negligible morbidity, or significant complications were not observed. Group I (1–4 points) had high-risk patients, and lowest safety, and group III (8–10 points) had low-risk patients, and highest safety, and group II (5–7 points) had with equivocal numbers.

Conclusion: Laparoscopic cholecystectomy was performed keeping these 10 points in mind with patience and precautions. Chances of conversion to open surgery can be reduced to zero, with minimal complications. The study suggests that in case of difficult anatomy, go gentle and slow to safeguard from injuries.

Keywords: Cholelithiasis, Conversion to open, Gallbladder stones, Laparoscopic cholecystectomy.

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Introduction

Gallbladder (GB) diseases are few of the commonest biliary tract diseases[1,2] and surgical conditions requiring intervention worldwide.[3,4] Laparoscopic cholecystectomy (LC) was introduced nearly 3 decades ago, and since then, it has become the gold standard;[5,6] nearly 90% cholecystectomies are laparoscopically performed.[7,8] Patient- or surgeon-related multiple factors can lead to various complications and conversion to open cholecystectomy (OC).[4,9,10] An OC is often performed for patients with GB mass or suspicion of GB malignancy, late third trimester of pregnancy, previous upper abdominal surgeries, >60 years of age, male sex, diabetes, history of endoscopic retrograde cholangiopancreatography, dilated common bile duct (CBD), and GB status; it is also performed when the laparoscopic approach fails.[7,11,12] Despite the experience, complication rates are higher with LC than OC, but those with OC are increasing due to decreased exposer to open procedure.[7,8,13,14]

During laparoscopic procedure, complication rates can be reduced with proper care and caution.[11,15] As a surgeon's experience increases, complication and conversion rates decrease.[11,16]

This study aimed to share the experience of surgeons while performing safe LC and points to consider in order to decrease complication and conversion rates.

Materials and Methods

This is a prospective study of LC performed in 8,000 patients by a chief surgeon and under his supervision during 2007 to 2017 at SMS hospital, Jaipur, India. The SMS hospital's surgical center performs cholecystectomy using laparoscopy, except for few special cases where OC is beneficial. The center has eight surgical units, and the study was conducted by one unit only. In this unit, nearly 15 laparoscopic cholecystectomies are performed per week. Approval was obtained from Institutional Ethical Committee before initiating the study.

Most of the patients were admitted for elective procedure. Patients with symptoms of acute cholecystitis were either operated within 2–3 days of presentation or 6 weeks after the resolution of symptoms. Detailed history of the onset of symptoms, duration, and progression was obtained. Patients were subjected to routine blood tests, including complete blood count, liver function test, kidney function test, serum electrolytes, HIV, HBSAg, HCV, bleeding time, clotting time, prothrombin time, and the international normalized ratio. Serum amylase and lipase were evaluated to rule out pancreatitis, and serum alkaline phosphatase was evaluated to rule our biliary obstruction. Imaging studies, such as ultrasonography (USG), were performed. In some doubtful cases, magnetic resonance cholangiopancreatography (MRCP) and computed tomography scans were performed to look for other pathology. Those detected with CBD stones in USG were subjected to MRCP and endoscopic retrograde cholangiopancreaticography (ERCP) for stone clearance and operated after 6 weeks.

[1,2]Department of Surgery, SMS Hospital, Jaipur, Rajasthan, India

Corresponding Author: Ashok K Yadav, Department of Surgery, SMS Hospital, Jaipur, Rajasthan, India, Phone: +91 9549079488, e-mail: ashok.yadavmd@gmail.com

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Patients were monitored postoperatively for hospital stay, pain, nausea, vomiting, oral intake, and other complications.

Ten-point Strategy

A ten-point strategy was devised to perform LC based on visible anatomy on entering the abdomen; points were assigned as shown in Table 1. After creating pneumoperitoneum and placement for camera port, peritoneal cavity was properly inspected to rule out other pathology. Remaining ports were then placed, and a patient was positioned in slight right lateral and head up position. Gallbladder fossa was inspected after removing or retracting omentum and gut from the fossa. First, we examined the CBD for proper visualization; three points were assigned if surgery was expected to be performed safely. If the CBD was not visualized, no points were assigned. Presence of adhesions led to non-visualization of the CBD. If the CBD was visualized after the dissection of adhesion, three points were given. Based on the ease of dissection, adhesions were categorized as minimal and dense. The CBD is the most important duct that needs to be protected, and its safety is paramount because most dreaded complication of cholecystectomy is the CBD injury; thus, most weightage was given to the CBD by assigning three points. Second, Rouviere sulcus was considered. If the dissection was possible above the sulcus, one point was given. If the sulcus was not visible due to adhesions or absence but safe dissection was possible by holding the infundibulum/Hartman pouch, then one point was given. Third, while holding the infundibulum/Hartman pouch, the anatomy of cystic duct and artery and Calot's triangle was assessed. Presence of aberrant artery or variations in cystic duct and artery were confirmed. If the two structures were seen entering GB on inspection, then one point was assigned. If there were variations in anatomy or if the two structures were not visible clearly due to adhesion or variation, no point was assigned. Fourth, after confirming the above parameters, dissection of the Calot's triangle was initiated. Anterior dissection was initiated first in the majority of the patients to clear Calot's triangle. It included dissection around the cystic duct and artery and lymph node (LN) of Lund while clearing the peritoneum and soft fibrofatty tissue around the duct and artery. Posterior dissection was similarly followed to dissect the peritoneum and soft fibrofatty tissue to clear the duct and artery. If the two structures were clearly visible and free of fibrofatty tissue, Calot's triangle was considered cleared and two points were assigned. If due to adhesions or anatomical variation Calot's triangle was not cleared as described, no point was assigned. Fifth, posterior dissection was extended further toward cholecystic plate.

Table 1: Ten-point distribution

CBD visualized	3
Dissection above Rouviere sulcus	1
Two structures entering into GB, cystic duct, and cystic artery exposed	1
Calot's triangle clear	2
1/3 of cholecystic plate cleared	2
Elephant head appearance	1
Total	10
1–4	Low safety
5–7	Equivocal safety
8–10	Safe cholecystectomy

One-third of cholecystic plate was cleared by rule in all patients, and two points were assigned. If one-third cholecystic plate was not cleared, no point was assigned. Sixth, following all the aforementioned dissection, a rule was made to lift and gently pull the infundibulum to give it an appearance of Lord Ganesha or elephant head; seeing this sign, one point was assigned. If the Lord Ganesha sign was not there due to adhesions or obliteration of Calot's triangle, no point was assigned.

In all the patients, these 10 points were collectively calculated, and the three groups were made. In group I with 1–4 points, the surgery was considered risky; in group II with 5–7 points, the surgery was considered somewhat risky; and in group III with 8–10 points, the surgery was considered safe.

Results

Throughout the study, no significant complications were recorded. Tables 2 and 3 show age and sex distribution in all the three groups. Table 4 shows various etiologies for which LC was performed. Not a single case of conversion to OC was found. Complications that occurred while performing the surgery and the subsequent treatments are discussed in Tables 4 and 5.

Complication were divided into intraoperative and postoperative periods. No mortality occurred, and morbidity was negligible.

Different variables were analyzed and compared considering the three groups. Anatomical variations (Table 5 and Fig. 1), such as presence of adhesions, obliteration of Calot's triangle, contracted GB, presence of mucocele, and free-floating GB, were analyzed.

Table 2: Distribution of age according to three groups

	Mean age	
Total points	*Mean*	*SD*
1–4	34.51	12.06
5–7	31.09	10.09
8–10	32.72	11.64

Table 3: Distribution of sex according to three groups

	Sex			
Total points	*Male*	*(%)*	*Female*	*(%)*
1–4	176	2.2	384	4.8
5–7	392	4.9	640	8
8–10	2,352	29.4	4,056	50.7
Total	2,920	36.5	5,080	63.5

Table 4: Diagnoses included in study

Diagnoses	*Group I (1–4)*	*Group II (5–7)*	*Group III (8–10)*
Acute cholecystitis (ACC)	80	160	100
Chronic cholecystitis (CCC)	400	320	1,120
Gallstone pancreatitis (GSP)	80	160	480
Empyema (EMP)	0	320	640
Symptomatic GB stone (SGBS)	0	80	960
Asymptomatic GB stone (AGBS)	0	0	1,360
GB polyp (GBP)	0	0	1,040

Table 5: Anatomic variation

Variation	*Group I (1–4)*	*Group II (5–7)*	*Group III (8–10)*	*χ^2 test with 2° of freedom*	*p value*
No adhesions	0	160	3216	885.483	0.0000 (s)
Minimal adhesions	160	330	992	211.961	0.000 (s)
Dense adhesions	400	320	80	3390.843	0.000 (s)
Calot's triangle obliterated	320	240	160	1888.098	0.000 (s)
Contracted GB	280	200	160	1637.966	0.000 (s)
Mucocele	80	240	440	253.480	0.000 (s)
Free floating GB	0	320	320	83.333	0.000 (s)

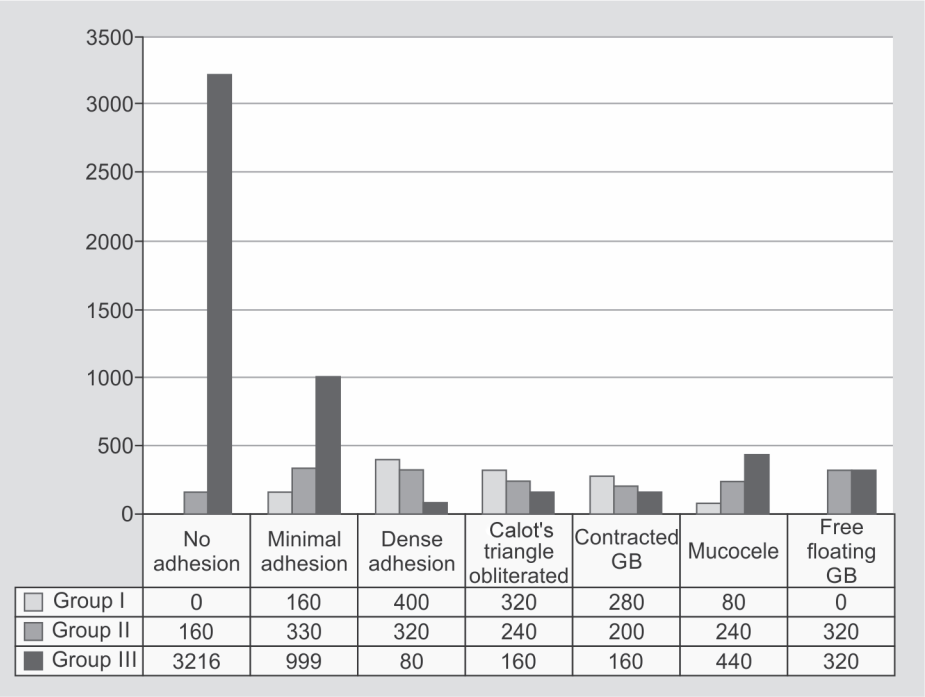

Fig. 1: Showing anatomic variation

Table 6: Duration of surgery

Duration	*Group I (1–4)*	*Group II (5–7)*	*Group III (8–10)*	*χ^2 test with 2° of freedom*	*p value*
<45 minutes	0	160	5,200	2977.907	0.000 (S)
45–90 minutes	160	640	1,200	877.656	0.000 (S)
>90 minutes	400	240	0	3938.844	0.000 (S)

The timing of surgery was evaluated to know which group needed more time for safe surgery (Table 6 and Fig. 2).

Intraoperative complications were evaluated in the three groups as shown in Table 7.

This ten-point strategy was followed in all the surgeries. So, in cases of difficult anatomy, the surgeon slowly and gently performed the surgery to properly delineate the anatomy. These 10 points can be followed, and injuries can be safeguarded.

Comparing the three groups, maximum number of patients with complicated anatomy were present in group I followed by group II, whereas group III included most patients with simple anatomy. Group I needed more time to perform the surgery safely because of the presence of complicated anatomy; in this case, group I was followed by group II. Maximum number of surgeries in group III were performed within stipulated time of 45 minutes.

Analyzing the complication rates in all the three groups showed that group I had maximum number of cases with complications and group III had the least number of complications, whereas group II was in-between. This shows that if LC is performed considering the aforementioned steps and the 10-point strategy, the surgery would be safe. Also, as the points go up, the chances of safe surgery go up (Table 8).

Discussion

The present study shows the author's experience as a chief surgeon performing LC, in a teaching hospital, over a period of 10 years.

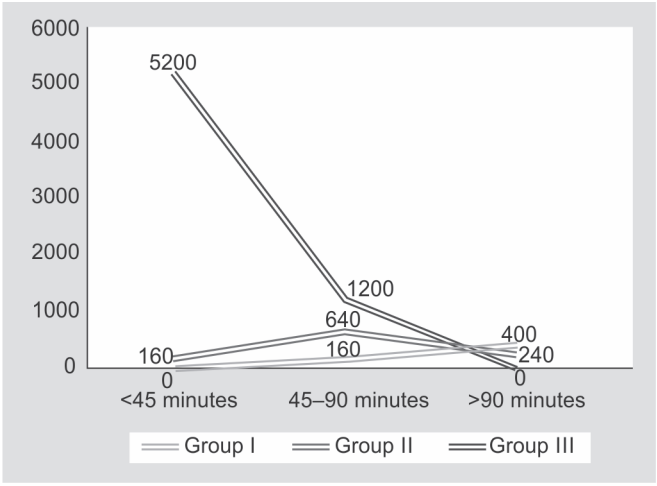

Fig. 2: Duration of surgery

Table 7: Intraoperative complications

	Groups		
Complications	*1–4*	*5–7*	*8–10*
Perforation of GB	147	63	30
Stones spilled	80	0	80
Spilled bile	80	80	80
Soiling of wound by bile/stones	166	83	71
Slipped cystic duct ligature	16	10	0
Cystic artery bleeding	28	13	2
Bowel injury	0	0	0

Chi-square = 147.323 with 12° of freedom; $p = 0.000$ (S)

Table 8: Postoperative complications

	Groups		
Complications	*1–4*	*5–7*	*8–10*
Excess pain	131	100	82
Prolonged drainage	20	3	0
Prolonged ileus	0	0	0
Nausea/vomiting	160	330	962
Subhepatic collection	5	6	3
Wound infection	163	81	13
Postoperative fever	81	81	87
Jaundice	0	0	0
Retained stones	4	4	0

Chi-square = 622.554 with 16° of freedom; $p = 0.000$ (S)

While performing the surgery, it is suggested that a surgeon follows the ten-point strategy and goes step by step and in case of difficult anatomy, performing the dissection gently and slowly to delineate anatomy and safeguard from injuries is advisable. By this approach, even the GB with the most difficult anatomy can be removed with laparoscopy without converting it into OC.

Laparoscopic cholecystectomy has become the gold standard for the removal of GB.[17] With increased use of LC, it is obvious that certain complications rarely seen with OC are more frequent with LC. These complications included intestinal and vascular injuries from trocar or Veress needle insertion and major bile duct injuries.[18–20]

This study also shows that if LC is performed with patience, complication rates can be reduced to minimal and conversion rates can be reduced to zero.

Bile duct injury is one of the most dreaded complications during LC than in OC.[21–23] In the infancy of LC, a CBD injury occurred more frequently during LC than OC. Although the incidence of CBD injury during LC is no longer as high as it was initially, it still exceeds that of OC (0.1–0.5 in LC vs 0.2% in OC).[24] Risk factors for a CBD injury are lack of experience (learning curve), misidentification of biliary anatomy, intraoperative bleeding, lack of recognition of anatomical variation of biliary tree, and improperly functioning instruments. Other factors are acute and chronic cholecystitis, empyema, long-standing recurrent disease, advanced age, obesity, and previous surgery.[24,25] Considering the factors, in mind we assigned three points in the strategy.

There are few steps that need to be followed during LC to avoid complication rates. The critical view of safety introduced by Professor Steven Strasberg is one of the important landmarks. Several studies confirm that using these techniques routinely eliminates chances of complication, such as CBD injury. Clearing the fibrofatty tissue from Calot's triangle, freeing up the lower third of the GB from the liver bed/cystic plate, and confirming that the only two structures are seen entering the GB are three requirements for the critical view of safety. No tubular structure duct should be clipped and divided unless the critical view of safety is achieved.[26,27]

Always use 30° telescope with HD camera or good endovision system.[28] While entering the port, first visualize where and how the CBD is located (create a rough image in mind).[29] Retraction of fundus applies a firm cephalic and lateral traction on the fundus and infundibulum, respectively, so that the cystic duct is perpendicular to the CBD.[29] Separation of omental adhesions—Always from the CBD toward fundus.[30] Use cystic LN of Lund as valuable landmark for identifying cystic artery. Use Rouviere's sulcus as valuable anatomical landmark for LC.[31] Always dissect near the GB. Perform anterior dissections for ease of process or on complementary basis but as a rule, always do perform posterior dissection before clipping of cystic artery and duct.

Perform posterior dissection with clearance of cholecystic plate at least 5 cm. The GB–duct junction is fully mobilized to give the "elephant head" appearance. Clarify Calot's triangle.[30] Check again and again, to delineate the curvature of infundibulum and cystic duct for removing the possibility of CBD. Any vessel that pulsates before cutting is hepatic artery, and the one which pulsates after cutting is cystic artery. Follow Strasberg's rule of "Critical View of Safety". Clear the stones from the cystic duct. Apply clips on cystic duct and artery separately and never together. Cut cystic duct and artery using only scissors and not any kind of energy sources. If bleeding occurs then keep your patience; never use any type of energy sources until the clearance of structures. It is better to stop the bleeding using gauze piece, wait patiently. Always recheck the area of the CBD after removal of GB (to see any bile leek, bleeding, or even clip dislocation). Use cholangiogram or indocyanine green (ICG) dye in doubt, if facilities are available. Perform partial cholecystectomy and save the life of the patient instead of risking it, whenever there is a doubt.[32] Never hesitate to convert into open surgery whenever necessary; the life of a patient is worth more than a surgical challenge.[26,33–37]

Conclusion

The study reveals the experience of surgeons of performing LC step by step by considering the aforementioned 10 points. Moreover, the study suggests that in case of a complicated anatomy, surgeons should be gentle and slow during the dissection and reconsider the 10 points to delineate proper anatomy and safeguard from injury.

This study suggests that if LC is performed with precaution and patience, the chances of conversion to open surgery can be reduced to zero. Meticulously performing the surgery reduces complication rates to minimal. When cholecystectomy is performed with due care, caution, safety, and standardized techniques, complications can be reduced.

This study has discussed a ten-point strategy along with some simple steps to perform LC safely. The study suggests that every surgeon must include these steps in their practice.

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