

## Comparative study of conventional open versus laparoscopic cholecystectomy for symptomatic cholelithiasis

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### ABSTRACT

**Objective:** To compare the results of conventional open with laparoscopic cholecystectomy regarding their operative time and postoperative parameters.

**Methodology:** This is a comparative study of 400 patients of cholelithiasis operated for either open or Laparoscopic cholecystectomy during five years from January 2004 to December 2008. The cases were compared for operative time and various postoperative parameters in order to assess the advantages and disadvantages of each procedure. The patients were divided into two groups, group OC for open and group LC for laparoscopic cholecystectomy, each comprising of 200 cases.

**Results:** The operative time was longer in OC than LC patients with mean operative time of 54.16± 11.94 minutes in OC and 46.89±14.83 minutes in LC group (P<0.001). The overall frequency of postoperative complications was relatively high in OC group 50.5% as compared to LC (37%) including all minor and major problems with combined morbidity of 43.75% (P<0.001). The mean hospital stay was shorter in LC group as compared to OC group i.e. 3.02±1.75 (range 1-5) days versus 5.56±9.8 (range 4-10) days respectively. Return to normal work was also significantly shorter in LC group i.e. 18.06±5.16 days (range 1-4 weeks) as compared to 31.61±7.6 days (range 3-6 weeks) in OC group with p value <0.001.

**Conclusions:** The laparoscopic cholecystectomy is superior to open cholecystectomy due to short operative time, early mobilization and fast recovery, less postoperative pain and complications, short hospital stay and early return to work.

**KEY WORDS:** Cholelithiasis, Cholecystectomy, Laparoscopic, Conventional, Comparison.

Pak J Med Sci January - March 2011 Vol. 27 No. 1 33-37

### How to cite this article:

Talpur KAH, Malik AM, Sangrasi AK, Memon AI, Leghari AZ, Qureshi JN. Comparative study of conventional open versus laparoscopic cholecystectomy for symptomatic cholelithiasis. Pak J Med Sci 2011;27(1):33-37

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- \* Received for Publication: August 23, 2010
- \* Revision Received: October 6, 2010
- \* Revision Accepted: October 8, 2010

### INTRODUCTION

Gall stones disease is the commonest biliary pathology<sup>1</sup> affecting females predominantly all over the world. The prevalence of disease varies from 15-25 % in U.K, U.S.A. and Australia whereas it is rare in Africa involving less than 1% of population.<sup>2</sup> Cholecystectomy, open or laparoscopic is one of the common operations performed in surgery.

Open cholecystectomy was the gold standard for past 100 years<sup>3</sup> and now the laparoscopic cholecystectomy is considered as first option for cholelithiasis.<sup>4,5</sup> Traditional biliary surgery has undergone some changes from conventional open to minilaparotomy cholecystectomy<sup>6</sup> but since the

introduction of laparoscopy into general practice in 1990<sup>7</sup> the surgical treatment of gallstones is changed and therefore elective laparoscopic cholecystectomy has almost replaced the open procedure.<sup>8</sup>

About 70-80% of cholecystectomies are done laparoscopically<sup>9</sup> where as 20-30% are still completed by open cholecystectomy<sup>4</sup> often performed in elderly patients, cardiopulmonary compromised patients and patients with complicated gallstones where laparoscopic procedure is not feasible.<sup>10</sup> However it can safely be performed in cirrhotic patients<sup>11</sup> and in cases of acute cholecystitis<sup>12</sup> by experienced surgeon. Also clinically and financially laparoscopic cholecystectomy has advantages over open cholecystectomy<sup>13</sup> and has become popular alternative to open procedure<sup>14</sup> due to many advantages including shorter operative time, early recovery, short hospital stay, low morbidity, and low cost.<sup>15</sup> This study will emphasize various operative and postoperative parameters of the two procedures in order to assess the better surgical option for patients with cholelithiasis. The criteria to be assessed was operative time, mobilization, recovery time, postoperative pain and complications, hospital stay and duration of return to normal work.

### METHODOLOGY

This is an observational comparative study conducted at the department of surgery Liaquat University of Medical and Health Sciences, Jamshoro for period of five years from Jan. 2004 to Dec. 2008. All diagnosed cases of cholelithiasis admitted from outpatient department were included in the study. The criteria for selection of procedure either open conventional or laparoscopic cholecystectomy were decided on choice of patient, presentation of gallstone disease (simple or complicated), obesity and associated comorbid conditions of patients. Usually the cases above the age of 65 years, having compromised cardio-respiratory status and patients with complicated gallstone disease were preferred for open cholecystectomy. The cases with medical or surgical jaundice, pancreatitis, and suspected or proven gallbladder malignancy were excluded from study.

The patients were given verbal and written information concerning the type of operation along with details of their intra and postoperative complications, expected hospital stay and convalescence.

The patients were divided into two groups one for open cholecystectomy (OC) and other for laparoscopic cholecystectomy (LC) comprising equal number of cases. The results of each procedure were recorded on a special proforma designed according

to the objectives of study.

The open cholecystectomy was performed with Kochers subcostal incision or transverse minilaparotomy incision whereas laparoscopic procedure was done with standard four ports technique. Every patient was encouraged for early mobilization and necessary analgesia was given in form of non steroidal anti inflammatory drugs and opioid derivatives whatever required according to severity of pain. The data was evaluated in statistical programme SPSS version 16.0. The recode option was used for numerical parameters and was categorized Pearson's chi square test was applied for categorical variables on 95% confidence interval. P value <0.05 was considered as level of significance.

### RESULTS

All 400 patients of cholelithiasis included in the study were divided into two groups (OC & LC) each comprising of 200 cases. More cases preferred open cholecystectomy in early years of study when patients were reluctant for laparoscopic procedure, however later on majority of cases preferred laparoscopic cholecystectomy.

Female to male ratio observed was 6.4:1 in OC and 8:1 in LC group. Age ranged from 10-80 years in both groups with mean age of 45.56 ± 12.18 years in OC and 37.64 ± 9.08 years in LC group. There was no major difference in clinical presentation of both groups and majority presented with upper abdominal pain (pain in right hypochondrium), dyspepsia and nausea and vomiting. Ultrasound revealed multiple stones in 77.5% of cases in OC and 76% in LC group.

Table-I: Operative time & Postoperative pain.

Parameter	OC n = 200 (%)	LC n = 200 (%)	P value
<i>Operative time:</i>			
30 Minutes	17 (8.5%)	45 (22.5%)	<0.001
45 Minutes	53 (26.5%)	73 (36.5%)	
60 Minutes	78 (39.0%)	55 (27.5%)	
75 Minutes	32 (16.0%)	15 (7.5%)	
90 Minutes	20 (10.0%)	12 (6.0%)	
<i>Severity of Pain:</i>			
Mild	29 (14.5%)	99 (49.5%)	<0.001
Moderate	98 (49.0%)	78 (39.0%)	
Sever	73 (36.5%)	23 (11.5%)	
<i>Mean Operative Time:</i>			
	OC = 54.16 ± 11.94 minutes, LC = 46.8.9 ± 14.83 minutes.		
<i>Median Operative Time:</i>			
	OC = 50.02 minutes, LC = 43.15 minutes.		

Operative time was significantly longer in OC group. 45 to 95 minutes in 91.5% as compared to LC group where it ranged from 30-60 minutes in 86.5% of cases with mean operative time of  $54.16 \pm 11.94$  minutes in OC and  $46.89 \pm 14.83$  in LC group (Table-I). Similarly postoperative pain was of moderate to severe nature in OC group (85.5%) in comparison to LC group where it was of mild to moderate nature in 88.5% of cases (Table-II).

Frequency of postoperative complications assessed was also higher in OC group as compared to LC group (Table-II). The general complications like nausea and vomiting, chest infections, bleeding and biliary leak was seen in both groups with relatively higher incidence in OC patients. However wound sepsis (13.5%) was particular problem of OC group and port-site sepsis (6.5%) and shoulder pain (5.5%) were specific complications related to LC group. Two cases (1%) of LC group required conversion to open cholecystectomy due to uncontrollable bleeding from cystic artery where as re-exploration was required in (1%) of cases in OC and 1.5% of LC group. The postoperative bleeding observed from drain was minor and stopped within 24-48 hours. Overall morbidity assessed in both groups including minor and major complications was 43.75% (OC=50.5% VS LC=37%).

Table-II: Mobilization Time and Postoperative Complications.

Parameter	OC n=200 (%)	LC n=200 (%)	P value
<i>Mobilization time:</i>			
4-8 hours	13 (6.5%)	32 (16.0%)	<0.001
9-12 hours	30 (15.0%)	61 (30.5%)	
13-16 hours	47 (23.5%)	81 (40.5%)	
17-20 hours	76 (38.0%)	17 (8.5%)	
21-24 hour	34 (17.0%)	9 (4.5%)	
<i>Complications:</i>			
Nausea & vomiting	27 (13.5%)	15 (.5%)	<0.001
Chest infection	19 (9.5%)	12 (6.0%)	
Bleeding	17 (8.5%)		
Wound Sepsis	27 (13.5%)	11 (5.5%)	
Port-site sepsis	0	13 (6.5%)	
Conversion to open	0	2 (1.0%)	
Re-exploration	2 (1.0%)	3 (1.5%)	
Biliary leak	9 (4.5%)	7 (3.5%)	
	(with CBD injuries 2 cases)	(with CBD injuries 3 cases)	
Shoulder pain	0	11 (5.5%)	

\* Post operative morbidity in OC 50.5% and in LC 37%.  
 \* Over all morbidity in both groups 43.75%  
 \* CBD common bile duct

The hospital stay (Table-III) was significantly longer for OC patients ranging from 4-10 days (91%) as compared to laparoscopic group where it was One to five days (94.5%). The mean hospital stay was  $5.56 \pm 2.98$  days in OC and  $3.02 \pm 1.75$  days in LC group. Nine cases (4.5%) in OC group remained for 15-30 days where as 10 cases (5%) in LC group for 6-15 days due to either major complications or re-exploration. The return to normal work was early in LC group where majority of patients (98.5%) resumed their job in one to four weeks however in OC 96.5% joined there job in three to six weeks with mean resumption time of  $31.61 \pm 7.6$  days in OC and  $18.06 \pm 5.16$  days in LC group.

### DISCUSSION

The principle variables of present study which will help to analyze the efficacy of each procedure are operative time and postoperative parameters like pain, early mobilization, complications, hospital stay and duration of resumption to work. The prevalence of gallstones in females of western countries is about twice to that of males<sup>2</sup> which is lower than present study. The sex ratio found in this study was 6.4:1 (86.5%: 13.5%) in OC and 8:1 (89%: 11%) in LC group however sex ratio observed by Iqbal J. et al<sup>16</sup> in their

Table-III: Showing Hospital Stay & Return to Work.

Parameter	OC n=200 (%)	LC n=200 (%)	P value
<i>Hospital stay:</i>			
1 day	0	33 (16.5%)	<0.001
2 day	0	51 (25.5%)	
3 day	9 (4.5%)	65 (32.5%)	
4 day	85 (42.5%)	27 (13.5%)	
5 day	53 (26.5%)	13 (6.5%)	
6 day	19 (9.5%)	5 (2.5%)	
7 day	16 (8.0%)	3 (1.5%)	
10 day	9 (4.5%)	0	
15 day	5 (2.5%)	2 (1.0%)	
20 day	3 (1.5%)	1 (0.5%)	
30 day	1 (0.5%)	0	
<i>Return to work:</i>			
1 week	0	25 (12.5%)	<0.001
2 weeks	7 (3.5%)	69 (34.5%)	
3 weeks	35 (17.5%)	81 (40.5%)	
4 weeks	83 (41.5%)	22 (11.0%)	
5 weeks	47 (23.5%)	3 (1.5%)	
6 weeks	28 (14.0%)	0	

*Mean Hospital Stay:*

OC =  $5.56 \pm 2.98$  days,  
 LC =  $3.02 \pm 1.75$  days.

*Mean Resumption time:*

OC =  $31.61 \pm 7.6$  days,  
 LC =  $18.06 \pm 5.16$  days.

study was 13.5:1 (93.10%:6.9%) for OC and 10.19:1 (91.06%:8.94%) for LC patients. The frequency of gall stone formation increases with age so that between 50 and 60 years of age about 20% of women and 5% of men are affected.<sup>17</sup> In our study high incidence was seen in 3<sup>rd</sup> to 6<sup>th</sup> decade in OC group with mean age of 45.56 ± 12.18 years where as 3<sup>rd</sup> to 5<sup>th</sup> decade with mean age of 37.64 ± 9.08 years in LC group which shows higher mean age in OC group. Same high incidence has been shown by Rosen muller M et al<sup>18</sup> 59 years for OC and 49 years for LC group and Meyer C et al<sup>10</sup> 60 years for OC and 54 years for LC group.

Mean operating time was 54.16 ± 11.94 minutes for OC and 46.89 ± 14.83 minutes for LC with range of 30-90 minutes in both groups (P< 0.001). However in OC group operative time utilized was longer than LC groups (45-90 minutes in 91.5% for OC V/S 30-60 minutes in 86.5% for LC). This is contrary to other studies which shows longer operative time in LC group patients.<sup>8,10,19-22</sup> The median operative time utilized was 50.02 minutes for OC and 43.15 minutes for LC group which is shorter as compared to study of Johansson M et al<sup>8</sup> (OC = 80 V/s LC = 90 minutes).

Patients with open cholecystectomy looks more ill<sup>17</sup>, feel more pain and have delayed recovery as compared to laparoscopic cholecystectomy where they have minimum surgical stress, less postoperative pain, fast recovery<sup>15,22</sup> and early gastrointestinal motility and feeding.<sup>24</sup> In this study majority of cases (85.5%) of OC group felt moderate to severe pain and have late recovery as compared to LC group where 88.5% felt mild to moderate pain (P<0.001) with fast recovery and early mobilization and therefore need of postoperative analgesia was less in LC group. Same has been found in other studies conducted by Jan YY and Chen MF<sup>25</sup> and Buanes T and Mjaland O<sup>26</sup> and Gondal SH et al.<sup>27</sup> The mobilization time ranged from 9-24 hours in 93.5% cases of OC and 4-16 hours in 87% cases (P<0.001) of LC group. Similar results has been found by Porte RJ and De Varies BC in their study.<sup>28</sup>

The Postoperative morbidity due to various major and minor complications was found higher in OC as compared to LC group (OC=50.5% V/s LC=37%). Overall morbidity in both groups was 43.75% (P<0.001) which is quite high as compared to Leo Jonas et al<sup>29</sup> (6%). The rate of postoperative complications given by Jan YY and Chen MF<sup>25</sup> (LC=4.4% V/s OC=2.2%) and by Buanes T and Mjaland O<sup>26</sup> [(LC=9% V/s OC=16% (P<0.01))] is also less than present study. The wound sepsis assessed in OC was

13.5% as compared to LC group (6.5%) which is two times higher than LC group. However frequency of wound infection given by Siddiqui K and Khan AF<sup>30</sup> in their study for cases of acute cholecystitis and empyema is three times higher in OC as compared to LC patients. The bleeding (OC=8.5% Vs LC=5.5%) and biliary leak (OC=4.5% Vs LC=3.5%) were the complications responsible for re-exploration [OC=2 cases (1%) V/s LC=3 cases (1.5%)] and conversion [2 cases (1%) from LC to OC] of the patients. The conversion rate from LC to OC varies from 3.9% to 12% as given in different studies.<sup>7,28,16,31</sup> In cases of biliary leak two patients of OC and three of LC group had common bile duct injury. The bile duct injury given by Ros A et al<sup>22</sup> was one case in each group in his study.

Laparoscopic cholecystectomy is associated with a shorter hospital stay and quicker convalescence as compared to classical open cholecystectomy.<sup>3</sup> The hospital stay in this study ranged from 3-30 days in OC and 1-20 days in LC with mean length of hospitalization as 5.56 ± 2.98 days in OC and 3.02 ± 1.75 days in LC group (P 0.001). It is comparable to other studies given by different authors like 5.1 days in OC Vs 2.5 days in LC<sup>7</sup>, 7.9 days in OC Vs 2.6 days (P<0.001) in LC<sup>10</sup>, 6.5 ± 3 days for OC and 2.0 ± 2 days for LC.<sup>31</sup>

Return to normal work extended from three to six weeks in OC and 1-4 weeks in LC group in majority of cases [OC=96.5% Vs LC 98.5% (P<0.001)]. Mean resumption time to work was 31.61 ± 7.6 days for OC and 18.06 ± 5.16 days for LC patients. This shows early return to job in LC as compared to OC group. Return to normal work given by Supe ANN et al<sup>21</sup> in their study was 19.5 ± 5.4 days for minicholecystectomy and 91.1 ± 3.2 days for LC group. The sick leave time given by Buanes T and Mjaland O<sup>26</sup> is 28 days (18 to 48 days) for OC and 10 days (2-21 days) for LC patients. This duration is shorter as compared to our study which may be due to reluctancy of our patients to join their duty after any operation. Over all time of return to normal activity and work is shorter in LC as compared to OC patients which is also supported by other studies<sup>19,21,31,32</sup> published in literature.

## CONCLUSION

This study concludes that LC is superior than OC in many respects like short operating time, early mobilization, less postoperative pain, less postoperative complications, short hospital stay and early return to job.

**Disclosure statement and conflict of interest:**

Authors have no financial interest in any commercial device, equipment, instrument or drug that is a subject of the article.

**Authors Contribution:**

KAH Talpur conceived, designed and did statistical analysis & editing of manuscript. AM Malik, AK Sangrasi, AI Memon & AA Leghari did data collection and manuscript writing. JN Qureshi reviewed and approved the final manuscript.

**REFERENCES**

- Conlon K. The gallbladder and bile ducts. In Russel RCG, Williams NS, Bulstrode CJK editors. Baily and loves short practice of surgery 25<sup>th</sup> ed Arnold international students edition 2008;2:1119.
- Cuschieri AS. Disorders of biliary tree. In Cuschieri AS, Steele RJC, Moosa AR editors. Essential. Surgical Practice, 4<sup>th</sup> ed, Arnold Euston Road London NW 2002; 13 BH;II(I):406.
- Keus F, De Jong JA, Gooszen HG, Van Laarhoven CJ. Laparoscopic versus small incision cholecystectomy for patients with symptomatic cholecystolithiasis.. Cochrance Database Sys Rev 2006;18(4):CD006229.
- Ros A, Carlsson P, Rahmqvist M, Bachman K, Nilsson E. Non-randomised patients in a cholecystectomy trial characteristics, procedures and outcomes. BMC Surgery 2006;doi:10.1186/1471-2482-6-17.
- Berggren U, Gordh T, Grame D, Haglund U, Rastad J, Arvidsson D. Laparoscopic versus open cholecystectomy hospitalization, sick leave, analgesia and trauma responses. Br J Surg 1994;81(9):1362-1365.
- Candela G, Varriale S, Manetta F, Dilibero L, Civitello F, Argenziano G, et al. Mimilaparotomy versus laparoscopy in treatment of cholelithiasis our experience. G Chir 2007;28(1-2):35-38.
- Syrakos T, Antonitsis P, Zacharakis E, Takis A, Manousari A, Bakogiannis K, et al. Small incision (Mini-Laparotomy) versus laparoscopic cholecystectomy: A retrospective study in a University Hospital. Langenbecks Arch Surg 2004;389(3):172-177.
- Johansson M, Thune A, Nelvin L, Stiernstan M, Westman B, Lundell L. Randomised clinical trial of open versus laparoscopic cholecystectomy for acute cholecystitis. Br J Surg 2005;92(1):44-49.
- Livingstone EH, Rege RV. A nationwide study of conversion from Laparoscopic to open cholecystectomy. Am J Surg 2004;188:205-211.
- Meyer C, De Mamzini N, Rohr S, Thiry CL, Perim-Khalil FC, Bachellier-Billot C. 1000 cases of cholecystectomy 500 by laparotomy versus 500 by laparoscopy. J Chir (Paris) 1993;130(12):501-506.
- Poggio JL, Rowland CM, Gores GJ, Nagorney DM, Donohue JH. A comparison of laparoscopic and open cholecystectomy in patients with compensated cirrhosis and symptomatic gallstones. Surgery 2000;127(4):405-411.
- Chau CH, Tang CN, Sui WT, Ha JP, Li MK. Laparoscopic cholecystectomy versus open cholecystectomy in elderly patients with acute cholecystitis retrospective study. Hong Kong Med J 2002;8(6):394-399.
- Schietroma M, Carlei F, Liakos C, Rossi M, Carloni A, Enang GN, et al. Laparoscopic versus open cholecystectomy an analysis of clinical and financial aspects. Pannienerva Med 2001;43(4):239-242.
- Zacks SL, Sandler RS, Rutledge R, Brown RS Jr. Laparoscopic cholecystectomy and open cholecystectomy. Am J Gastroenterol 2002;97(2):334-340.
- Attwood SE, Hill AD, Mealy K, Stephens RB. A prospective comparison of Laparoscopic versus open cholecystectomy. Ann R Coll Surg Engl 1992;74(4):397-400.
- Iqbal J, Ahmad B, Iqbal Q, Rashid A. Laparoscopic V/S Open Cholecystectomy morbidity comparison. Professional Med J 2002;9(3):226-234.
- Doherty GM, Way LW. Biliary tract. In Doherty GM editor current diagnosis and treatment 12<sup>th</sup> ed, Lange international edition MC Graw Hill companies 2006;582.
- Muller MR, Haapamaki MM, Nordin P, Stenlund H, Nilsson E. Cholecystectomy in Sweden 2000-2003: A nationwide study on procedures, patient characteristics and mortality BMC Gastro-Enterol 2007;7:35.
- Vegenas K, Spyrapopoulos P, Karamikolas M, Sakelaropoulos G, Maroulis I, Karavias D. Mini-laparotomy cholecystectomy versus laparoscopic cholecystectomy which way to go. Surg Laparosc Endosc Percutan Tech 2006;16(5):321-324.
- Puckayastha S, Tilney HS, Giorgiou P, Athanasiou T, Tekkis PP, Darzi AV. Laparoscopic Cholecystectomy versus mini-Laparotomy cholecystectomy a meta-analysis of randomized control. Surg Endosc 2007;21(8):1294-1300.
- Supe ANN, Bapat VN, Pavdya SV, Dalvi AN, Bapat RD. Laparoscopic versus mini laparotomy cholecystectomy for gallstone disease. Indian J Gastroenterol 1996;15(3):94-96.
- Ros A, Gustafsson L, Krook H, Nordgren CE, Thorell A, Wallin G, et al. Laparoscopic Cholecystectomy versus Mini Laparotomy Cholecystectomy randomized single blind study. Ann Surg 2001;234(6):741-749.
- Schietroma M, Carlei F, Cappelli S, Pescosolido A, Lygidakis NJ, Amicucci G. Effects of cholecystectomy (laparoscopic versus open) on PMN elastase. Hepatogastroenterol 2007;54(74):342-345.
- Geng W, Cao Y, Chang Y, Tan W, Han J. Recovery of gastrointestinal motility following laparoscopic versus open cholecystectomy. Zhonghua Waike Za Zhi 1999;37(7):415-417.
- Jan YY, Chen MF. Laparoscopic versus open cholecystectomy a prospective randomized study. J Formos Med Assoc 1993;92(Suppl 4):5243-5249.
- Buanes T, Mjaland O. Complications in laparoscopic and open cholecystectomy: A prospective trial. Surg Laparosc Endosc 1996;6(4):226-272.
- Gondal SH, Javed S, Bhutta AR. Postoperative pain Comparison between a Laparoscopic and Open Cholecystectomy: A two years experience. Pak Postgrad Med J 2000;11(1):44-46.
- Port RJ, DeVries BC. Laparoscopic versus open cholecystectomy: A prospective matched cohort study. HPB Surg 1996;9(2):71-75.
- Jonas L, Filipovic G, Kremmentsova J, Norblad R, Soderholm M, Nilsson E. Open cholecystectomy for all patients in era of laparoscopic surgery: A prospective cohort study. BMC Surg 2006;6:5
- Siddiqui K, Khan AFA. Comparison of frequency of wound infection: Open Vs laparoscopic cholecystectomy. J Ayub Med Coll Abbottabad 2006;18(3):21-24.
- Hardy KJ, Miller H, Fletcher DR, Jones RM, Shulkes A, Mc Neil JJ. An evaluation of Laparoscopic versus open cholecystectomy. Med J Aust 1994;160(2):58-62.
- Saeed T, Zarin M, Aurangzeb M, Wazir A, Muqeen R. Comparative study of Laparoscopic versus Open Cholecystectomy. Pak J Surg 2007;23(2):96-99.