

# Comparison of Early Outcomes and Costs Between Laparoscopic and Open Cholecystectomy for Mild and Moderate Cases of Cholelithiasis in Rural Morocco: A Retrospective Comparative Study

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## Abstract

**Background:** Laparoscopic cholecystectomy (LC) was first introduced in the late 80's, replacing open cholecystectomy as the standard surgical approach for cholelithiasis in developed countries. In contrast, there were initially many controversies in developing countries regarding the laparoscopic techniques.

**Objectives:** This study aimed to compare the early outcomes and costs between laparoscopic and open cholecystectomy for cholelithiasis in a rural hospital in a developing country.

**Patients and Methods:** This retrospective study included all consecutive patients who underwent cholecystectomy for mild and moderate symptomatic gallstone, in the Marche Verte hospital, in the Boulemane province in Morocco between January and December 2011. Demographics, postoperative outcomes, and costs were compared between laparoscopic and open surgery groups. Duration of hospital stay was calculated from the time of operation to the time of discharge. The total costs for each patient included the sum of: the average hospitalization costs per day; the average operating room costs; and material and medications costs. Chi-square test or Fisher's exact test and student or Mann-Whitney U tests were used for comparison, as appropriate.

**Results:** During the study period, 95 patients were included; among them, 53 patients underwent laparoscopic surgery and 42 laparotomy. There were no statistical differences between the two groups concerning age, gender distribution, American society of anesthesiologists (ASA) classification, and number of acute cholecystitis. Rate of conversion to open surgery was 5.6% (3 patients). Patients in the laparoscopic group had shorter hospital stay (2.9 vs. 4.7 days,  $P = 0.0001$ ), lower rates of infectious complications (3.7% vs. 16.6%,  $P = 0.04$ ), and lower costs (169 vs. 231.62 US dollars,  $P = 0.0001$ ).

**Conclusions:** The results of the present study showed that, in a rural hospital setting in a developing country, laparoscopic cholecystectomy for symptomatic cholelithiasis was associated with shorter hospital stay, less infectious morbidity rates, and reduced costs, compared to open surgery. Thus, laparoscopic cholecystectomy should be advised as a routine technique for management of cholelithiasis in rural areas of developing countries.

**Keywords:** Laparoscopic Cholecystectomy, Rural Surgery, Treatment Outcomes, Comparative Study

## 1. Background

Laparoscopic cholecystectomy (LC) was first introduced in the late 80's, replacing open cholecystectomy as the standard surgical approach for cholelithiasis in developed countries (1-3), including rural areas (4, 5). In contrast, there were initially many controversies in developing countries regarding the laparoscopic techniques (6), mainly due to the high costs and resources required (6-8). As a result, the use of laparoscopy is limited to few specific areas (9, 10). In Morocco, laparoscopic cholecystectomy was introduced in the early 90's and then became the standard approach for the management of gallstone in university hospitals and some public hospitals in major cities in 2000. In rural areas, open cholecystectomy remained the most practiced approach. Due to limited

medical equipment (restricted access to laboratory and radiological explorations) and qualified human resources, laparoscopic surgery is considered a luxury medical practice. In fact, the priority in these regions remains to be able to provide medical assistance to the most common health-related problems in the country, mainly obstetric and pediatric emergencies and infectious diseases. Only a few studies have compared laparoscopic to open surgery in rural areas in developing countries, questioning its routine use in this context.

## 2. Objectives

The aim of this study was to compare the early morbidity rates, duration of hospital stay, and costs between lap-

aroscopic and open cholecystectomy in a rural hospital in Morocco, in order to determine whether laparoscopy should be considered as the standard approach for cholelithiasis in rural areas of developing countries.

### 3. Patients and Methods

This retrospective comparative study was performed in the Marche Verte hospital, in the Boulemane province in Morocco, between January and December 2011. All consecutive patients who were operated by two general surgeons for symptomatic cholelithiasis were included. The study was approved by the medical committee of the hospital.

#### 3.1. Inclusion and Exclusion Criteria

Mild and moderate cases of symptomatic cholelithiasis were diagnosed by ultrasonography. Intra-biliary explorations (intra-operative cholangiography and ERCP), and intensive care unit were not available in our hospital. Therefore, patients presenting with jaundice, who had a history of pancreatitis or jaundice, a dilated common bile duct on abdominal ultrasonography (above 8 mm), and/or an American society of anesthesiologists (ASA) score of 3 or 4 were referred to the nearest university hospital and were excluded from this study.

#### 3.2. Pre-Operative Work-Up

Pre-operative work-up performed for all patients included clinical examination, abdominal ultrasonography; chest radiography; blood count; blood levels of urea, creatinine and glucose; activated partial thromboplastin time; prothrombin ratio; and anesthesiology assessment. Before surgery, the ultrasonography report had to include: number and sizes of biliary stones, thickness of the gallbladder wall, and the common bile duct's diameter. The choice to perform laparoscopic and open approach was left to surgeon's preference.

#### 3.3. Surgical Technique

Laparoscopic cholecystectomy was performed by 4-trocar's technique. Dissection of the cystic pedicle was performed using the mono-polar hook, starting from the right side of the gallbladder. Cystic duct and artery were controlled using titanium clips. At the end of the procedure, the gallbladder was removed in a plastic bag, through the umbilical trocar.

Open cholecystectomy was performed through a right subcostal incision. A clear identification of hepatic pedicle elements was obtained before the ligation of cystic artery and duct using absorbable sutures.

In the postoperative period, the surgeons reported the follow-up outcomes in the patients' medical file. Patients were divided into two groups: laparoscopic versus open surgery and the following variables were compared between the two groups: age, gender, ASA score, diagnosis

(non-complicated or acute cholecystitis), and type of surgery (open or laparoscopic). In case of conversion to open surgery, patients were included in the laparoscopic group (intention to treat).

#### 3.4. Endpoints Criteria

Duration of hospital stay was calculated from the day of surgery to the day of discharge. Short-term morbidity was defined as any complication occurring within 30 days from the date of the surgical procedure.

Total costs, calculated with the assistance of the statistical unit of the hospital for each patient, included the sum of: the average hospitalization costs per day; the average operating room costs, in addition to material and medications cost. Costs are presented in Moroccan dirham (MAD) and converted to US dollars according to the currency on August 21st, 2015.

#### 3.5. Statistical Analysis

Variables were expressed according to their type: qualitative variables in percentages and quantitative variables in mean and standard deviation (SD) or as median with interquartile range (IQR), as appropriate. They were compared using Chi-square test or Fisher's exact test, and student or Mann-Whitney U tests, as appropriate. Results were considered statistically significant when the P value was less than 0.05. Statistical analysis was performed using SPSS statistics software (Chicago Illinois, version 13).

## 4. Results

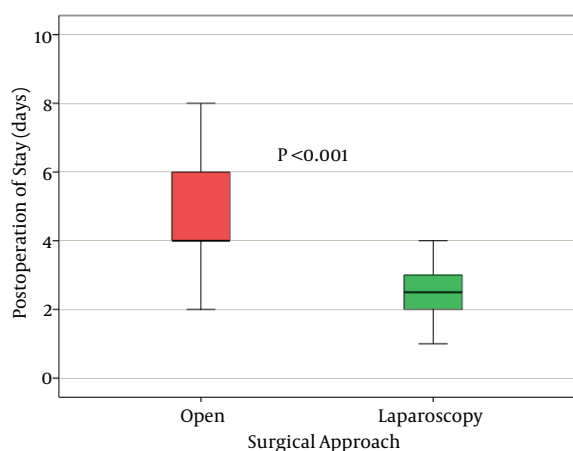
During the study period, 95 patients underwent surgery for cholelithiasis. There were 85 women (89.5%) with a mean age of 53.4 years (minimum = 21, maximum = 78. SD =  $\pm$  13.87). Fifty - three patients were operated by laparoscopic approach (55.8%), and three of them were converted to open surgery (5.6%). Reasons for conversion included acute cholecystitis with no clear identification of the anatomy in two cases and common bile duct lateral injury discovered and managed per operatively using T-tube in one case. There was no statistical difference between the two groups regarding age, sex distribution, ASA score, and the presence of cholecystitis (Table 1).

**Table 1.** Comparison of Patients' Characteristics Between Open and Laparoscopic Groups<sup>a</sup>

Variable	Laparoscopy (n = 53)	Open (n = 42)	P Value
Women	49 (92.5)	36 (85.7)	.32
Age, y	50.3	52.6	.42
Acute cholecystitis	9 (17)	6 (14.3)	.72
ASA 2 <sup>b</sup>	14 (26.4)	13 (30.9)	.80

<sup>a</sup>Values are presented as No. (%) except age that is presented as median age.

<sup>b</sup>ASA: American society of anesthesiologists score. Patients in this study were either ASA 1 or 2.



**Figure 1.** Comparison of Postoperative Duration of Hospital Stay Between Laparoscopic and Open Cholecystectomy

**Table 2.** Comparison of Early Outcomes and Costs Between Laparoscopic and Open Cholecystectomy

Complications	Laparoscopy (n = 53)	Open (n = 42)	P Value
<b>Infectious complications</b>			0.04
Wound infection	1	4	
Urinary tract infection	1	2	
Pulmonary infection	0	1	
Total <sup>a</sup>	2 (3.7)	7 (16.6)	
<b>Biliary complications</b>			0.08
Biliary leakage	0	1	
Postoperative jaundice	0	2	
Total <sup>a</sup>	0	3 (7.1)	
<b>C - D <math>\geq</math> 2 complications<sup>a,b</sup></b>	1 (1.8)	6 (14.2)	0.04
<b>Duration of stay<sup>c</sup></b>	2.9	4.1	0.001
<b>Global costs<sup>d</sup></b>			0.001
Moroccan dirham	1627.45	2230.33	
US dollars	169.00	231.62	

<sup>a</sup>Values are presented as No. (%).

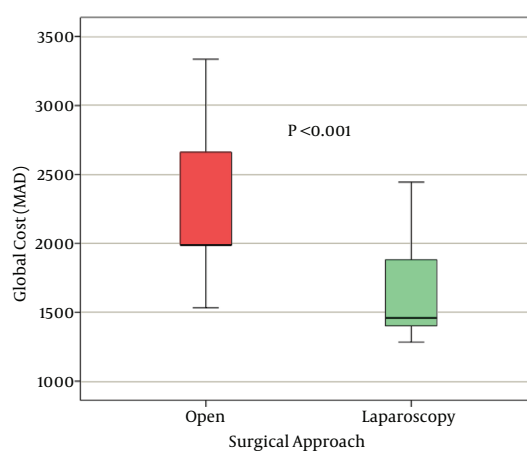
<sup>b</sup>Clavien et al. (11).

<sup>c</sup>Median duration of stay in days.

<sup>d</sup>Median global costs (the total costs for each patient included the sum of: the average hospitalization costs per day, the average operating room costs, in addition to material and medications costs).

The median duration of hospital stay was three days (interquartile range: 2 - 4.25). Patients in the laparoscopic group had a statistically shorter hospital stay (2.9 vs. 4.1 days,  $P < 0.0001$ ) (Figure 1).

Complications occurred in 11 patients (11.5%) (Table 2). Wound infections occurred in four cases (9.3%) in the open group and one case (1.8%) in the laparoscopic group. There were statistically more infectious complications in the open group ( $P = 0.04$ ). Three patients in the open group had biliary complications. The first one had biliary leakage from the drain that resolved spontaneously after few days. The two other patients had postoperative jaundice, secondary to a common bile duct stone. Both were referred to the nearest university hospital for endoscopic sphincterotomy.



**Figure 2.** Comparison of Costs Between Laparoscopic and Open Cholecystectomy

The median total costs of the hospital was 1650.8 MAD (IQR: 1401.5 - 2129.8) (150.87 euros), statistically higher in the open group: 1627.45 MAD (IQR: 1401.5 - 1884.2) vs. 2230.33 MAD (IQR: 1903 - 2661),  $P = 0.0001$  (169 vs. 231.62 US dollars) (Figure 2).

## 5. Discussion

The results of the present study showed that laparoscopic cholecystectomy for mild and moderate cases of cholelithiasis ensured shorter hospital stay and infectious morbidity rates, compared to open surgery in a rural hospital setting in a developing country. It also showed that the use of mini-invasive approach reduced the costs significantly by 27%, when compared to open procedures.

The present study confirmed the previously known advantages of laparoscopic approach in terms of better postoperative outcomes in the setting of a rural area in a developing country (6). However, it is the first study demonstrating the cost-effectiveness of laparoscopic surgery, compared to open surgery in this context.

The shorter hospital stay is one of the most reported arguments to advocate the use of laparoscopy over open surgery in developed countries. In a meta-analysis of randomized trials (12), Keus et al. showed that laparoscopic cholecystectomy for symptomatic cholelithiasis was associated with a significantly shorter hospital stay (-3 days) (12). Straub et al. reported identical results on laparoscopic cholecystectomy in rural Mongolia, as they reported a 121.3 hours reduction of stay in the laparoscopic group (13). In the present study, there was a median of 48 hours reduction in the duration of stay in the laparoscopic group.

One of the reasons for longer duration of hospital stay is the occurrence of postoperative morbidity, especially in rural areas. Patients in the open group reported higher rates of infectious complications, compared to laparoscopic surgery. Although better outcomes were reported

in laparoscopic groups by many authors, this fact was never confirmed in high-quality studies. Keus et al. (12) found similar minor and major complications between open and laparoscopic cholecystectomies.

In rural areas in Morocco, many conditions may explain the difficulty of new surgical techniques and technologies, like laparoscopy. These were previously reported in the literature, including lack of human resources and adequate equipment; lack of training for both medical and nursing staff; organizational and administrative deficiencies; and a poor traffic system, making the access to health facilities difficult (14). These reasons explain the need to postpone patient's discharge until a complete insurance that the patient would not require any additional care. Patients in the open cholecystectomy group had higher morbidity rates and, therefore, required a prolonged duration of stay, increasing the workload of the nursing team. This improvement of postoperative outcomes in the laparoscopic group influenced not only the patient, but also the work condition of the medical team.

Additionally, the mini-invasive technique showed a 27% significant reduction in the hospital costs ( $P = 0.0001$ ) and consequently, according to this study, it is a cost-effective procedure in management of cholelithiasis in our context. This fact was already demonstrated in developed countries (15, 16); however, by the time the article was written, no such comparative cost-analysis study was performed in a rural setting of a low-income country. Proving the cost-effectiveness of laparoscopy is required to justify its use as a standard technique. In a context of limited resources and difficult economy, efforts to reduce the costs while preserving a good quality of care are mandatory. In our practice, some measures, already described (17, 18), were adopted to reduce the costs of this approach, including the use of reusable instruments, tissue camera protectors, and using sterile plastics from nasogastric tube packaging as an extraction bag for the gallbladder.

Major limitations of this study included its retrospective design, possible bias, particularly due to the fact that the choice to perform laparoscopic or open approach was left to surgeon's preference, and the limited number of patients included. However, based on our results, we were able to implement laparoscopic surgery as a standard technique for cholelithiasis in our hospital and promote its use in other similar areas in our country. Prospective randomized studies are needed to confirm the advantages of laparoscopy in this context.

The results of the current study showed that, in a rural hospital setting in a developing country, laparoscopic cholecystectomy for mild and moderate cases of symptomatic cholelithiasis was associated with shorter hospital stay, less infectious morbidity rates, and reduced costs, compared to open surgery. Laparoscopic cholecystectomy should be considered the first option for rural patients in low-income countries.

## Footnote

**Authors' Contribution:** Study concept and design: Mohammed Anass Majbar; analysis and interpretation of data: Mohammed Anass Majbar and Amine Souadka; drafting of the manuscript: Mohammed Anass Majbar; critical revision of the manuscript for important intellectual content: Amine Souadka and Amine Benkabbou; statistical analysis: Mohammed Anass Majbar and Amine Souadka.

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