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Mini-Laparoscopic Cholecystectomy Versus Conventional Laparoscopic Cholecystectomy. A Prospective Randomized Control Study

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ABSTRACT

Background: While some observational studies showed that mini-laparoscopic procedures lengthen the time required to complete cholecystectomy, others showed that mini-laparoscopic cholecystectomy (MLC) has a similar operative duration to standard laparoscopic cholecystectomy (LC) with a lower rate of morbidities. To our knowledge, no prospective randomized trial compared the outcome.

Objective: The aim of this work was to compare the outcome of MLC versus conventional LC.

Methods: This was a prospective randomized comparative study that enrolled hundred and two patients with chronic calcular cholecystitis. Eighty-four patients were eligible and randomized into 2 groups. Detailed pre-, intra- and postoperative data were collected. All cases were evaluated according to difficult laparoscopic cholecystectomy scoring systems, Soltes scoring system, Randhawa scoring system and Visual Analogue Scale (VAS).

Results: There was a statistically significant higher mean operative time among MINI group than the conventional group (47.62 versus 37.98 minutes). Mean VAS score was statistically significantly higher in the conventional than MINI group (4.76 versus 2.95). A statistically significant higher mean cosmetic satisfaction score among cases with MINI group than conventional group (4.62 versus 2.26). There was no significant difference between studied groups regarding the intraoperative, postoperative complications and conversion rate.

Conclusion: Mini-laparoscopic cholecystectomy showed better results concerning postoperative pain and led to better patient satisfaction with the cosmetic result, in comparison to conventional LC. MILC took longer to be performed, but was not associated with serious complications or a high conversion rate. Mini-laparoscopic cholecystectomy is a safe and feasible procedure for gallbladder disease in elective cases.

Keywords: Mini laparoscopic cholecystectomy, Conventional, Difficult laparoscopic cholecystectomy, Soltes scoring system, Randhawa scoring system.

INTRODUCTION

Since the introduction of LC by **Mouret** in 1987, it has become of choice for the treatment of gallstone disease [1]. Advantages of LC in comparison with open cholecystectomy are well-described and often include reduced postoperative pain, shorter ileus, earlier oral intake, and earlier return to daily activities along with better cosmetic outcome [2]. Since laparoscopic procedures have advanced, cholecystectomy are carried out with smaller incisions and/or fewer ports, generally referred to as mini-laparoscopic cholecystectomy [3].

Needle-scopic surgery is a subcategory of mini-laparoscopic cholecystectomy using the standard 4 incisions/ports and instruments that are ≤ 3 mm in diameter versus the 5-mm instruments which are utilized traditionally [4].

While some observational studies showed that mini-laparoscopic procedures lengthen the time required to complete cholecystectomy [5], others showed that MLC has a similar operative duration to standard LC [6] with a lower rate of morbidities (e.g., bile duct injury) [7].

The aim of this work was to compare mini-laparoscopic cholecystectomy versus conventional laparoscopic cholecystectomy, regarding the incidence of intraoperative complications (bleeding, bile duct injuries, etc.), operative time, postoperative pain, hospital stay and return to daily activities, cosmetic outcome, patient satisfaction and postoperative complications (as; incisional hernia, wound complications).

PATIENT AND METHOD

This was a **prospective** randomized control study that was carried out at Mansoura University Hospital, from February 2021 until February 2022. We enrolled hundred and two patients with symptomatic gall bladder stones and fit for anesthesia with BMI below 40 kg/m^2 and provided informed consents. We excluded patients unfit for anesthesia, patients with any contraindication to pneumoperitoneum as chronic obstructive pulmonary disease (COPD), severe asthma, or severe cardiopulmonary insufficiency, pregnant females, patients with BMI above 40 kg/m^2, patients with acute cholecystitis proved by inflammatory marker and ultrasound, patients with psychologic disorders and cognitive disorders and patients with history of upper abdominal surgeries.

Methods

All 84 eligible patients were randomized into 2 groups by computer generated software. Enrolled patients were evaluated by taking full clinical history as (age, previous cholecystitis attack, history of previous

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hospitalization), general and local examination as; body mass index, previous upper abdominal scars, palpable gall bladder (GB), right upper quadrant pain and right upper quadrant rigidity. Complete routine laboratory tests were done before the operation as: complete blood count, INR, liver function (GGT, Alkaline phosphatase, ALT, AST, Bilirubin total and direct), kidney function, and random blood sugar. Also, radiological assessment by ultrasound was done to every case.

All cases were operated by well-trained surgeons who had more than 3 years' experience with laparoscopic surgery. Cholecystectomies during which technical problems occurred were then identified for each surgeon when the operative time exceeded 1.5 times the surgeon's individual base time.

Patient Preparation

Preoperative dose of 1 gm of 3rd generation cephalosporine IV, 1 hour before the operation was given, LMWH was given also 12 hours before the operation. Patient position was supine, the anesthesia was general anesthesia.

Technique

Conventional Laparoscopic Technique

A 10-mm incision was performed in the umbilical region. Then, a Verses needle was passed into the peritoneal cavity for establishing a 15 mm Hg pneumoperitoneum via CO_2 gas. A 10-mm trocar was inserted into the peritoneal cavity from the umbilical incision.

The patient's position was then changed to Trendelenburg position with his/her right side turned uppermost and the surgeon standing on the left side. The peritoneal cavity was assessed with a 10 mm 30° laparoscope with a 3-chip video camera and light source introduced through the umbilical port.

Another 10 mm trocar was introduced into the peritoneal cavity in the subxiphoid area and two 5 mm trocars were introduced in the right upper quadrant and right flank. Two 5 mm grasps were introduced through the right upper quadrant and flank ports to lift the gallbladder upwards.

Cystic duct and artery were dissected using an electro dissector through the subxiphoid port. Once they are exposed, double 10 mm clips were inserted for ligation of the cystic duct and artery and divide them using shears. A hook dissector was inserted through the subxiphoid port to dissect and separate diseased gallbladder from liver bed.

The gallbladder was removed through the umbilical port under direct vision of the 10 mm laparoscope which was directed to the site through the subxiphoid port. The umbilical and subxiphoid wounds underwent closure using a needle holder with a 1-0 absorbable synthetic polyglycolic acid suture however, the other two 5-mm wounds were closed with sterilized strips only.

Miniport Technique

Following infra umbilical local anesthesia (bupivacaine) for postoperative pain relief, pneumo-peritoneum was made using the open insertion procedure through the umbilicus by placing a hidden intra-umbilical incision, through which a blunt 5 mm trocar was inserted.

The pneumo-peritoneum was made by utilizing a CO_2 pressure (8–12 mmHg). Then, a 30° laparoscope, 5 mm in diameter, was utilized for the whole technique. Another 3 low-friction trocars of 3.5 mm were utilized to improve the performance. One 3.5-mm trocar was placed in the epigastrium to dissect, cut, coagulate, irrigate and to aspirate. Two other mini trocars were introduced at the right subcostal margin; the most lateral trocar was utilized for fundus retract towards the diaphragm and the most medial trocar was utilized to grasp and expose Hartmann pouch.

The position of trocars was slightly underneath the costal margin for avoidance of bending and damage of instruments. An endoscopic inspection of the abdominal cavity was performed before cholecystectomy.

The procedure began with dissecting peritoneum near the infundibulum and Calot triangle of gallbladder. The cystic artery was ligated at about 3–5 mm of its length with Vicryl 2/0 or sealed using monopolar. The cystic duct was ligated with intracorporeal surgical knots utilizing polyglactin 2-0 (Vicryl).

Liver bed dissection and hemostasis were performed utilizing a monopolar hook electrode.

Gallbladder removal had been carried out utilizing an extraction bag. A bag made from a sterile glove initially inserted through the umbilical port might be strategically utilized for gallbladder removal, avoiding the utilization of expensive, specially manufactured retrieval bags. Once the bag was inserted into the abdominal cavity through the umbilical 5-mm port, the 5-mm laparoscope was re-introduced and the gallbladder was placed in the bag. A mini forceps was utilized to get hold of the outer edge of the bag, which was delivered into the umbilical trocar in a retrograde manner.

Then, the bag was grasped and retrieved under direct vision and when needed extension of the umbilical aponeurotic incision with minimal aesthetic compromise was performed, in cases of cholecystitis or big stones. The technique was ended by suturing of umbilical aponeurotic incision with purse string suture; other 3.5-mm ports often heal without suture. No drain was inserted.

Evaluation

All cases were evaluated according to scoring systems; the first scoring system is called **difficult laparoscopic cholecystectomy score** (DiLC score). The sum of points gives the DiLC score with values between 0 and 18. The DiLC score gives four levels to determine the difficulty. It is low when (0), moderate (1-4), high (5-9) and extremely high (≥ 10) probability of difficult

cholecystectomy (Table 1). The second scoring system was **Soltes score**.

The sum of points gives the Soltes score with values between 0 and 10. The score gives five levels to determine the difficulty. It is easy when (0), minor problem (1), difficult (2), very difficult (3), conversion (>4) (Table 2). The third scoring system was **Randhawa score**. The sum of points gives the Randhawa score with values ranging between 0 and 15.

The score gives three levels to determine the difficulty. It is easy when (0-5), difficult (6-10), extremely difficult (11-15) (Table 3). The fourth scoring system was **VAS** measures pain severity. It consists of a 10 cm line, with 2 end points representing 0 ('no pain') and 10 ('the most severe pain') (Figure 1).

Table (1): Difficult laparoscopic cholecystectomy (DiLC) scoring system [2]

Sex	**Female (0)**		**Male (2)**	
Previous cholecystitis attack	No (0)		Yes (3)	
Neutrophil count (/mL)	<8,000(0)	8,000–11,999 (1)	12,000–15,999 (2)	>16,000 (4)
Fibrinogen (g/L)	<4 (0)	4-5.99 (2)	6-8.99 (5)	>9 (6)
Alkaline phosphatase (IU/L)	<80 (0)	80-159 (1)		>160 (3)

Table (2): Soltes scoring system for predicting difficult LC [8]

Patient history	Male sex	NO (0)	Yes (1)
	Biliary colic within previous three weeks	NO (0)	Yes (1)
	History of acute cholecystitis	NO (0)	Yes (1)
	Earlier upper abdominal operation	NO (0)	Yes (2)
Physical examination	Right upper quadrant pain	NO (0)	Yes (1)
	Rigid right upper abdomen	NO (0)	Yes (1)
Abdominal ultrasound	Thickened gallbladder wall	NO (0)	Yes (1)
	Hydropic gallbladder	NO (0)	Yes (1)
	Shrunken gallbladder	NO (0)	Yes (1)

Table (3): Randhawa scoring system for predicting difficult LC[9]

Age		**<50 (0)**	**> 50 (1)**	
Sex		Female (0)	Male (1)	
History of hospitalization		No (0)	Yes (4)	
Clinical	BMI	<25 (0)	25-27.5 (1)	>27.5 (2)
	Abdominal scar	No (0)	Infra-umbilical (1)	Supra-umbilical (2)
	Palpable gallbladder	No (0)	Yes (1)	
Sonography	Wall thickness	< 4 mm (0)	> 4 mm (2)	
	Pericholecystic collection	No (0)	Yes (1)	
	Impacted stone	No (0)	Yes (1)	

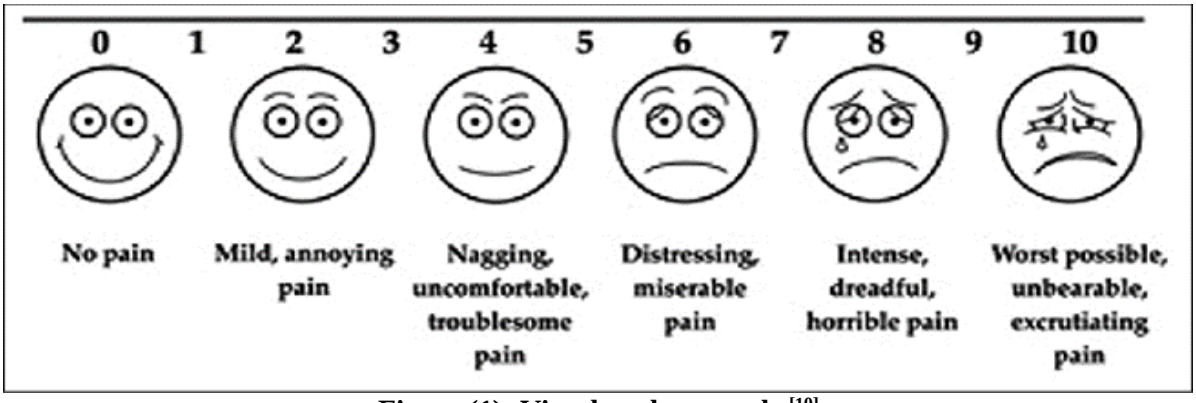

Figure (1): Visual analogue scale [10]

Ethical consent:

An approval of the study was obtained from Mansoura University Academic and Ethical Committee. After explaining our research objectives, written informed consent was obtained from all study participants. This study was conducted in compliance with the code of ethics of the world medical association (Declaration of Helsinki) for human subjects.

Statistical analysis

Data were analysed by SPSS, v18. Qualitative data were expressed as numbers and percents. Quantitative data were expressed as means± standard deviations (SD). Significance of a result was set at P≤0.05 level. Independent samples t-test was utilized to compare between 2 independent groups of normally distributed variables (parametric data). Chi-Square, test was utilized to compare qualitative data between groups as appropriate. Significance test results were quoted as two-tailed probabilities.

RESULTS

The present study assessed the outcome of MLC versus conventional laparoscopic cholecystectomy.

Table (4) shows non statistically significant difference between both groups as regards age, gender, BMI and associated co-morbidities. In both groups there was a female predominance as; 78.6% are females versus 88.1% of conventional group. For MINI group; 7.1% have hypertension and 4.8% diabetes and for conventional group; 16.7% hypertension, 7.1% diabetes.

Table (4): Demographics of the studied groups

	Type of Surgery		**Test of Significance**
	MINI N=42	Conventional N=42	
Age/Years Mean±SD	34.26±10.26	37.95±9.14	T=1.74 P=0.09
Sex N (%)			
Male	9 (21.4)	5(11.9)	X^2=1.37
Female	33(78.6)	37(88.1)	P=0.242
BMI (Kg/M^2) Mean±SD	30.69±3.45	32.09±3.36	T=1.89 P=0.062
Co-Morbidities N (%)			
Hypertension	3(7.1)	7(16.7)	X^2=1.82, P=0.178
DM	2(4.8)	3(7.1)	FET=0.213, P=1.0

t: Student t test, FET: Fisher exact test, X^2: Chi-Square test

Table (5) demonstrates non-significant difference between both groups regarding biliary colic, rigidity at the right hypochondrium, and acute cholecystitis.

Table (5): Different clinical presentation among studied groups

	Type Of Surgery		**Test of Significance**
	MINI N=42(%)	**Conventional N=42(%)**	
Biliary colic within last 3 weeks	39(92.9)	39(92.9)	X^2= FET=0.0 P=1.0
History of acute cholecystitis in the last three month	2(4.8)	2(4.8)	FET=0.00 P=1.0
Rigidity at the right hypochondrium	9(21.4)	15(36.6)	X^2=2.32 P=0.128

FET: Fischer exact test, X^2: Chi-Square test

Table (6) demonstrates a non-significant difference between both groups in terms of bilirubin level, alkaline phosphatase and neutrophil count. All cases within each of the studied groups have bilirubin level < 1.

Table (6): Laboratory findings among studied groups

	Type of surgery		Test of significance
	MINI n=42(%)	Conventional n=42(%)	
Bilirubin level (<1)	42(100)	42(100)	X^2 =FET=0.0 P=1.0
Alkaline phosphatase <80 80-160	 26 (61.9) 16 (38.1)	 32(76.2) 10(23.8)	 X^2=2.01 P=0.238
Neutrophil count <8 8-11.5	 30(71.4) 12(28.6)	 34(81.0) 8(19.0)	 X^2=1.05 P=0.306

X^2: Chi-Square test

Table (7) demonstrates a non-significant difference between both groups as regards, gall bladder thickness, pericholecystic fluid, stone number, intraoperative complications, postoperative complications and conversion rate.

Gall bladder thickness was found < 4 mm in 90.5% in MINI group and in 97.6% in conventional group, respectively.

Intraoperative complications were detected among only 2 cases of MINI group, while no cases were reported among conventional group. Three cases were converted from mini to conventional and 2 cases in conventional group experienced postoperative complications.

Table (7): Preoperative radiological findings between studied groups

	Type Of Surgery		**Test of Significance**
	MINI N=42(%)	**Conventional N=42(%)**	
Gall Bladder Thickness **<4 Mm** **>4 Mm** **Equal**	 38(90.5) 2(4.8) 2(4.8)	 41(97.6) 1(2.4) 0	 MC=2.45 P=0.294
Pericholecystic Fluid	5(11.9)	4(9.5)	X^2=0.077 P=0.781
Stone Number **Single Stone** **Multiple Stone**	 12(28.6) 30(71.4)	 8(19.0) 34(81.0)	 X^2=0.357 P=0.646
CBD Diameter **< 6 Mm**	42(100)	60(100)	
Intraoperative Complications	2(4.8)	0	X^2 =FET=2.05 P=0.494
Postoperative Complications	0	2(4.8)	FET=2.05 P=0.494
Conversion	3(7.1)	0	FET=3.111 P=0.241

X^2: Chi-Square test

Table (8) shows the distribution of different cases of both groups based on difficult laparoscopic cholecystectomy scores. According to Ranhdaw score, there was 7 and 9 difficult cases in mini and conventional group respectively. Three of difficult mini cases were converted to conventional.

According to Soltes score all cases were difficult, three and four cases in mini and conventional group respectively supposed to be converted.

According to DiLC score the majority of the cases were low and moderate and only 7, 9 cases in mini and conventional group were high and very high in difficulty.

Table (8): Distribution of different cases of studied groups based on laparoscopic cholecystectomy scores

	Type of Surgery	
	MINI, N=42 (%)	**Conventional, N=42(%)**
Randhawa Score (2009)	Easy (35) Difficult (7)	Easy (33) Difficult (9)
Soltes Score (2014)	Easy (0) Minor (0) Difficult (39) Conversion (3)	Easy (0) Minor (0) Difficult (38) Conversion (4)
DiLC Score (2016)	Low and Mod (33) High and Very High (9)	Low and Mod (37) High and Very High (5)

Table (9) demonstrates a statistically significant higher mean operative time among MINI group than conventional group. Mean VAS score was statistically significantly higher among conventional than MINI group. A statistically significant higher mean cosmetic satisfaction score among cases with MINI group than conventional group.

Table (9): Mean operative time, VAS score of pain and cosmetic satisfaction score between studied groups

	Type of surgery		Test of significance
	MINI (N=42)	**Conventional (N=42)**	
Operative time/minutes mean±SD	47.62±9.26	37.98±9.69	t=4.66 p<0.001*
VAS score of pain mean±SD	2.95±0.88	4.76±0.69	t=10.46 p<0.001*
Cosmetic satisfaction score mean±SD	4.62±0.62	2.26±0.94	t=13.56 p<0.001*

t: Student t test, *statistically significant

Table (10) shows that 3 cases in MINI group were converted, with their mean age was 45.25, two females and one male, the three cases had biliary colic within last 3 weeks, alkaline phosphatase from 80 to 160, neutrophils count from 8 to 11.5, and rigidity in the upper quadrant, and CBD diameter <6 mm.

Table (10): Data of converted cases among studied groups

	N=3	**%**
Age/years (mean ±SD)	45.25±7.54	
Sex N (%) Male Female	 2 1	 75.0 25.0
BMI (kg/m^2) -mean±SD	36.50±2.08	
Co-morbidities N (%) Hypertension DM	 1 1	 50.0 50.0
Biliary colic in the previous three weeks	3	100.0
History of jaundice	0	0.0
History of pancreatitis	0	0.0
History of acute cholecystitis	0	0.0
Alkaline phosphatase (80-160)	3	100.0
Neutrophil count (8-11.5)	3	100.0
Rigidity upper quadrant	3	100.0
Gall bladder thickness <4 mm >4 mm Equal	 0 1 2	 0 25.0 75.0
Pericholecystic fluid	2	75.0
Stone number Single stone Multiple stone	 1 2	 25.0 75.0
CBD diameter (<1 cm)	3	100.0

DISCUSSION

Less than 4 decades ago, the first LC was carried out as a minimally invasive alternative to open approach [11]. Recent technological advancements have armed surgeons with smaller-caliber laparoscopic instruments, better optics, and improved light sources [12].

In the early 90's, MLC was used to further decrease the invasiveness of LC [13]. The theoretical basis for this is that, by utilizing fewer smaller ports the degree of invasiveness is reduced with improved surgical outcome [14].

The current study compared MLC versus conventional LC regarding the incidence of intraoperative complications and postoperative recovery.

Starting with patients' demographics, the mean age was 34.6 and 37.9 years in the mini and standard groups respectively, without significant difference between both groups. This is in accordance with a previous report, which stated that patients with symptomatic gallstones tend to be in their thirties or forties [15]. Another study reported significantly older ages for both groups. De **Carvalho *et al.*** reported that their patients had mean ages of 52 and 47 years in the conventional and mini-laparoscopic groups, respectively [16].

In this study, the mean BMI was 30.69 and 32.9 kg/m^2 in the mini and standard groups respectively, which was statistically comparable between both groups. One can see that most of our included cases were overweight or obese. Previous research has confirmed that high BMI is considered as an independent risk factor for gallstones. A total of 396 subjects were enrolled in this study, with 103 cases and 293 control subjects. The mean BMI of GSD patients was 27.576±5.753, whereas control subjects had a mean BMI of 25.638±7.008 (p=0.08). Approximately 26.4% of patients had an average fat intake higher than 100 g/d in comparison with 11.9% in control subjects (p=0.035). The average red meat consumption was 222 g weekly in patient group versus 210g in control subjects (p=0.001) [17]. Previous studies have also shown that obesity was closely linked to cholelithiasis, although proof was not clear [18].

In our study, diabetes was present in **4.8% and 6.7%** of cases in the mini and standard groups respectively, without significant difference between both groups. Diabetes is linked to an enhanced risk of cholesterol gallstones. In a case-control study, diabetes was more frequent in those with gallstones compared with control group, even according to gender (18.3% versus 9.9% in males and 9.3% versus 2.6% in females) [19]**.** How diabetes is associated to gallstones is not-well clear. Hepatic insulin resistance seems to be significant [20,21]. Other contributory factors might be hypertriglyceridemia and autonomic neuropathy causing biliary stasis because of decreased gallbladder motility [22].

In this study, previous acute cholecystitis was reported by **4.8%** of patients in the mini and conventional groups respectively, without significant difference between both groups. **Roig *et al.*** [14] reported **higher** prevalence of previous acute attack in their selected patients. Previous attacks were reported by 20% and 15% of patients in the mini and conventional groups respectively (p = 0.592).

In this study, all of the included cases had serum bilirubin level below 1 mg/dl (normal levels), and that can be clarified by the fact that patients should have normal bilirubin levels before being scheduled for laparoscopic cholecystectomy, as the existence of hyperbilirubinemia may suggest the presence of concomitant common bile duct stones that may induce bile leakage after cholecystectomy [23, 24].

Our findings showed that most cases had serum alkaline phosphatase below 80 IU/l (61.9% and 78.3% of patients in the mini and standard laparoscopic cholecystectomy groups respectively). This coincides with a previous recent report which stated that most patients undergoing laparoscopic cholecystectomy should have normal laboratory findings [25].

In the current study, intraoperative complications were encountered in **4.8%** of patients who underwent the mini-laparoscopic approach, in comparison with 0% in the conventional group. Yet, that difference was statistically irrelevant. **Sarli *et al.*** [26] reported that the two approaches had a comparable intraoperative complication rates. The incidence of complications was **19.12% and 17.91%** in the conventional and mini groups respectively. These complications included perforation of the gallbladder, intraoperative bleeding, iatrogenic hepatic injury, subcutaneous emphysema, and bleeding. In a relatively more recent study, **Alhashemi *et al.*** [27] reported that intraoperative complication were encountered in **2.6% and 3.1%** of cases in conventional and mini groups respectively (p = 1.0).

Our results demonstrated the occurrence of postoperative complications in three patients (5%) the conventional laparoscopic group versus no cases in the mini-laparoscopic group, without significant difference between both groups. **Another study** reported that both approaches had comparable occurrence of postoperative complications. No patients developed wound infection in either group. However, trocar site bleeding occurred in two patients (6.67%) in the conventional group versus no patients in the mini-laparoscopic group [28]. **Alhashemi and his associates** [27] reported that postoperative complications occurred in 2.6% and 6.3% of cases in the conventional and mini groups respectively, which was comparable on statistical analysis (p = 0.59).

In this study, three patients in the mini-laparoscopic group required conversion to the conventional laparoscopic approach (7.1%). This could be explained by difficulties in exerting sufficient traction on tissues using fragile mini-instruments,

especially that we encountered some cases with thick gall bladder wall and pericholecystic fluid. The reported rate of conversion in the current literature ranges between **0% up to 38%** [12,14,16,29-31], and our incidence lies within the lower limits in that range, indicating our surgical expertise in the use of these mini-instruments.

When it comes to operative time in our study, we noted a significant lengthening of the operative time in mini-laparoscopic group (47.62 minutes vs. 38.17 minutes in conventional group). The relative difficulty of grasping inflamed and thick tissue by the mini-instruments compared to the conventional ones could explain the previous finding. Also, the more expertise gained with the conventional approach compared to the mini-laparoscopic one could be a second etiology. Multiple studies confirmed our findings [28, 31,32]. In 2013, **Saad *et al.*** [33] reported similar findings, as the same parameter demonstrated a significant decrease with the conventional technique (35 versus 47.3 minutes in the mini approach – $p < 0.05$).

In contrast to the previous findings, another study conducted in 2013 did not report significant difference between both approaches as regards the duration of operation (45 and 42 minutes in the mini and conventional groups, respectively) [16].

In our study, a significant decline in postoperative pain scores was found in association with the mini-laparoscopic approach (2.95 vs. 4.95 in the conventional group – $p < 0.001$).

Pain after laparoscopic cholecystectomy has three main sources, parietal pain (originating from the abdominal wall), visceral pain (from the peritoneum), and shoulder pain (referred from the diaphragm due to its distension and CO_2 irritation) [34]. It seems reasonable that lesser incisions created in the mini approach could results in lower pain severity compared to its corresponding longer incisions in the conventional approach.

Consistent with our results, Sarli *et al.* [26], found that the mean VAS scores among MLC patients were significantly lower at postoperative different times until 24 h, when the assessment stopped. **Bisgaard *et al.*** [29] reported that incisional pain along with the cumulative scores were significantly lower in the mini group in comparison with the conventional one. Nonetheless, individual pain scores were statistically comparable between both groups. Conversely, **Saad and his colleagues** [33] reported comparable postoperative pain scores between the conventional, mini-laparoscopic, and even the single-port approaches when performing laparoscopic cholecystectomy.

The previous authors [29-33] attributed their findings to the complexity of postoperative pain regarding its nature, sources, and patient threshold of pain, making the effect of such small difference in port size less effective in improving post-laparoscopic cholecystectomy pain.

In this study, the mini-laparoscopic approach significantly improved patient satisfaction compared to the conventional approach (4.62 vs. 2.26 respectively, $p < 0.001$). It is reasonable that patients with smaller abdominal scars (the mini-laparoscopic approach) had better cosmoses compared to patients with larger ones (the standard approach). Similarly, another study reported that cosmetic outcomes were better among MLC cases based on the study nurse and patient's evaluations. When evaluated by the nurse, mean scores were 38.9 ± 2.1 for MLC cases versus 28.9 ± 5.7 for conventional cases ($P < 0.001$). Also, when evaluated by the patient, the mean cosmesis scores were 38.8 ± 1.7 and 33.4 ± 5.7, respectively ($P = 0.001$) [12]. Also, **Alhashemi and his colleagues** [27] reported that there was a significant benefits for MLC in patient's evaluation of the scar appearance at one and three months, and with scar satisfaction at three months.

In contrast, the study conducted by **de Carvalho *et al.*** [16] revealed similar cosmetic score between both cholecystectomy approaches ($p = 0.246$). The median value of the cosmetic score was 9 (range, 8 – 10) in the conventional group, compared to a median of 9.75 in the mini group (range, 9 – 10).

CONCLUSION

Mini-laparoscopic cholecystectomy showed better results concerning postoperative pain and led to better patients' satisfaction with the cosmetic outcome, in comparison to conventional LC. Mini-laparoscopic cholecystectomy took longer time to be performed, but was not associated with serious complications or a high conversion rate. Mini-laparoscopic cholecystectomy is a safe and feasible procedure for gallbladder disease in elective cases

Limitations

This work has some limitations. First, it included a relatively small sample size. Additionally, all patients were collected from a single surgical institution. We recommend to conduct larger multicenter studies in the near future.

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