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Original Research Article

Outcome of comparative study of mini-laparoscopic cholecystectomy versus conventional laparoscopic cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is considered the gold standard for cholecystectomy procedures. In recent years, many investigators have attempted to further improve the established technique of LC with the goal of minimising invasiveness of this procedure by reducing the number and size of the operating ports and instruments.
Methods: This was a retrospective study done in a tertiary care hospital comparing the safety and efficacy of mini-laparoscopic cholecystectomy (MLC) with conventional laparoscopic cholecystectomy (CLC) done during the time period of June 2020 to January 2022 based on the variables like total operating time, post-operative pain, conversion rate to open procedure, duration of hospital stay and cosmetic results.
Results: Out of 40 cases were collected and analysed, MLC has an advantage over CLC like postop pain on postop day 1 ($p=0.016$) and on postop day 3 (0.025) and postoperative scar ($p<0.001$). In aspects like duration of hospital stay ($p=0.359$) and operating time ($p=0.805$) MLC is equally comparable to CLC. CLC is proved to be better than MLC in one aspect- conversion to open cholecystectomy ($p=0.042$).
Conclusions: Miniaturised instrumentation is an area of research which is studied for the past 3 decades. Although improved instrument durability and better optics are needed for widespread use of miniport techniques, this MLC approach can be routinely offered to many properly selected patients undergoing elective LC.

Keywords: Conventional laparoscopic cholecystectomy, Mini-laparoscopic cholecystectomy

INTRODUCTION

Gall stones constitute a significant health problem in developed societies, affecting 10%-15% of the adult population.[1]

Patients with asymptomatic gallstones develop complications at an annual rate of 1-2%. In symptomatic patients, the complication rate increases to 1-3%.[2] They are composed mainly of cholesterol and can be less often pigment stones. Cholesterol stones form as a result of cholesterol super-saturation, accelerated cholesterol crystal nucleation and impaired gall bladder motility.[3]

Cholecystectomy or surgical removal of the gall bladder, can be done as emergency or elective. Based on the technique it can be done by open method or laparoscopic.

Laparoscopic cholecystectomy (LC) was performed for the first time in 1987. In India the first laparoscopy was performed in 1990 by Dr. T. E. Udwadia at the JJ Hospital Mumbai.[4] The technique can be classified further into standard four-port laparoscopic surgery, reduced 2-3 port laparoscopic surgery, single incision laparoscopic surgery (SILS) and natural orifice transluminal endoscopic surgery (NOTES); to create no-visible-scar surgery. The standard four-port laparoscopic

surgery is further divided into conventional laparoscopic surgery and mini-laparoscopic surgery.

Our study aimed to provide a comparison between MLC and CLC with the following parameters: total operating time; conversion rate from MLC to CLC, CLC to open cholecystectomy, MLC to open cholecystectomy; degree of postoperative pain using visual analog scale (as shown in Figure 1); duration of POSTOPERATIVE hospital stay (in days); cosmetic results as of Vancouver scar scale (as shown in Table 1).

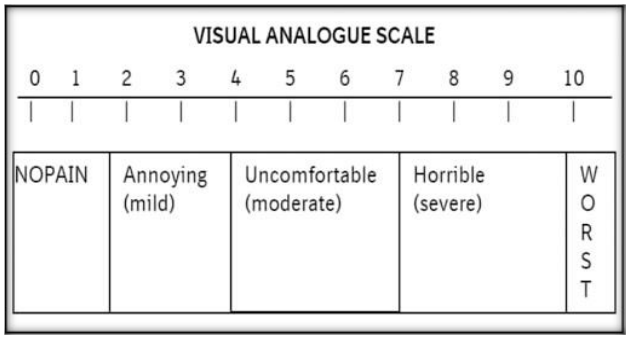

Figure 1: Visual analogue scale.

Table 1: The Vancouver scar scale.

Scar characteristic		Score
Vascularity	Normal	0
	Pink	1
	Red	2
	Purple	3
Pigmentation	Normal	0
	Hypopigmentation	1
	Hyperpigmentation	2
Pliability	Normal	0
	Supple	1
	Yielding	2
	Firm	3
	Ropes	4
	Contracture	5
Height	Flat	0
	<2 mm	1
	2-5 mm	2
	>5 mm	3
	Total score	13

METHODS

This was a retrospective analytical study done in our institution- MGM Institute of health Sciences, Navi Mumbai.

Inclusion and exclusion criteria

Inclusion criteria were those patients who electively underwent laparoscopic cholecystectomy between June 2020 and Jan 2022, which came out to be 38 patients. Patients who underwent direct open cholecystectomy electively were excluded.

The patient selection for the respective procedure was based on the discretion of the operating surgeon and anesthetists. Data and photographs regarding the intra-op and early postop findings were procured from all the hospital records. All the patients were followed up regularly and the set parameters were monitored and compared.

The data was analyzed using statistical software (IBM SPSS, IBM Corporation, Armonk, NY, USA) The Numerical/Continuous data were analysed by the 'Unpaired t test' and the Categorical data were analysed by the Chi square test (Fischer's exact test was used when more than 20% of the cells had value less than 5). Bar charts, pie diagrams and scatter plots were used for the presentation of the data as applicable. P value of less than 0.05 was considered as "statistically significant".

Table 2 shows the various instruments which was used for each of MLC and CLC.

Table 2: Instruments with their port sizes used for the respective procedures.

Port site	Conventional laparoscopy	Mini-laparoscopy
Umbilical port	10 mm Hasson port 10 mm laparoscope	10 mm Hasson port 10 mm laparoscope
Epigastric port	10/5 mm bladed port 5 mm Maryland dissector 5 mm hook electrocautery 5 mm suction or irrigator 10 mm endoclip 10 mm laparoscope (during gall bladder retrieval)	5 mm bladed port 5 mm Maryland dissector 5 mm hook electrocautery 5 mm suction or irrigator 5 mm endoclip 10 mm laparoscope (during gall bladder retrieval)
Subcostal port	5 mm bladed port 5 mm grasper	3 mm port 3 mm grasper
Lateral Port	5 mm bladded port 5 mm gall bladder grasper	3 mm port 3 mm grasper

Figure 2: Comparison between 5 mm and 3 mm instruments in its length and tip size.

Figure 2 shows the comparison between 5mm and 3mm instruments in its length and tip size.

RESULTS

Out of 38 patients, 65.7% were females (25) and 35.3% were males (13). The mean age was 44.20±15.99 years. The age difference between the genders was statistically insignificant (p value: 0.118). Figure 3 shows the age distribution of the patients. The mean operative time was 122±36.36 minutes. The difference between the groups was statistically insignificant (p value: 0.805). Table 3 shows the distribution of operative time in the study population.

Table 4 shows the conversion rate in patients undergoing CLC and MLC. In one of the cases MLC was converted to CLC in view of reduced operating field but in the same setting procedure was converted to open cholecystectomy in view of bleeding. That case was considered as MLC to open and was used for statistical analysis. The conversion rate for MLC was 21.05% while of CLC was 0%; with statistically significant difference (p value: 0.042).

Table 5 shows the distribution of duration of hospital stay in the study population. The mean duration was 3.21±0.41 days. The difference between the groups was statistically insignificant (p value: 0.359).

Table 6 shows the distribution of post-operative pain score in the study population. The mean pain score on POD 1 was 4.53±0.69 and on POD 3 was 2.26±0.50, when assessed by VAS score. Both the scores were significantly more in the CLC group than in the MLC group (p value: less than 0.05).

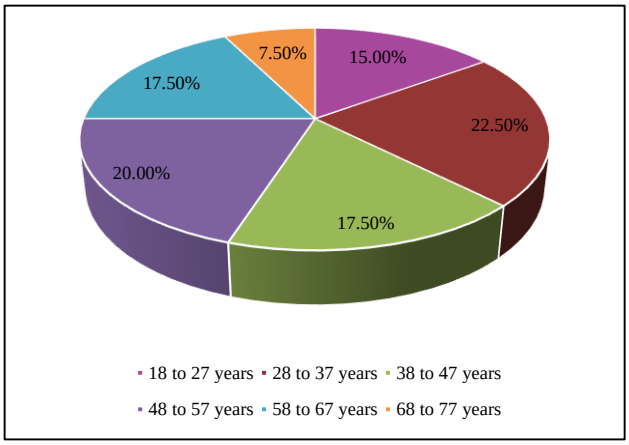

Figure 3: Age distribution charts of the patients.

Table 3: Distribution of the study population according to the procedure and operative time (in minutes).

Parameter	CLC	MLC	Total	P value
Number of cases	23	15	38	
Operative time	120.83±39.49	123.87±32.20	122±36.36	0.805

Table 4: Distribution of conversion rate according to the surgical procedure.

Conversion	CLC		MLC		Total	
	N	%	N	%	N	%
No	21	52.50	14	35	35	87.50
Yes	0	0	5	12.50	5	12.50
Total	21	52.50	19	47.50	40	100
P value	0.042*					

*Statistically significant

Table 5: Distribution of the study population according to the procedure and duration of hospital stay (in days).

Parameters	CLC	MLC	Total	P value
Number of cases	23	15	38	
Duration of hospital stay	3.26±0.45	3.13±0.35	3.21±0.41	0.359

Table 6: Distribution of the study population according to the procedure and post-operative pain scores.

PARAMETER	CLC	MLC	Total	P value
Number of cases	23	15	38	
Pain on POD 1 (VAS)	4.74±0.75	4.20±0.41	4.53±0.69	0.016*
Pain on POD 3 (VAS)	2.39±0.58	2.07±0.26	2.26±0.50	0.025*

*Statistically significant

Table 7: Distribution of the study population according to the procedure and cosmesis (post-operative scar score).

Parameter	CLC	MLC	Total	P value
Number of cases	23	15	38	
Postop 3rd week scar (Vancouver)	2.79±0.37	1.52±0.15	2.29±0.70	<0.001*

*Statistically significant

Table 7 shows the distribution of cosmesis assessed by the post-operative average scar score in the study population. The average scar score is calculated by the average of the scores for each of the sites. In patients who were converted to open, the average was not calculated and the findings were excluded from the statistical analysis.

The average scar score assessed by Vancouver score was 2.29±0.70. The score was significantly more in the CLC group than in the MLC group (p value: less than 0.001).

DISCUSSION

Conversion rate

In the present study, it was found that the conversion rate was 21.05% in mini LC cases while it was 0% in conventional LC cases. The difference between the two groups was statistically significant (p value: 0.042).

Intraoperative MLC conversion to CLC/Open depends upon many factors like- inability to get a good optical field, inability to dissect thick structures like fibrosed gall bladder, bulky omentum; intraoperative bile spillage, intraoperative bleeding obscuring the visual field.

In our study the reason for conversion to open was intraoperative bleeding in 2 cases, bile leak in 1 case. Conversion to CLC was because of inability to dissect tough structures.

Studies by Cheah et al, Look et al, Gagner and Garcia-Ruiz et al showed conversion rate percentage of 5, 7 and 5 respectively which are comparable to our study.[5-7]

Equipment concerns were addressed in many studies like Ainslie et al.[8] They have postulated that a reduction in diameter of the telescope caused reduction in the angle of view and further reduction in the light transmission and image quality.

Study by Huang et al have told the reason for conversion being inability to grasp inflamed gall bladder with micro instruments.[9] Reardon et al has given the reason to be inability to dissect off tenacious adhesions around gall bladder especially in morbidly obese patients.[10] Study by Sarli et al have reported a case of intraoperative bile spillage due to micro-instrument failure.[11]

Thus, it can be concluded that the conversion rate is more following mini LC than the conventional LC.

Operative time

Operating time involves time from incision to closure. In our study we have taken the total time from start to finish. In studies like Ainslie et al, the time taken for each of the steps in the operation was compared.[8] It was found that the time taken to clip the cystic duct was 2 mins longer in MLC than in CLC, the reason given was MLC instruments were less rigid compared to CLC.

Operating time is depending upon many factors: the expertise of the surgeon, the optical resolution of telescope, the intraoperative handling of the micro-instruments, intraoperative complications like bleeding/ bile leak etc. In our study the surgeries were performed by expert surgeons who had an experience in laparoscopic cholecystectomy for more than 10 years.

In the present study, the mean operative time was 122±36.36 minutes (range: 55 to 222 minutes). It was also found that there was no statistically significant difference in the operative time between the two groups (p value: 0.805).

In the study by Novitsky et al the mean operative times were similar in the MLC and CLC groups (p value-0.24).[12] Similar were the findings in the study by Sarli et al, Alponet et al, Yuan et al.[11,14]

In the study by Yuan et al it was found that the for the first 5 cases of MLC the time taken was more but as the surgeon got used to it, the time reduced.[13] Also in their study, the mini-telescope was inserted through the sub-xiphoid port so the operating field was different.

However, in certain studies conducted by Gagner and Garcia-Ruiz et al and Reardon et al conducted in the years 1998 and 1999 respectively in USA, the operating time was found to be increased in MLC than in CLC.[7,14] These were attributed to the poorer optical resolution of the telescope. Miniature fibre telescopes containing both light carrying and imaging fibres- had a resolution and colour reproduction inferior to the standard rod lens optical telescopes.

In our study, the optical fibre telescope used was the same in both procedures and was inserted through the 10 mm umbilical port, hence no problem with the visibility.

Thus, it can be concluded that both the surgical procedures are comparable with respect to operating time and are mostly equal with no statistical significance.

Duration of hospital stay

With the advent of expertise in the field of laparoscopic surgery and with the widespread awareness among people in the developed nations, laparoscopic cholecystectomy is becoming a day care surgery where the patients are discharged on the same day postop. However, in developing nations this practice is not yet implemented.

In uncomplicated situations patients are usually kept for 3 days postop. In the present study, the mean duration of hospital stay was 3.21±0.41 days (range: 55 to 223 minutes). It was also found that there was no statistically significant difference in the duration of hospital stay between the two groups (p value: 0.359).

The duration of hospital stay depends upon the following factors: preop- uncontrolled diabetes mellitus/ systemic hypertension which required fixing of appropriate OHA/insulin/antihypertensive doses postop; intraop- any complication like bile spillage which required patient to be left with an intra-abdominal drain or T-tube for more than 3 days which requires close monitoring postop; postop- need for prolonged intravenous antibiotics or any surgical site infections which requires prolonged hospitalisation.

In our study there was one patient of MLC which had intraoperative bile spillage and was converted to open cholecystectomy. That patient was kept in hospital for seven days and was discharged.

Studies by Atasoy et al, Sarli et al found that found that the mean duration of hospital stay was similar in both the groups (p value: 0.486, more than 0.05 respectively).[11,15]

However, in some studies conducted by Yuan et al and Alponet et al in Taiwan and Turkey in 1997 and 2002 respectively, the duration of hospital stay for MLC was found to be shortened which was attributed to the efficiency of the intraop and postop management.[14]

Thus, it can be concluded that both the surgical procedures are comparable with respect to the duration of hospital stay with no statistical significance

Pain scores

Pain post laparoscopic cholecystectomy can be postulated due to many reasons- incisional pain from the skin, parietal pain due to the cutting of the parietal peritoneum and referred pain to the right shoulder due to the irritation of right-side diaphragm by the CO_2 gas infiltrated; the reason being C_3 myotome supplied to the diaphragm has dermatomal extent to the tip of right shoulder.

The standard analgesia with injection diclofenac sodium 75 mg Aq (in 100 ml NS) i.v. 12 hourly were given to all patients for 2 days. This was followed by oral analgesic like tablet diclofenac 50 mg SOS. In the present study, it was observed that the mean VAS score for pain on the 1st post-operative day was 4.53±0.69. The mean score was significantly higher in the patients undergoing conventional LC (4.74±0.75) than in those undergoing Mini LC (4.20±0.41); p value: 0.016. The pain described here is mainly incisional pain. The reason is due to the fact that a more area of parietal peritoneum was cut in CLC.

The mean VAS score for pain on the 3rd post-operative day was 2.26±0.50. The mean score was significantly higher in the patients undergoing CLC (2.39±0.58) than in those undergoing MLC (2.07±0.26); p value- 0.025.

In our study patient did not complain about the right shoulder tip pain which may be because of the good effect of the analgesia given.

Studies conducted by Cheah et al, Look et al, Bisgaard et al, Huang et al, Yuan et al, Gagner and Garcia-Ruiz et al, the pain in MLC was found be decreased when compared to CLC, which is comparable to our study.[5-7,9,13,16]

Interestingly, in a study conducted by Sarli et al, it was found that shoulder tip pain was higher in MLC compared to CLC, the reason given was that in MLC there was a failure in evacuation of the residual pneumoperitoneum through the small incision in the sheath.[11] This was not found in our study.

Thus, it can be effectively concluded the post-operative pain is significantly less after Mini LC than after Conventional LC.

Cosmesis

Wound healing post- laparoscopy is usually by primary intention. Although patient factors like nutrition status, comorbidities, immunocompromised state, etc play a role in wound healing, the effects are not usually seen in laparoscopic wounds. In the present study, the cosmesis was assessed by the average Vancouver score. It was found that the mean of the average Vancouver score for scar on the 3rd post-operative week was 2.29±0.70. The mean score was significantly higher in the patients undergoing conventional LC (2.79±0.37) than in those undergoing mini LC (1.52±0.15); p value: less than 0.001. This indicates better cosmesis in mini LC than conventional LC.

These results were similar to all the studies conducted worldwide mentioned in the meta- analysis. The reason postulated was that as the wound area is shorter the wound also heal better. Also due to the fibrosis which occurs in stage III of healing the 3 mm port sites hardly develop any scar.

This is considered as the hallmark advantage of MLC over CLC.

Thus, it can be effectively concluded that the cosmesis is better after the mini LC than after the conventional LC.

Table 8: Final outcome of the study.

Variables	MLC	CLC
total operating time	Equal	Equal
conversion rate to open	Increased probability	Decreased probability
post-operative pain	Decreased	Increased compared to MLC
duration of post-op hospital stay	Equal	Equal
cosmetic results	Better cosmesis	Less than MLC

Table 9: Analysis of various MLC versus CLC studies conducted till now.

Source	Country	No. of patients	Operating time for MLC	Pain in MLC	Cosmesis in MLC	Conversion from MLC to CLC (%)	Length of hospital stay	Additional comments
Schwank et al, 2000[18]	Germany	M-LC- 25 C-LC-25	Equal	No difference	Superior	1	No difference	No difference in pulmonary function, less pain with coughing
Cheah et al[5], 2001	Singapore	M-LC- 37 C-LC- 38	Equal	Decreased	NA	5	No difference	Simple oral analgesic requirements
Look et al[6], 2001	Singapore	M-LC- 28 C-LC- 36	Not evaluated	Decreased	NA	7	Not evaluated	Similar functional recovery
Alponet et al, 2002[14]	Turkey	M-LC- 22 C-LC-22	Equal	No difference	Superior	5	Shortened	Randomisation after laparoscopic examination. M-LC is a feasible alternative
Bisgaard et al[16], 2001	Denmark	M-LC- 25 C-LC-27	Not evaluated	Decreased	Superior	4	Not Evaluated	M-LC is feasible
Sarli et al[11], 2003	Italy	M-LC- 67 C-LC- 68	Equal	Decreased	Superior	Not reported	No difference	M-LC enhances the advantages of laparoscopy
Ainslie et al[8], 2003	United Kingdom	M-LC-21 C-LC- 19	Equal	No difference	NA	3	No difference	Reduced use of parenteral analgesia. No difference in immune response, pulmonary function or quality of life
Huang et al[9], 2003	Hong Kong	M-LC- 25 M-LC- 29 C-LC- 30	Increased Equal Equal	Decreased	No difference	5 1	No difference	No reason for M-LC to become universally accepted
Yuan et al[13], 1997	Taiwan	MLC- 14 CLC- 31	Equal	Decreased	Superior	Nil	Shortened	MLC is superior
Gagner et al[7], 1998	USA	MLC 60 CLC 60	Increased	Decreased	Superior	5	No difference	MLC is advantageous
Reardon et al[10], 1999	USA	MLC 50 CLC 50	Increased	No difference	Not evaluated	10	No difference	No significant advantage of MLC found
Leggett et al[17], 2000	USA	MLC 159 CLC 100	Equal	Increased	Not evaluated	3.1	Not evaluated	CLC was superior in many ways
Our study	India	MLC 19 CLC 21	Equal	Reduced	Superior	12.5	No difference	MLC is equally comparable to CLC

Table 8 shows the final outcome of our study comparing the various variables affecting MLC and CLC.

Table 9 is an extensive meta-analysis of all the MLC versus CLC comparative studies conducted in various

parts of the world and their respective findings with respect to the parameters of our study.

The limitations of this study are that the present study was limited by the OPD attendance of the patients requiring cholecystectomy. Also due to COVID-19 Pandemic, the number of elective laparoscopic surgeries were reduced. Therefore, the results may not be generalised to the whole population.

CONCLUSION

Laparoscopic cholecystectomy is considered the gold standard for cholecystectomy procedures. Miniaturized instrumentation is an area of research which is studied for the past 3 decades. From our study it is proved that in many aspects, MLC has an advantage over CLC like postop pain on postop day 1 (p=0.016) and on postopday 3 (0.025) and postoperative scar (p<0.001). In some aspects like duration of hospital stay (p=0.359) and operating time (p-0.805) MLC is equally comparable to CLC. However CLC is proved to be better than MLC in one aspect- conversion to open cholecystectomy (p-0.042) where the former has lesser probability. Although improved instrument durability and better optics are needed for widespread use of miniport techniques, this approach can be routinely offered to many properly selected patients undergoing elective LC.

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