

**ORIGINAL RESEARCH ARTICLE****COMPARATIVE STUDY BETWEEN 3-PORTS AND 4-PORTS LAPAROSCOPIC CHOLECYSTECTOMY FOR THE CASES OF GALL STONE DISEASE**Kishor Kumar Tamrakar¹, Pragyan Khwaunju^{1*}, Keshar Bahadur Sah¹¹ Department of Clinical Microbiology and Immunology, Chitwan Medical College, Bharatpur, Nepal.*Correspondence to: Dr. Pragyan Khwaunju, Department of Surgery, Chitwan Medical College. Email: pragyan_kh@hotmail.com**ABSTRACT**

Background: Laparoscopic cholecystectomy is currently accepted approach for the management of patients with cholelithiasis. The standard method for removal of gall bladder in laparoscopic cholecystectomy is by using four ports. Although other techniques such as by using 3 ports or only single port are being practiced, their safety and efficacy has not been established. This study was done to assess the efficacy and safety of the use of only three ports for laparoscopic cholecystectomy. Methods: Between August 2013 and February 2014, 78 patients with the diagnosis of cholelithiasis were operated. Patients were randomized into 3-ports group and 4-ports group using random number. Operative time taken for the procedure and operative findings were noted. Postoperative pain and complications were noted in both groups. The two groups were compared using student-T test and chi square test. Results: There was no significant difference in the operating time taken for the 3-ports laparoscopic cholecystectomy and 4-ports laparoscopic cholecystectomy. However operating time was significantly higher when the cases that had dense adhesions present were compared with those who did not have. Conversion from 3-ports technique to 4-ports technique was determined mainly by the degree of adhesions and to some degree by the BMI of the patient. Postoperative wound infection rate was similar among the two groups. There was no incidence of biliary injury in both the groups. Conclusion: 3-ports laparoscopic cholecystectomy is safe and efficient approach for the selected patients who seek for lesser invasive method of laparoscopic cholecystectomy.

Key words: *Cholecystectomy, Gall stone, Laparoscope.***INTRODUCTION**

Laparoscopic cholecystectomy is the gold standard approach for the management of symptomatic cholelithiasis.¹ Since its introduction in 1985, it has replaced open cholecystectomy as a surgical option in all forms of symptomatic cholelithiasis including acute cholecystitis.²⁻⁴ It is safe and simple technique which is more appreciable to the patient than the open technique. Not only is it cosmetically more appreciable than the open technique, but it also has lesser number of complications.⁵⁻⁶ Postoperative pain, operative blood loss, wound infection rate, days of hospital admission all are reduced in laparoscopic technique. Delayed complications like

incisional hernia, adhesive intestinal obstruction are also reduced in this technique.

The currently accepted technique for laparoscopic cholecystectomy is by using four ports.⁷ Umbilical port is for inserting laparoscope whereas epigastric, right subcostal and right lumbar ports are used for inserting the instruments for dissection. Although it is considered safe approach, laparoscopic cholecystectomy has been associated with increased incidence of biliary complications than the open technique.⁸⁻¹⁰ The incidence of biliary complications is thought to increase if lesser invasive techniques

like SILS(single incision laparoscopic surgery)or 3-ports laparoscopic cholecystectomy are used and thus these techniques have not been well accepted all over the world.¹¹⁻¹² A straightforward logic would be that lesser the number of ports that you use, the more difficult the procedure would be and thus more the chances of biliary injuries that can occur. However it is a known fact that the biliary injury in laparoscopic cholecystectomy is due to the visual misconception rather than the difficult dissection.¹³ So theoretically the use of only three ports should not increase the biliary complications because the visual system used in both the techniques are same. This study was thus conducted to see the efficacy, safety and appreciability of 3-ports laparoscopic cholecystectomy vs. 4-ports laparoscopic cholecystectomy.

METHODS

This study is a randomized controlled trial comparative study performed in the patients whose laparoscopic cholecystectomy was done in Chitwan Medical College between August 2013 and February 2014 after taking the ethical approval from the institute. Total of 78 patients were operated during this time interval who were included in the study. Patient's consent was taken in each case.

Inclusion criteria:

- Gall stone disease with definite surgical indication for cholecystectomy
- Gall bladder polyp > 1cm

Exclusion Criteria:

- Gallstone pancreatitis
- CBD stone
- Coexistent other disease for which surgery was done
- Pregnancy
- Malignancy

The patients were randomized into 3-ports group and 4-ports group using random number table. Patients were operated after assessing operative fitness. Pneumoperitoneum was created using Hassan's

canula. 4-ports laparoscopic cholecystectomy was done by using standard approach. Instrument from right lumbar port was used to retract the fundus of gall bladder towards the right shoulder whereas the instruments from right subcostal port and epigastric port were used to do the dissection at the calot's triangle. Cystic duct and cystic artery were dissected, and then the lower part of the GB was separated from the liver bed to create the broad open window. Cystic duct and artery were then sequentially divided after applying liga clips. In 3-ports technique, right lumbar port was not inserted; retraction was done using instrument from right subcostal port. If calot's triangle could not be visualised properly, fourth port was inserted. Operative time taken, operative findings and any inadvertent biliary spillage or biliary injury were noted.

Postoperatively patients were followed for the period of one month. Post operative pain was graded by using visual analog method for the first three postoperative days. Any postoperative complications like wound infection or biliary complications were noted.

STATISTICAL ANALYSIS

The operative times taken for both the groups were expressed as mean and standard error of mean. All statistical calculations were performed using the statistical package for social sciences (SPSS) II software for windows version 16.0. Student t test & Chi square test were used for analysis of data. P-value of less than 0.1 was considered statistically significant. Pearson's correlation was used to compare the correlation between different variables.

RESULTS

During the period of six months, total of 78 patients were operated. Among them nine were male patients and 69 were female. Maximum numbers of patients operated were of age group 30 to 40 years. Only two patients were less than 20 years of age and 9 patients were more than 60 years of age. The graphs showing age and sex distribution of the patients operated are shown below.

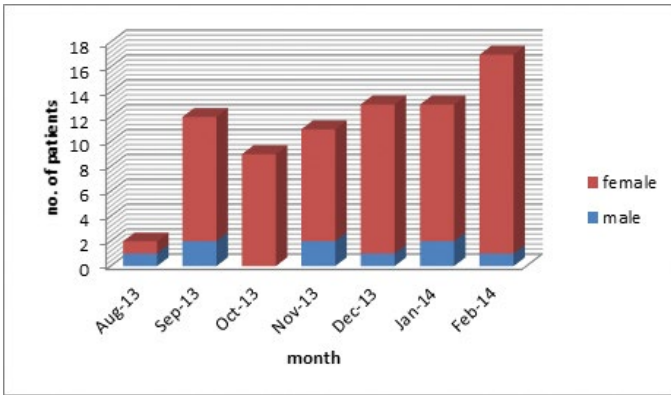


Fig 1: Sex distribution of the patients operated during different time of the year

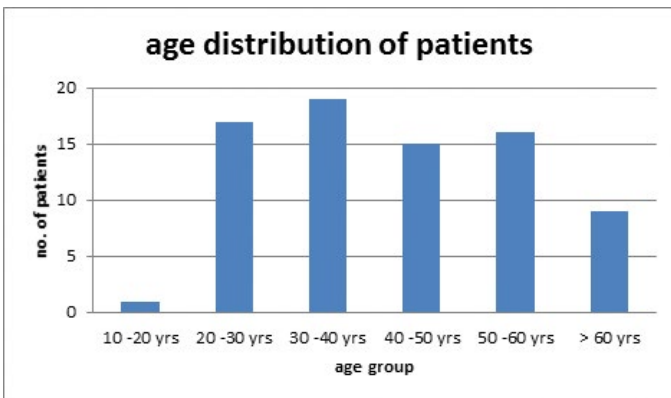


Fig 2: Age distribution of the patients operated during the period

Among the 78 patients, 34 patients had laparoscopic cholecystectomy done through 4-ports technique. In 44 patients the procedure was started by insertion of only three ports. Five patients in 3-ports group were male and 39 were female. Similarly four patients in 4-ports group were male and 30 were female. This difference was statistically not significant (p-value 0.9). Similarly there was no statistically significant difference between the two groups when age factor, sex ratio and lab investigations were considered.

Among the 44 patients whose procedure was started using 3 ports, only 31 patients had the procedure completed without requiring additional port insertion. Rest thirteen patients required conversion to 4-ports technique. Conversion to open technique was required in none of the patients in both the groups. The mean operating time taken for 3-ports laparoscopic cholecystectomy was 53.79 ± 30.9 mins. When the cases which required conversion to 4-ports technique were excluded, it was 41.09 ± 9.6 mins. Mean time taken for 4-ports technique

was 49.02 ± 22.9 mins. It took average of 84.07 ± 42.2 mins to complete the procedure in the patients who required conversion from 3-ports to 4-ports technique. Among these 13 patients six patients required conversion because of dense adhesions whereas seven patients required conversion because of difficult retraction, mainly because of obesity or enlarged liver. Time taken in earlier group was 111 ± 47.6 mins and in latter was 61 ± 17.7 mins.

There was no statistically significant difference between the time taken for 3-ports laparoscopic cholecystectomy and 4-ports technique (p-value <0.4). Times taken for cases of 3-ports technique which required conversion to 4-ports technique and the cases which did not require conversion to 4-ports technique were not statistically significant from the time taken in 4-ports technique (p-value 0.25 & 0.25 respectively). However there was statistically significant difference in the time taken between the cases which required conversion from 3-ports to 4-ports technique and the cases which did not require conversion from 3-ports technique to 4-ports technique (p-value <0.1). When only the cases where the conversion to 4-ports technique was required because of obesity and not because of dense adhesions were considered, there was no significant difference between the time taken in these cases and the time taken in the cases where the procedure was completed using only three ports (p-value 0.4). But when the cases where the conversion to 4-ports technique was required because of dense adhesions were considered, there was significant difference between the time taken in these cases and the time taken in the cases where the procedure was completed using only three ports (p-value <0.1).

Among the patients who required conversion from 3-ports technique to 4-ports technique five patients had only single stone in the gall bladder, one had two stones and seven patients had multiple stones. Among the patients who did not require conversion to 4-ports technique ten patients had single stone, three had two stones and eighteen patients had multiple stones. This difference was statistically not significant (p-value <0.9).

The mean BMI of the patients in 3-ports group was 24.9 ± 3.2 and that of the patients in 4-ports group was 22.8 ± 3.3 . This difference was not statistically

significant (p-value- <0.25). The mean BMI of the patients who required conversion from 3-ports technique to 4-ports technique was 28.2±3.3 and that of patient who did not require conversion to 4-ports technique was 23.5±2.0 and this difference was statistically significant(p-value <0.1).

Operative time was also affected by the BMI of the patient. There was slight correlation between the BMI of patient and operative time. Pearson's correlation coefficient was 0.56 in 3-ports group and 0.45 in 4-ports group. Besides this the conversion rate was also more in obese patients. The graph showing relationship between operative time and BMI is shown below.

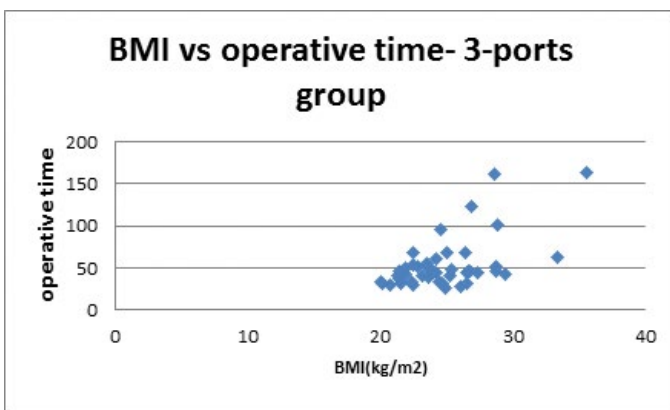


Fig 3: Correlation between BMI and operative time in 3-ports group

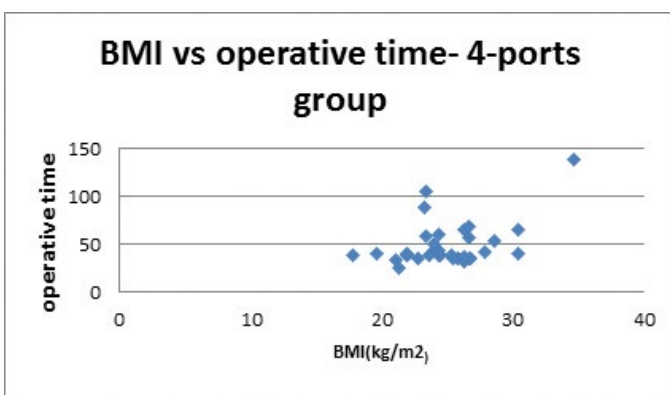


Fig 4: Correlation between BMI and operative time in 4-ports group

DISCUSSION

Laparoscopic cholecystectomy was introduced with the world seeking for safe, efficient and less invasive method for removal of gallbladder. Currently this procedure is one of the most common surgical

procedures being done in the world. Because of the safety and relative less complication of the procedure than the open method, the threshold of cholecystectomy for gallstone disease has decreased since its introduction.¹⁴ However the procedure is not free from complications. Biliary injury is one of the most dreaded complications of the procedure. The incidence of biliary injury after laparoscopic cholecystectomy is 0.5-3% and after open cholecystectomy it is 0.1-0.5%.¹⁵⁻¹⁸ With other lesser invasive techniques like SILS or 3-ports the incidence is thought to increase.¹⁹ Because the complications significantly increase the morbidity and overall cost to the patient, the safety of the procedure need to be evaluated before proceeding for these novel techniques.²⁰

Although the standard 4-ports technique is safe and cosmetically appreciable, the world is still seeking for lesser invasive and cosmetically better procedure. The availability of the surgeon and time factors are also important especially in the countries like Nepal where the number of surgeons is so few for them to prolong the operative procedure just for having cosmetically better scar. Previous studies have shown that laparoscopic cholecystectomy using only three ports is a safe method.²¹⁻²² Similar findings have been found in this study. This study has shown that there is no significant difference between the operating time between the 3-ports technique and 4-ports technique. The previous studies have shown many factors causing prolonged operative time in laparoscopic cholecystectomy like age, sex, BMI, ASA score, previous abdominal surgery, preoperative endoscopic retrograde cholangiopancreatography, acute cholecystitis, and surgeon's experience.²³ This study however showed no correlation between age and operative time in both the groups (pearson's correlation coefficient- 0.1). Sex of the patient was also not the determinant for the prolonged operative time in this study (p-value -0.25). The cases with CBD stones or previous surgeries were excluded in this study. The main determinants for prolonged operative time in this study were operative adhesions and BMI of the patient. Although there was wide variation of operative time taken in both the groups in this study resulting in high standard deviation, still it shows that the dense adhesions make the procedure difficult causing prolonged operative time in both the groups.

The need of conversion to 4-ports technique was determined mainly by the adhesions in the Calot's triangle. The adhesions around gallbladder was graded into minimal if there was flimsy adhesions, mild if there was fatty adhesions, moderate if there was omental adhesions and dense if there was dense fibrous adhesions. None of the patients who had minimal adhesions required conversion from 3-ports technique to 4-ports technique whereas six patients with mild adhesions, one patient with moderate adhesions and 6 patients with dense adhesions required conversion from 3-ports to 4-ports technique. Among the patients who did not require conversion to 4-ports technique sixteen had minimal adhesions, thirteen had mild adhesions, two had moderate adhesions and none had dense adhesions. This difference was statistically significant (p -value <0.001).

The conversion rate was higher in obese patients because of the difficulty in retraction among them. When the retraction was facilitated by adding extra port operative time was not prolonged much. The operative time was significantly higher in the patients who required conversion because of adhesions rather than the patients who required conversion because of obesity (p -value <0.1).

The 3-ports technique also did not increase the incidence of complications. Operative bleeding was insignificant in both the groups. There was no incidence of biliary injury in any groups. Biliary spillage was seen in six patients who had the procedure done using only three ports. In the cases where procedure was done using four ports biliary spillage was seen in four cases. This difference is not statistically significant (p -value <0.8). Postoperative wound infection was seen in two cases (4.5%) after 3-ports laparoscopic cholecystectomy which is similar to the other studies which shows infection rate after laparoscopic cholecystectomy to be around 1-4%.²⁴⁻²⁵ Three cases in 4-ports group (8.8%) had postoperative wound infection and this difference was not statistically significant (p -value <0.8). Postoperative pain grade in 3-ports group was 3.4 ± 0.7 and in 4-ports group was 3.7 ± 0.9 and this difference is statistically not significant (p -value <0.25). All these findings show that 3-ports technique is safe with regards to the complications that can occur to the patient.

CONCLUSION

This study shows that 3-ports technique for laparoscopic cholecystectomy is safe, efficient and acceptable option for selected patients of cholelithiasis. Adhesions around the gallbladder and BMI of the patient are the factors that determine the requirement for the conversion to 4-ports technique.

REFERENCES

1. Mosimann F. Laparoscopic cholecystectomy has become the new gold standard for the management of symptomatic gallbladder stones. *Hepatogastroenterology* 2006;53(69):1.
2. Reynolds W Jr. The first laparoscopic cholecystectomy. *JLS* 2001;5(1):89-94.
3. Kitano S, Matsumoto T, Aramaki M. Laparoscopic cholecystectomy for acute cholecystitis. *J HepatobiliaryPancreatSurg* 2002;9(5):534-7.
4. Chandler CF, Lane JS, Ferguson P, Thompson JE, Ashley SW (2000) Prospective evaluation of early versus delayed laparoscopic cholecystectomy for treatment of acute cholecystitis. *Am Surg* 66: 896-900.
5. Steiner CA, Bass EB, Talamini MA, et al. Surgical rates and operative mortality for open and laparoscopic cholecystectomy in Maryland. *N Engl J Med* 1994;330(6):403-8.
6. Delaitre B, Testas P, Dubois F. Complications of cholecystectomy by laparoscopic approach. *Chirurgie* 1992;118(1-2):92-9.
7. Fabiani P, Iovine L, Katkhouda J, et al. Dissection du triangle de Calot par voie coelioscopique. *Presse Med* 1993;22(11):535-7.
8. Strasberg SM, Hertl M, Soper NJ. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. *J Am Coll Surg* 1995;180(1):101-25.
9. Adams DB, Borowicz MR, Wootton FT 3rd, et al. Bile duct complications after laparoscopic cholecystectomy. *Surg Endosc* 1993;7(2):79-83.
10. Connor S, Garden OJ. Bile duct injury in the era of laparoscopic cholecystectomy. *Br J Surg* 2006;

- 93 (2):158-68.
11. Carr A, Bhavaraju A, Goza J, Wilson R. Initial experience with single-incision laparoscopic cholecystectomy. *Am Surg* 2010;76:703-7.
 12. Tacchino R, Greco F, Matera D. Single-incision laparoscopic cholecystectomy: surgery without a visible scar. *SurgEndosc* 2009;23:896-9.
 13. Davidoff AM, Pappas TN, Murray EA, Hilleren DJ, Johnson RD, Baker ME et al. Mechanisms of major biliary injury during laparoscopic cholecystectomy. *Ann Surg*. 1992;215(3):196-202.
 14. Escarce JJ, Chen W, Schwartz JS. Falling cholecystectomy thresholds since the introduction of laparoscopic cholecystectomy. *JAMA* 1995;273:1581-5.
 15. Moore MJ, Bennett CL. The learning curve for laparoscopic cholecystectomy. The Southern Surgeons Club. *Am J Surg* 1995;170(1):55-9.
 16. Bingham J, McKie LD, McLoughlin J, Diamond T. Biliary complications associated with laparoscopic cholecystectomy – an analysis of common misconceptions. *Ulster Med J* 2000;69 (2):106-11.
 17. Diamond T, Mole DJ. Anatomical orientation and cross-checking – the key to safer laparoscopic cholecystectomy. *Br J Surg* 2005; 92 (6): 663-64.
 18. Fletcher ER, Hobbs MS, Tan P, et al. Complications of cholecystectomy: risks of the laparoscopic approach and protective effects of operative cholangiography. A population based study. *Ann Surg* 1999;229:449-57.
 19. Marks J, Tacchino R, Roberts K, et al. Prospective randomized controlled trial of traditional laparoscopic cholecystectomy versus single-incision laparoscopic cholecystectomy: report of preliminary data. *Am J Surg* 2011;201:369-73.
 20. Glasgow RE, Cho M, Hutter MM, Mulvihill SJ. The spectrum and cost of complicated gallstone disease in California. *Arch Surg* 2000;135:1021-7.
 21. Cerci C, Tarhan OR, Barut I, Bulbul M. Three-port versus four-port laparoscopic cholecystectomy. *Hepatogastroenterology* 2007;54:15-16.
 22. Tagaya N, Kita J, Takagi K, Imada T, Ishikawa K, Kogure H, Ohyama O. Experience with three-port laparoscopic cholecystectomy. *J Hepatobiliary Pancreat Surg* 1998;5:309-311.
 23. M Zdichavsky et al. Impact of risk factors for prolonged operative time in laparoscopic cholecystectomy. *Eur J Gastroenterol Hepatol* 2012 Sep;24(9):1033-8.
 24. Jasim D Saud, Mushtaq Ch Abu Al-Hail. Surgical site infections after laparoscopic cholecystectomy. *Bas J Surg* 2010 March;16.
 25. M. jawein et al. Surgical site infection following cholecystectomy. *IJIC* 2008;4:1.