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Editorial

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Welcome to the September-December 2019, Volume 12, Number 3 issue of the World Journal of Laparoscopic Surgery. In this issue, we have many interesting articles. Longer life expectancies found in this century and increasing incidence of gallbladder stones with increasing age have resulted in a greater number of elderly patients being operated. In this issue, we have an article discussing the challenges of laparoscopic cholecystectomy in the elderly. Another good article is on port positions in cardiothoracic surgery is very important and, and another one on describing the principle behind correct port positions on cardiothoracic surgery. We also have information regarding laparoscopic ureterolysis without omentoplasty in the management of the uropathy secondary to idiopathic retroperitoneal fibrosis.

The year 2020 is ahead, and we are coming with some important enhancements. The first is that the journal will enable faster processing rate of the articles and give us scope to include more articles in a year. To get the best benefits out of this improvement, we encourage more practice-based articles, state-of-the-art content, and critical review articles. This will help us in scoring high in performance measures and moving up in journal-ranking lists.

Though the World Journal of Laparoscopic Surgery has a long history, and it continues to improve with time, we cannot ignore the importance ascribed to the ranking exercises. It is time for us to look at the WJOLS as a truly international publication of minimal access surgery and continue to work hard to help the journal in climbing up the ranking ladder.

Together we would work towards making this journal a truly influential publication. Comments, suggestions, and special issue proposals are always welcome.

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ORIGINAL ARTICLE

Laparoscopic vs Open Surgical Management of Adhesive Bowel Obstruction in Children: A Retrospective Study Comparing the Outcomes at a Tertiary Care Center for Pediatric Surgery

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Abstract

Background: Laparoscopic approach for management of adhesive bowel obstruction has become an established technique both in adults and children. There is an increased need of reporting of the outcome using this method of treatment in pediatric practice.

Aim: To compare the outcome of laparoscopic vs open surgery in children with adhesive bowel obstruction.

Materials and methods: Data were collected on children with adhesive bowel obstruction who were managed at a tertiary care level center for pediatric surgery from January 2007 to September 2017. Patients who were successfully managed by conservative management were excluded. Also the cases in which laparoscopic procedure was converted into an open surgery were excluded. Factors such as operative time, need for total parenteral nutrition, time to resume oral feeds, postoperative length of hospital stay, and complications during or after surgery were studied in laparoscopic and open group.

Results: Eighty children with adhesive intestinal obstruction were admitted. Eight were managed conservatively hence excluded. Forty-two were managed by open surgery and laparoscopic management was performed for 30. Four (10.3%) out of these were converted into open laparotomy. These were also excluded. Operative time was not significantly different between open (122 minutes) vs laparoscopic group (138 minutes). During dissection, complications like serosal tear were higher (20 vs 0) in the open group. Resection anastomosis (15 cases) and wound infections (6 cases) rate was also higher with open laparotomy. Mean time in days to start oral feeds (2.5 vs 5.9) and length of hospital stay (5.5 vs 11.3) was significantly shorter in laparoscopic group.

Conclusion: Laparoscopic management of adhesive bowel obstruction in children is safe and is associated with early postoperative recovery, shorter hospital stay and lower complication rate in comparison with open surgical management of these cases.

Keywords: Adhesive bowel obstruction, Laparoscopic management, Open laparotomy.

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Introduction

Postoperative adhesions are an inevitable outcome of abdominal surgery in both adult and pediatric populations. Up to 90–95% of adult patients develop intra-abdominal adhesions following a laparotomy.[1,2] Incidence of postoperative adhesive bowel obstruction in children has been reported in the range of 1–5% although it varies according to primary pathology and type of operation performed.[3–6] Adhesive bowel obstruction can occur anytime from the early postoperative period after the index operation to many decades later. The management of adhesive bowel obstruction continues to evolve in both adult and pediatric patients. Open laparotomy is widely accepted as the standard approach for patients with adhesive bowel obstruction in whom conservative treatment fails. In recent times, laparoscopic approach has become a widely accepted treatment modality for adhesive small bowel obstruction in adults because of its advantages like less pain, fast recovery and reduced morbidity.[7] Following its successful use in adult population, laparoscopic surgery has been increasingly used for the treatment of adhesive small bowel obstruction in children with good outcome.[8–10]

Although advanced laparoscopic surgery is now commonly available in the majority of tertiary pediatric centers for the treatment of both urgent and elective cases still data on the laparoscopic treatment of bowel obstruction due to adhesions are scarce. The purpose of this study was to report our institutional experience comparing outcomes in patients with adhesive bowel obstruction treated by laparoscopic adhesiolysis and open laparotomy.

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Materials and Methods

This retrospective study was conducted in the Department of Pediatric Surgery at Ibn Sina Hospital of Kuwait. This is a Tertiary Care

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Center for Pediatric Surgery dealing with all routine and emergency cases in pediatric surgery from newborn period till 12 years of age. In this study, charts of all the patients who were admitted with diagnosis of adhesive bowel obstruction from January 2007 to September 2017 were reviewed and analyzed. During first half of study period (January 2007–August 2012). All the patients who needed surgical intervention were managed by open laparotomy. In the second half of the study period (September 2012–September 2017), laparoscopic management was adopted and laparoscopic adhesiolysis was performed for these cases by the consultant pediatric surgeon who is well-versed with advanced laparoscopy. Adhesiolysis was performed by blunt and sharp dissection using bipolar diathermy in open laparotomy cases while in laparoscopic cases mostly sharp dissection was performed using laparoscopic scissors or laparoscopic energy device for thick bands. Children who were successfully managed with conservative treatment without any surgical intervention were excluded from this study. Also, the cases where the laparoscopic procedure was converted into an open laparotomy were excluded from the study. Demographic data of all the patients with diagnosis of adhesive intestinal obstruction were obtained. Details of primary pathology and surgical procedure, time between previous surgery and penetration, the duration of adhesiolysis surgery, intraoperative findings and techniques, need for total parenteral nutrition, duration of hospital stay, and complications were recorded for both the open and laparoscopic groups. After discharge from the hospital, all the patients were followed up for a minimum period of 1 year. Statistical analysis was carried out comparing open and laparoscopic group and significance was devised using paired *t*-test. $p < 0.05$ was considered statistically significant.

Results

Seventytwo of 80 children with adhesive bowel obstruction needed surgical intervention. These children aged between 2 months and 132 months (mean = 53.88 ± 37.58). There were 43 men and 29 women. All of these 72 children had undergone at least one surgical procedure before they had presented with adhesive bowel obstruction. Previous surgical procedures done on these children are shown in Figure 1. They include colostomy or ileostomy closure after anorectal malformation (five), Hirschsprung's disease (three cases), necrotizing enterocolitis (five cases), meconium ileus (three cases), appendicectomy (six cases), Meckel's diverticulum (three cases), intussusception (four cases), Ladd's procedure for malrotation (four cases), congenital diaphragmatic hernia (four cases), Nissen fundoplication (three cases), and six cases of intra-abdominal benign or malignant masses (ganglioneuroma 1, hepatoblastoma 1, Wilms tumor 1, mesenteric cyst 1, ovarian cyst 1, and one retroperitoneal cyst). In the open laparotomy group, mean age in months (51.83 ± 38.92) and weight in kilograms (19.58 ± 13.24) was not significantly different from laparoscopic group where mean age in months and weight in kilograms was 56.19 ± 35.79 and 17.50 ± 8.49, respectively. Mean duration since previous surgery in open laparotomy group was 20 months while in laparoscopic group it was 28 months. Average operative time was 138 minutes in laparotomy group and 122 minutes in laparoscopic group. Intraoperative findings were similar in both the groups. Transitional zone due to adhesive band or bands between proximal dilated and distal collapsed small intestine was observed in all patients in both open and laparoscopy group. In open laparotomy group, three patients (7.1%) had single obstructing band while multiple obstructing bands between the bowel loops and abdominal scar were seen in 39 (92.8%). Four patients (16.4%) in the laparoscopic group had a single thick obstructing band (Fig. 2) while in 22 (84.6%) of the laparoscopic group patients had multiple adhesive bands with scar and bowel loops (Fig. 3). During adhesiolysis in open surgery, serosal tears were reported in 20 patients and two of them needed intraoperative blood transfusion. None in laparoscopic group had this complication. In 35% (15) of laparoscopic cases, it was required to resect a segment of small intestine because it was of doubtful viability. No bowel resection and anastomosis was needed in laparoscopic group. In one case which was managed by open laparotomy left dome of diaphragm was injured while separating dense adhesions with diaphragmatic dome. It was repaired with interrupted nonabsorbable stiches. One case in each open and laparoscopic group developed postoperative pneumonia, which was managed chest physiotherapy and antibiotics. Wound complications like seroma and infection occurred in six cases in open laparotomy group. There were no wound-related complications in laparoscopic group. Thus, overall rate of intraoperative and postoperative complications was significantly higher in open laparotomy group ($p = 0.000$). Children in laparoscopic group were fed on postoperative day 2–4 (mean = 2.58) and no total parenteral nutrition was required for any patient in this group.

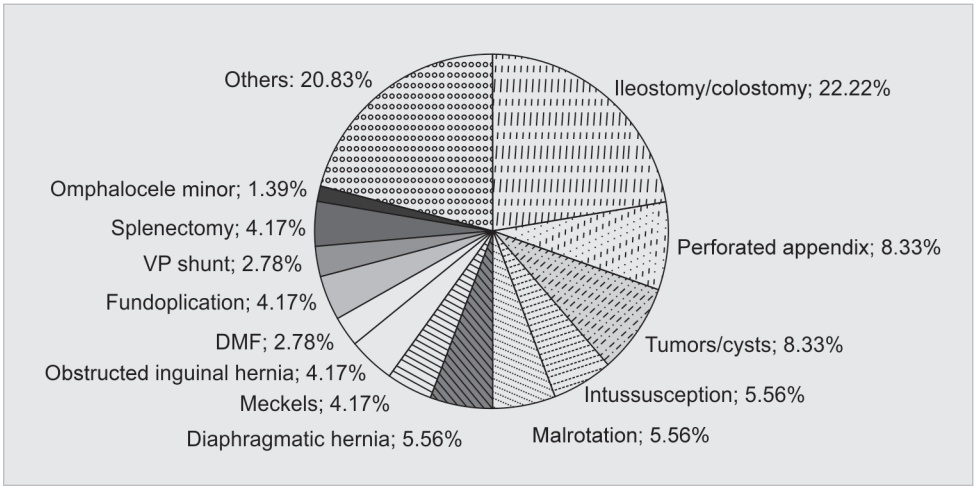

Fig. 1: Previous surgeries performed in all 72 patients with adhesive bowel obstruction

While in open laparotomy group oral feeds were delayed until day 5–9 (mean = 5.9) and total parenteral nutrition was required in many (36) of these cases length of hospital stay in laparoscopic group (range = 3–8 days, mean = 5.5 days) was significantly shorter ($p \leq 0.05$) than open laparotomy group (range = 6–27 days, mean = 11.3 days). Thus, over all postoperative recovery was better in the laparoscopic group (Table 1). After discharge, all patients were followed in outpatient department for any symptom or recurrence of adhesions for a minimum period of 12 months. Patients operated by open laparotomy follow-up for a period of 12–84 months and laparoscopic group patents were followed up from 12 months to 60 months after adhesiolysis. None of the patients in either group developed recurrence after surgery.

Discussion

In this retrospective study, we reviewed all cases of adhesive bowel obstruction managed in our department from January 2007 to September 2017. Nonoperative management was started in all children after admission and it was successful in eight of our cases. Initial conservative management is adopted in adult and pediatric practice for management of adhesive bowel obstruction but the success of conservative treatment in children varies between different studies.[11–14] Certain pediatric surgical procedures like ileostomy closure or formation, Ladd's procedure for malrotation, appendicectomy for perforated appendix and tumor surgery are more prone to adhesion formation.[6,15–17] In our series, ileostomy or colostomy closure after anorectal malformation, Hirschsprung's disease and necrotizing enterocolitis, appendicectomy for perforated appendix, Meckel's diverticulectomy, open surgery for intussusception, various tumors and cyst excisions, and Nissen fundoplication were among frequent surgical procedures, which led to the adhesive intestinal obstruction (Fig. 1). Historically, laparotomy with lysis of adhesions has been the conventional management for adhesive small bowel obstruction in children.[18,19] In the adult literature, there have been multiple retrospective publications demonstrating the utility of laparoscopy in the treatment of adhesive small bowel obstruction. They show earlier recovery of bowel function and reduced length of stay and decreased incisional complications. In addition, laparoscopy has the theoretical advantage of reducing additional adhesion formation and thus recurrence.[20,21] There are no randomized, controlled trials in the literature that examine the role of laparoscopy in treating adhesions in children and there are actually few publications that examine the role of laparoscopy in the management of adhesions in children. However, recent review articles and case series advocate laparoscopic management of adhesive bowel obstruction in children.[8–10] At our institute, we have adopted laparoscopic adhesiolysis since 2012. Our conversion rate of 10.3% is lower than 23–30% conversion rate reported by other investigators.[8,22–24] All our laparoscopic adhesiolysis surgeries are performed by an experienced pediatric surgeon who is well versed with advanced laparoscopic skills in children. We always try to keep laparoscopic adhesiolysis as first case in our operation theater in morning hours as far as possible so that operating surgeon can work at ease in comfortable environment. First, trocar is placed by open technique. We lyse adhesion with sharp dissection and energy device was used cautiously to divide

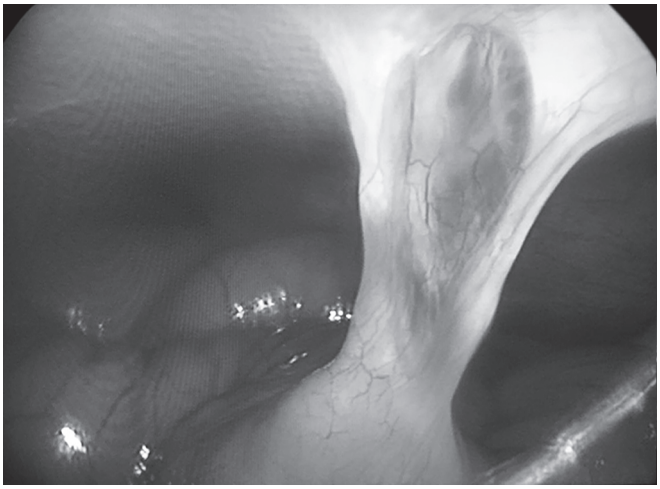

Fig. 2: Laparoscopic view of single adhesive band

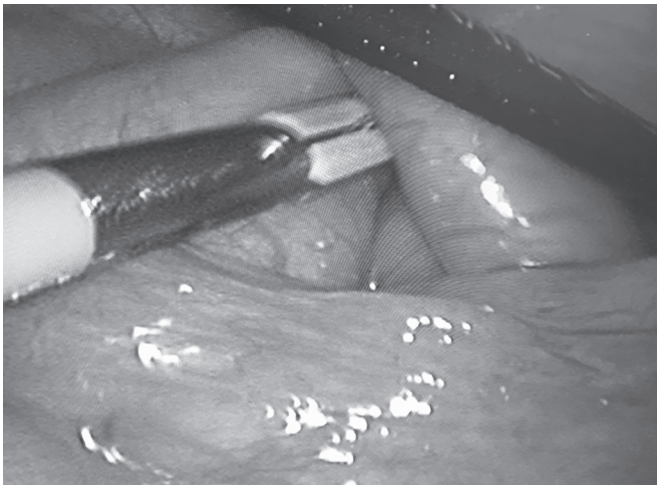

Fig. 3: Laparoscopic view of multiple adhesive bands between bowel loops

Table 1: Comparing outcome between open and laparoscopic group

	Mean age in months	*Mean weight in kilograms*	*Day of start in minute mean*	*Complications*			*Day of start of oral feeds (mean)*	*Length of hospital stay in days (mean)*
				ST	*RA*	*WI*		
Open laparotomy ($n = 42$)	51.8 ± 38.9	19.59 ± 13.2	122 ± 18	20	15	6	5.95 ± 1.56	11.38 ± 4.13
Laparoscopic ($n = 26$)	56.19 ± 35.79	17.50 ± 8.49	138 ± 19	0	0	0	2.58 ± 0.57	5.50 ± 1.39
Paired *t* test *p* value	0.400**	0.923**	0.670**	0.000*			0.000*	0.000*

*p value <0.05 is significant; **p value >0.05 is insignificant
ST, serosal tear
RA, resection and anastomosis
WI, wound infection

thick vascular bands away from the bowel wall. We always run the bowel from duodeno-jejunal junction till ileo-caecal area to make sure we lyse all adhesions and to inspect the bowel for any iatrogenic injury. While comparing intraoperative and postoperative complications in our open laparotomy group and laparoscopic group we observed that serosal tear happened in 20 out of 42 open surgery cases while no such injuries occurred in laparoscopic group. This could be because of the fact that in laparoscopic group adhesions were divided more precisely and always under magnified vision. Serosal tears and subsequent bleeding could be one of the reasons for prolonged ileus in open surgery cases. In 15 (35%) out of 42 cases managed by open laparotomy resection anastomosis of the intestine was done which will definitely delay recovery of intestinal function. Laparoscopic incisions have a lower incidence of wound related complications and this was evident in our study as well where six cases had seroma or wound infection in laparotomy group. There was no wound related complication in laparoscopic group which could be one reason for shorter hospital stay in this group of patients. Lee et al. studied a large, pediatric administrative database to examine the management of adhesive small bowel obstruction and found that laparoscopic treatment was associated with shorter median length of stay (6 vs 8 days), lower postoperative complication rates (5.6% vs 10.4%), and lower mean total hospital costs.[25] Although our study has limitations like retrospective nature of the study and small sample size but our results are encouraging to continue laparoscopic management of adhesive bowel obstruction. Results from our study indicate that time to start oral feeds (2.5 vs 5.9 days), length of hospital stay in days (5.5 vs 11.3), and serosal tear rate (0 vs 20), need for resection anastomosis (0 vs 15) were significantly lower ($p \leq 0.05$) in laparoscopic group in comparison to open laparotomy group. Thus, we conclude that laparoscopic management of adhesive bowel obstruction in children can be safely carried out by an experienced laparoscopic pediatric surgeon and it is associated with better outcome in form of early starting of oral feeds, shorter length of hospital stay, and less complications in comparison to open laparotomy although more randomized control studies are required to support our observations.

References

1. Menzies D. Peritoneal adhesions. Incidence, cause, and prevention. Surg Annu 1992;24(Pt 1):27–45.
2. Luijendijk RW, de Lange DC, Wauters CC, et al. Foreign material in postoperative adhesions. Ann Surg 1996;223(3):242–248. DOI: 10.1097/00000658-199603000-00003.
3. Lautz TB, Barsness KA. Adhesive small bowel obstruction-acute management and treatment in Children. Semin Pediart Surg 2014;23(6):349–352. DOI: 10.1053/j.sempedsurg.2014.06.006.
4. Festen C. Postoperative small bowel obstruction in infants and children. Ann Surg 1982;196(5):580–583. DOI: 10.1097/00000658-198211000-00012.
5. Grant HW, Parker MC, Wilson MS, et al. Population based analysis of the risk of adhesion-related readmissions after abdominal surgery in children. J Pediatr Surg 2006;41:1453–1456. DOI: 10.1016/j.jpedsurg.2006.04.023.
6. Grant HW, Parker MC, Wilson MS, et al. Adhesions after abdominal surgery in children. J Pediatr Surg 2008;43:152–157. DOI: 10.1016/j.jpedsurg.2007.09.038.
7. O'Connor DB, Winter DC. The role of laparoscopy in the management of acute small-bowel obstruction: a review of over 2000 cases. Surg Endosc 2012;26(1):12–17. DOI: 10.1007/s00464-011-1885-9.
8. Apelt N, Featherstone N, Giuliani S. Laparoscopic treatment for adhesive small bowel obstruction: is it the gold standard in children too? Surg Endosc 2013;27(10):3927–3928. DOI: 10.1007/s00464-013-2891-x.
9. Anderson SA, Beierle EA, Chen MK. Role of laparoscopy in the prevention and in the treatment of adhesions. Semin Pediatr Surg 2014;23(6):353–356. DOI: 10.1053/j.sempedsurg.2014.06.007.
10. Alemayehu H, David B, Desai AA, et al. Laparoscopy for small bowel obstruction in children-An Update. J Laparoendosc Adv Surg Tech A 2015;25(1):73–76. DOI: 10.1089/lap.2014.0228.
11. Devens K. Recurrent intestinal obstruction in the neonatal period. Arch Dis Child 1963;38:118–119. DOI: 10.1136/adc.38.198.118.
12. Janik JS, Ein SH, Filler RM, et al. An assessment of the surgical treatment of adhesive small bowel obstruction in infants and children. J Pediatr Surg 1981;16(3):225–229. DOI: 10.1016/S0022-3468(81)80669-0.
13. Akgur FM, Tanyel FC, Buyukpamukcu N, et al. Adhesive small bowel obstruction in children: the place and predictors of success for conservative treatment. J Pediatr Surg 1991;26:37–41. DOI: 10.1016/0022-3468(91)90422-P.
14. Vijay K, Anindya C, Bhanu P, et al. Adhesive small bowel obstruction (ASBO) in children—role of conservative management. Med J Malaysia 2005;60(1):81–84.
15. Murphy FL, Sparnon AL. Long-term complications following intestinal malrotation and the Ladd's procedure: a 15-year review. Pediatr Surg Int 2006;22(4):326–329. DOI: 10.1007/s00383-006-1653-4.
16. Tsao KJ, St Peter SD, Valusek PA, et al. Adhesive small bowel obstruction after appendectomy in children: comparison between the laparoscopic and open approach. J Pediatr Surg 2007;42(6):939–942. DOI: 10.1016/j.jpedsurg.2007.01.025[discussion 942].
17. Aguayo P, Ho B, Fraser JD, et al. Bowel obstruction after treatment of intra-abdominal tumors. Eur J Pediatr Surg 2010;20(4):234–236. DOI: 10.1055/s-0030-1253401.
18. Wilkins BM, Spitz L. Incidence of postoperative adhesion obstruction following neonatal laparotomy. Br J Surg 1986;73(9):762–764. DOI: 10.1002/bjs.1800730929.
19. Jolley SG, Tunell WP, Hoelzer DJ, et al. Postoperative small bowel obstruction in infants and children: a problem following Nissen fundoplication. J Pediatr Surg 1986;21(5):407–409. DOI: 10.1016/S0022-3468(86)80509-7.
20. Mancini GJ, Petroski GF, Lin WC, et al. Nationwide impact of laparoscopic lysis of adhesions in the management of intestinal obstruction in the US. J Am Coll Surg 2008;207(4):520–526. DOI: 10.1016/j.jamcollsurg.2008.04.026.
21. Kelly KN, Iannuzzi JC, Rickles AS, et al. Laparotomy for small-bowel obstruction: first choice or last resort for adhesiolysis? A laparoscopic approach for small-bowel obstruction reduces 30-day complications. Surg Endosc 2014;28(1):65–73. DOI: 10.1007/s00464-013-3162-6.
22. Becmeur F, Besson R. GECI. Treatment of small-bowel obstruction by laparoscopy in children multicentric study. Eur J Pediatr Surg 1998;8(6):343–346. DOI: 10.1055/s-2008-1071229.
23. Shalaby R, Desoky A. Laparoscopic approach to small intestinal obstruction in children: a preliminary experience. Surg Laparosc Endosc Percutan Tech 2001;11(5):301–305. DOI: 10.1097/00129689-200110000-00003.
24. Aguayo P, Fraser JD, Ilyas S, et al. Laparoscopic management of small bowel obstruction in children. J Laparoendosc Adv Surg Tech A 2011;21(1):85–88. DOI: 10.1089/lap.2010.0165.
25. Lee J, Tashjian DB, Moriarty KP. Surgical management of pediatric adhesive bowel obstruction. J Laparoendosc Adv Surg Tech A 2012;22(9):917–920. DOI: 10.1089/lap.2012.0069.

ORIGINAL ARTICLE

Laparoscopic Cholecystectomy: Challenges and Outcomes of the Procedure in Elderly Patients

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Abstract

Introduction: Gallstone disease is more prevalent in the elderly population besides having comorbid conditions and poor physiological reserves as compared with their younger counterpart. Laparoscopic procedures have certain inherent technical limitations and unique physiological demands. Hence, the procedures may have higher complications in elderly patients and need evaluation in this age-group of patients.

Aim: This study is aimed to evaluate the safety of the procedure of laparoscopic cholecystectomy in elderly patients in terms of preoperative and intraoperative difficulties, postoperative complications, morbidity, and mortality.

Materials and methods: The study was conducted retrospectively, collecting data from hospital record of a total of 390 patients (45 elderly patients) operated during a period from 2012 to 2017.

Results: The mean age of elderly patients was 66.7 years. All the patients who underwent laparoscopic cholecystectomy had an American Society of Anesthesiologist (ASA) score of I or II. Intraoperative difficulties were encountered in 35.55% patients. Average hospital stay was 2.5 days. One patient had a minor bile leak. No mortality occurred.

Conclusion: Procedure of laparoscopic cholecystectomy is safe in elderly patients.

Keywords: Elderly patients, Laparoscopic cholecystectomy, Procedural challenges.

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Introduction

Prevalence of gallstone disease increases with age.[1,2] Further, symptoms and complications of gallstones increase with age, leading to more frequent cholecystectomies.[3] As laparoscopic procedures have inherent technical limitations compared to open surgical procedures,[4] the procedure of laparoscopic cholecystectomy may have higher rate of complications in elderly patients due to the frequent comorbid conditions and poor functional reserves.[5] Hence, elderly patients may be considered as a separate group of patients for laparoscopic cholecystectomy. The present study is aimed to evaluate the procedure for its outcome and challenges in elderly patients.

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Conflict of interest: None

Aim

The aim of the study is to evaluate the safety of laparoscopic cholecystectomy in elderly patients in terms of preoperative and intraoperative difficulties, postoperative complications, morbidity, and mortality.

Materials and Methods

This study was conducted retrospectively, in the Department of General Surgery, at GGS Medical College, Faridkot, Punjab. We searched the hospital record of 390 patients who underwent laparoscopic cholecystectomy during a period from 2012 to 2017. Of these 390 patients, 45 patients were found to be in elderly age-group, i.e., >60 years (according to the World Health Organization definition for developing countries). Preoperative, intraoperative, and postoperative records of these patients were analyzed in terms of the ASA score, comorbid conditions, intraoperative bleeding, adhesions, difficulties of dissection, injury to organs and bile duct, operative time, conversion rate, hospital stay, and postoperative complications. The results were compared with other studies. All these patients were operated under general anesthesia and surgeries were performed by trained surgeons. Procedures were performed by four port techniques, using 10 mm, 30° telescope, and using titanium clips to ligate cystic duct and cystic artery. Gallbladder was dissected from fossa using monopolar electrocautery and extracted through 10 mm epigastric port. Postoperatively all the patients were managed in general wards and broad-spectrum antibiotics were used for 5–7 days.

Results and Discussion

Frequency of gallstones increases after the age of 40 to become 4–10 times more in older individuals and laparoscopy is gradually replacing common surgical procedures.[6,7] Our study comprises 45 elderly patients among a total of 390 patients who underwent laparoscopic cholecystectomy, during the mentioned period. In this study, the mean age of elderly patients was 66.7 years (range 61–76 years), and majority of the patients was female, with a male to female ratio of 1:2.75. When stratified for age, we observed that 82.22% patients was in 60–70 years age-group, whereas 17.77%

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was above 70 years. Although in epidemiological studies,[6] the prevalence of disease is reported to rise in conjunction with age, in our study, an inverse trend in age distribution with respect to the number of procedures (Table 1) reflects that lesser number of laparoscopic surgeries was conducted in higher age-groups. This can be justified by reports that laparoscopic surgery in elderly patients becomes more challenging due to the unique physiological demands of the procedure[8] and also the ASA score (American Society of Anesthesiologists score) increases with age, increasing the risk of anesthesia.[9,10] All the patients who underwent laparoscopic cholecystectomy had an ASA score of I or II, including those 17 patients (37.77%) who had comorbid conditions, i.e., hypertension and diabetes mellitus. So this suggests the patient selection pattern, i.e., only those patients who qualified the risk criteria were selected for the procedure.

In a considerable number of patients, i.e., 16 (35.55%), one or multiple difficulties were encountered intraoperatively as shown in the Venn diagram (Fig. 1). This has been reported in literature also that elderly patients suffer from repeated inflammation, resulting in adhering to the surrounding structures, rendering laparoscopic surgery difficult.[11,12] We found that 13 patients (28.88%) had difficult anatomy of Calot's triangle and in 5 patients (11.11%) dense adhesions were found with omentum, colon, and duodenum. Intraoperatively uncontrolled bleeding occurred in 5 patients (11.11%). This occurred from gallbladder fossa in two patients and cystic artery in three patients. This figure is in agreement with other series, in which the incidence of bleed has been reported to be nearly 10%, irrespective of the age of the patients.[13] So this suggests that the procedure does not carry any extra risk of bleeding in elderly people. Difficulty in extraction of gallbladder was experienced in seven (15.55%) patients. This was due to the either large number or large size of stones. Spillage of stones occurred in these patients. The procedure had to be converted to open in 13.33% (6 patients) and the final outcome was without any complication. This figure is higher than a standard conversion rate of 5–10%, mentioned in literature[14] but comparable to a figure, i.e., 14.7% mentioned in another study upon elderly patients.[15] The conversion was due to multiple and concomitant intraoperative difficulties, i.e., poor visualization of anatomy, adhesions, intraoperative bleeding from cystic artery or gallbladder fossa, which has been mentioned as an important cause by other studies also.[15] Operative procedure was uneventful in 29 patients. The mean operative time for all these patients was 80 minutes, which is in accordance with the mean 75 minutes in a similar study.[16] This suggests that the procedure involves operative difficulties in a significant proportion of elderly patients due to the chronicity of disease. Despite operative difficulties encountered in 16 cases, in 62.5% cases operative challenges could be successfully managed. We did not find any reporting of iatrogenic injury to visceral organ, major blood vessel, or bile duct. Therefore, more operative difficulties and comparatively higher conversion rate cannot be interpreted as a lack of procedural safety.

Table 1: Distribution of patients according to age

Age-group (years)	*No. of procedures*
60–65	18
66–70	19
71–75	6
75–80	2
	Total = 45

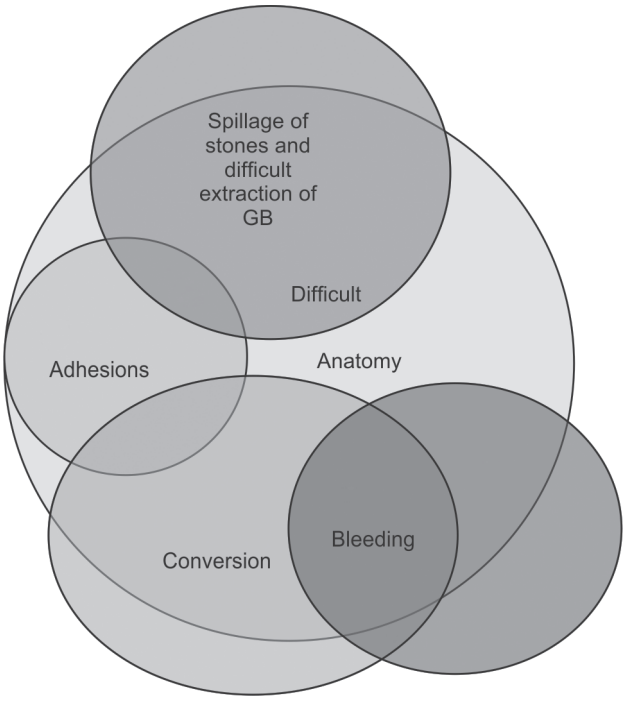

Fig. 1: Intraoperative difficulties

Average hospital stay was 2.5 days. In terms of morbidity and mortality, we had a low complication rate. Postoperatively, one patient had a minor bile leak which was managed by endoscopic retrograde cholangiopancreatography (ERCP) and common bile duct (CBD) stenting. Intraoperatively or postoperatively none of the patients developed any cardiac or respiratory complication and no mortality occurred. Although in some comparative studies of elderly vs young patients a higher morbidity has been reported in elderly patients,[17] a low complication rate has been reported by Marcari et al. even in octogenarians.[18] Therefore, age is not a contraindication for the procedure. Patient selection, considering risk and comorbid conditions besides timely conversion of the procedure, and weighing the intraoperative difficulties affect the outcomes of procedure. This study being retrospective in nature, exclusion and inclusion criteria, i.e., proper selection criteria, could not be determined exactly, and this was the limitation of the study. Further studies are required to determine patient selection criteria and hence to improve the outcome of the procedure.

Conclusion

Procedure of laparoscopic cholecystectomy is safe in elderly patients. Operative challenges can be managed by adequate experience and timely conversion. Proper patient selection by preoperative assessment can minimize the risk of complications.

References

1. Coelho JC, Bonilha R, Pitaki SA, et al. Prevalence of gallstones in a Brazilian population. Int Surg 1999;84(1):25–28.
2. Festi D, Dormi A, Capodicasa S, et al. Incidence of gallstone disease in Italy: results from a multicenter, population-based Italian study. World J Gastroenterol 2008;14(34):5282–5289. DOI: 10.3748/wjg.14.5282.
3. Völzke H, Baumeister SE, Alte D. Independent risk factors for gallstone formation in a region with high cholelithiasis prevalence. Digestion 2005;71(2):97–105. DOI: 10.1159/000084525.
4. Bergamaschi R, Arnaud J. Immediately recognizable benefits and drawbacks after laparoscopic colon resection for benign disease. Surg Endosc 1997;11(8):802–804. DOI: 10.1007/s004649900457.

5. Pessaux P, Tuech JJ, Derouet N, et al. Laparoscopic cholecystectomy in the elderly: a prospective study. Surg Endosc 2000;14(11):1067–1069. DOI: 10.1007/s004640000267.
6. Shaffer EA. Epidemiology and risk factors for gallstone disease: has the paradigm changed in the 21st century? Curr Gastroenterol Rep 2005;7(2):132–140. DOI: 10.1007/s11894-005-0051-8.
7. Bates AT, Divino C. Laparoscopic surgery in the elderly: a review of the literature. Aging Dis 2015;6(2):149–155. DOI: 10.14336/AD.2014.0429.
8. Safran DB, Orlando R. Physiologic effects of pneumoperitoneum. Am J Surg 1994;167(2):281–286. DOI: 10.1016/0002-9610(94)90094-9.
9. O'Leary E, Hubbard K, Tormey W, et al. Laparoscopic cholecystectomy: haemodynamic and neuroendocrine responses after pneumoperitoneum and changes in position. Br J Anaesth 1996;76(5):640–644. DOI: 10.1093/bja/76.5.640.
10. Struthers AD, Cuschieri A. Cardiovascular consequences of laparoscopic surgery. Lancet 1998;352(9127):568–570. DOI: 10.1016/S0140-6736(97)11478-7.
11. Polychronidis A, Botaitis S, Tsaroucha A. Laparoscopic cholecystectomy in elderly patients. J Gastrointestin Liver Dis 2008;17(3):309–313.
12. Simopoulos C, Botaitis S, Polychronidis A, et al. Risk factors for conversion of laparoscopic cholecystectomy to open cholecystectomy. Surg Endosc 2005;19(7):905–909. DOI: 10.1007/s00464-004-2197-0.
13. Kaushik R. Bleeding complications in laparoscopic cholecystectomy: incidence, mechanisms, prevention and management. J Minim Access Surg 2010;6(3):59–65. DOI: 10.4103/0972-9941.68579.
14. Palanivelu C. Laparoscopic cholecystectomy. In: Parthasarthi R. Art of laparoscopic Surgery, 1st ed., vol. 1 India: Jaya Publications; 2005; p. 570.
15. Yetkin G, Uludag M, Oba S, et al. Laparoscopic cholecystectomy in elderly patients. JSLS 2009;13(4):587–591. DOI: 10.4293/108680809X1258998404604.
16. Agrusa A, Romano G, Frazzetta G, et al. Role and outcomes of laparoscopic cholecystectomy in the elderly. Int J Surg 2014;12(Suppl 2):S37–S39. DOI: 10.1016/j.ijsu.2014.08.385.
17. Qasaimeh GR, Banihani MN. Laparoscopic cholecystectomy in the elderly and young: a comparative study. Hepatogastroenterology 2012;59(113):22–25. DOI: 10.5754/hge10198.
18. Marcari RS, Lupinacci RM, Nadal LR, et al. Outcomes of laparoscopic cholecystectomy in octogenarians. JSLS 2012;16(2):271–275. DOI: 10.4293/108680812X13427982376428.

ORIGINAL ARTICLE

Effect of Bariatric Surgery on Anthropometric and Biochemical Parameters in Morbidly Obese Patients

Ashish Ahuja[1], Jagdeep Choudhary[2], Preeti Bajaj[3]

Abstract

Background: The aim of this study was to evaluate the effect of bariatric surgery on the anthropometric and biochemical parameters of patients. The effect of surgery on anthropometric parameters like weight, body mass index (BMI), waist circumference, hip circumference, and waist–hip ratio was studied. The biochemical parameters included glycated hemoglobin A (HbA1c) and lipid profile [serum cholesterol, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL)].

Materials and methods: The study was conducted in a tertiary healthcare center in a 1.5-year period on male obese subjects who had undergone bariatric surgery for morbid obesity. Thorough preoperative evaluation was done by a bariatric team which included the bariatric surgeon, dietician, endocrinologist, chest physician, anesthesiologist, and cardiologist. A total of 17 patients who underwent surgery for morbid obesity and gave consent were included in the study and were followed up for 3 months thereafter.

Results: Significant weight loss along with a significant decrease in BMI, waist circumference, hip circumference, and waist–hip ratio was observed at 4 weeks and 3 months after bariatric surgery. A statistically significant difference was seen in the fall in HbA1c levels. There was a significant effect on serum cholesterol, serum triglycerides, and serum HDL and LDL levels. No statistically significant difference was seen in serum VLDL levels.

Conclusion: Significant weight loss after bariatric surgery in men results in improved clinical outcomes. Lipid profile and glycemic control also improved in patients over follow-up time. The improvement in metabolic parameters may serve as motivators for obese men considering surgery.

Keywords: Anthropometry, Bariatric surgery, Glycated hemoglobin A, Morbid, Obesity, Weight loss.

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Introduction

Obesity is a worldwide epidemic. It is one of the leading preventable causes of death all over the world with an increasing prevalence in both adults and children. It is one of the most serious public health problems of the 21st century.[1]

Globally, there are more than 1 billion adults who are overweight with at least 300 of them being obese. Obesity is now recognized as a "disease" because it is a physiologic dysfunction of the human organism with environmental, genetic, and endocrinological causes.

Obesity most commonly develops when the caloric intake of food exceeds energy expenditure over a prolonged period of time. Factors influencing obesity involve energy intake or expenditure (or both) and are affected by genetic, behavioral, cultural, along with socioeconomic factors. Obesity is calculated as Quetelet's body mass index (BMI) which is a ratio of weight (measured in kilograms) to height (measured in square meters). Persons with BMI >30 kg/m^2 are considered as obese. Morbid obesity (BMI >40 kg/m^2) is the harbinger of many diseases that affect essentially every organ system like cardiovascular, respiratory, metabolic, musculoskeletal, endocrinal, reproductive, dermatological, neurological, and many more.[2] Bariatric surgery has been recognized as the most effective treatment for morbid obesity.[3]

Various options which are available for the treatment of obesity can be broadly categorized into nonsurgical management and surgical interventions. Nonsurgical management of obesity includes behavioral modifications and interventions, pharmacotherapy for weight loss, dietary and herbal medications, and implanted electrical stimulators.

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However, surgical procedures are currently the most effective therapy for long-term weight loss.[4] In clinical trials, long-term survival is better in the surgically treated group than in those managed conservatively. Furthermore, some of these operations lead to the rapid remission of type II diabetes in a weight loss independent manner.[5]

The number of bariatric procedures performed in the United States increased from 13,365 in 1998 to more than 200,000 in 2008.[6] Bariatric surgery is usually considered when other weight loss efforts have failed. National Institutes of Health Consensus Development Conference Panel established the eligibility criteria in 1991. These still remain the most widely accepted criteria. Selection and exclusion criteria are listed in Table 1.[7–10]

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Table 1: Selection and exclusion criteria for bariatric surgery

Selection criteria
Able to adhere to postoperative care (e.g., follow-up visits and tests, medical management, and use of dietary supplements)
BMI ≥40 kg/m^2
BMI ≥35 kg/m^2 with obesity-related comorbidity
Previous failed nonsurgical attempts at weight reduction, including nonprofessional programs (e.g., weight watchers)
Exclusion criteria
Cardiopulmonary disease that would make the risk prohibitive
Current drug or alcohol abuse
Lack of comprehension of risks, benefits, expected outcomes, alternatives, and required lifestyle changes
Reversible endocrine or other disorders that can cause obesity
Uncontrolled severe psychiatric illness

The current surgical options can be broadly classified as gastric restrictive, malabsorptive procedures, or a combination of these two.[11] Jejunoileal bypass is the archetype malabsorptive procedure but has been largely abandoned because of profound adverse metabolic consequences that include renal calculi, vitamin deficiency, hypokalemia, hepatic dysfunction, and osteoporosis.[12] Bariatric surgery has been shown to decrease fat mass in various studies that measured body composition after bariatric surgery.[13] There is a decrease in both subcutaneous and visceral fat after bariatric surgery.[14]

Three procedures are commonly done: (i) laparoscopic adjustable gastric banding (LAGB), (ii) laparoscopic sleeve gastrectomy (LSG), and (iii) Roux-en-Y gastric bypass (RYGB). In LAGB, a hollow, flexible silicone band is placed around the upper stomach, which causes a restrictive effect thereby reducing stomach capacity and, henceforth, causes rapid feelings of satiety. The band is tightened by injecting saline into the band via a subcutaneous port which is located just inferior to the sternum or lateral to the umbilicus.

The LSG procedure resects most of the body and all of the fundus of the stomach, creating a long, narrow, tubular stomach. This procedure was first used as an initial step before a malabsorptive procedure in very high-risk patients but is now approved as a primary stand-alone procedure.[15,16]

In RYGB, a small gastric pouch is formed by dividing the upper stomach and joining it with the resected end of jejunum, so that food bypasses the stomach and upper small bowel, thereby restricting the size of the stomach and causing some malabsorption. Roux-en-Y gastric bypass may be a better choice in more obese patients and in those with type II diabetes [RYGB is the most common procedure (51%) performed in the United States and Canada, followed by LAGB (44%)].[17] The biliopancreatic diversion, with or without duodenal switch, is an older procedure that is no longer commonly performed.[6]

The choice of procedure depends on the expertise of the surgeon and surgical center, patient preference, and risk stratification. Several studies have shown that the risk of serious complications decreases with increasing procedure volume of the surgeon and center.[18–21]

Aims and Objectives

The aim of this study was to study the effect of bariatric surgery on the anthropometric and biochemical parameters of patients. The effect of surgery on anthropometric parameters like weight, BMI, waist circumference, hip circumference, and waist–hip ratio was studied. The biochemical parameters included HbA1c and lipid profile (serum cholesterol, triglycerides, HDL, LDL, and VLDL).

Materials and Methods

Preoperative Evaluation

The study was carried out in the Department of Surgery, Dayanand Medical College and Hospital, Ludhiana, on male obese subjects who underwent bariatric surgery for morbid obesity. After due institutional ethics committee approval, the study was conducted in a 1.5-year time period. Preoperative evaluation was done by a dedicated bariatric team which included the bariatric surgeon, dietician, endocrinologist, gastroenterologist, respiratory medicine physician, psychiatrist, anesthesiologist, and cardiologist.

The preoperative preparation of the patient included the following:

Counseling

All patients were counseled regarding:

- Management options available for obesity, including diet, exercise, pharmacotherapy, and surgery.
- Expected weight loss and benefits in terms of sustained weight loss and resolution/improvement of comorbidities.
- General information regarding all available surgical options and risks of surgery including irreversibility of the procedure.
- Need for regular follow-up and strict compliance with the dietary, exercise, and lifestyle modifications advised before and after the surgery.

Nutritional Counseling

Preoperative and postoperative diet was planned in consultation with the dietician. The target weight was calculated in that session.

Detailed Patient Interview to be Included

Specific inclusion and exclusion criteria and appropriate statistical methods and tests were applied (Table 1).

Patient's complete medical history including history of diabetes mellitus (DM), hypertension, hypothyroidism, and other comorbidities along with details of treatment, duration, and the dosages of medicines was obtained.

- History of sleep apnea and snoring, including requirement for assisted ventilation, home-based oxygen therapy.

All patients underwent a comprehensive multidisciplinary bariatric evaluation, which included the following:

- Cardiology evaluation: electrocardiogram, echocardiography, and, if required, stress thallium.
- Gastroenterology evaluation: an upper gastrointestinal endoscopy was done to rule out reflux esophagitis, hiatus hernia, and gastric ulcers.
- Evaluation by pulmonary physician included pulmonary function tests and arterial blood gas analysis.
- Endocrinology evaluation for detection, assessment and management of diabetes and hypothyroidism.

Out of a total of 17 patients, 12 (70.59%) underwent laparoscopic sleeve vertical gastrectomy (LSVG). Mini gastric bypass (MGB) was performed in 4 (23.53%) and open sleeve gastrectomy (OSG) in

1 patient (5.88%) (Fig. 1). Thepatients were kept on a follow-up for 3 months from the date of surgery. Particulars and demographic data of each patient were duly noted including their name, age, sex, occupation, admission number, occupation, and address for any future correspondence (Table 2).

The detailed history of each patient was obtained including history of presenting symptoms, any preexisting comorbid conditions, and the patient's past history including treatment and surgical history.

General physical examination and a thorough systemic examination of all patients were carried out at the time of admission. All the necessary routine preliminary investigations were done. All patients underwent specific anthropometric measurements such as weight, BMI, waist circumference, hip circumference, and waist–hip ratio, which were noted preoperatively and at 4 weeks and 3 months postoperatively. The laboratory investigations included HbA1c and lipid profile, e.g., serum triglycerides, serum cholesterol, serum HDL, serum LDL, and serum VLDL.

Patients presenting included in the study underwent hematological, biochemical, and radiological investigations. For this, patients included in the study were informed regarding their inclusion, and a written informed consent was obtained from all the patients included in the study.

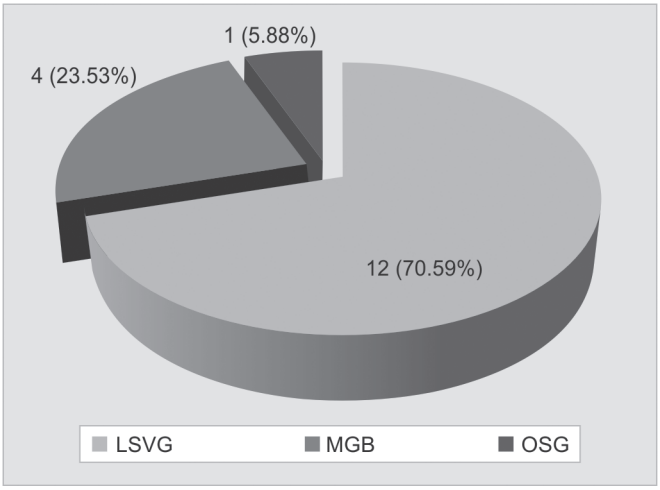

Fig. 1: Distribution of patients on the basis of procedure done

Table 2: Demographic data

Number (*n*)	17
Mean age (years)	43 ± 7.624
Mean height (m)	172.47 ± 6.09
Mean weight (kg)	138.71 ± 17.51
Mean BMI (kg/m^2)	46.67 ± 6.230

Results

Effect on Anthropometric Parameters

Weight was measured before surgery, at 4 weeks, and 3 months after surgery as depicted in Table 3. Preoperatively mean weight was 138.71 ± 17.51 kg. Significant weight loss was observed at 4 weeks and 3 months when mean weight was 130.47 ± 14.77 kg and 116.53 ± 15.64 kg, respectively, thus concluding that the procedure of bariatric surgery results in effective weight loss.

Body mass index is calculated by weight (in kg) divided by height (in m^2). The patient becomes eligible for bariatric surgery depending upon this main parameter. There was a marked decrease in BMI of the patients at 4 weeks and 3 months postoperatively that was highly statistically significant.

The waist circumference decreased from mean preoperative 132.94 cm to 126.47 cm at 4 weeks and to 106.93 cm at 3 months. The mean hip circumference decreased from preoperative 124.50 cm to 119.14 cm at 4 weeks and 108.21 cm at 3 months. The waist:hip ratio decreased from preoperative 1.06 cm to 1.05 cm at 4 weeks and 0.98 cm at 3 months.

Effect on Biochemical Parameters

There was a fall in HbA1c levels in patients (mean: 7.14 ± 2.62) following bariatric surgery (Table 3). The fall in HbA1c levels at 4 weeks (mean: 6.71 ± 2.22) and 3 months (mean: 5.57 ± 1.18) postoperatively was significant in both the groups. Serum cholesterol levels showed a significant improvement ($p = 0.003$) at 4 weeks (mean: 209.47 ± 55.67 mg/dL) when compared with preoperative levels (mean: 194.71 ± 47.17 mg/dL) and a highly significant improvement ($p = 0.00$) at 3 months (mean: 169.65 ± 31.06 mg/dL). Serum triglyceride levels showed an improvement

Table 3: Value of various parameters before operation and after 4 weeks and 3 months of operation

	Preoperative		*4 weeks*		*3 months*		*Preoperative vs 4 weeks*	*Preoperative vs 3 months*
Parameters	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p value*	*p value*
Weight (kg)	138.71	17.510	130.47	14.770	116.53	15.649	0.000	0.000
Weight loss	–	–	8.47	3.68	22.29	4.91		
%EWL	–	–	12.96	4.04	36.11	8.99		
Waist circumference	132.94	13.64	126.47	13.24	106.93	10.83	0.170	0.000
Hip circumference	124.50	8.28	119.14	7.96	108.21	7.48	0.063	0.000
Waist:hip ratio	1.06	0.06	1.05	0.06	0.98	0.05	0.630	0.002
BMI	46.67	6.230	43.95	5.317	38.67	4.610	0.000	0.000
HbA1c	7.14	2.628	6.71	2.222	5.57	1.181	0.008	0.002
Serum cholesterol	209.47	55.679	194.71	47.170	169.65	31.068	0.003	0.000
Triglyceride	305.47	76.81	287.70	70.87	250.88	63.08	0.488	0.030
HDL	25.23	5.70	29	5.91	38.94	8.16	0.067	0.0001
LDL	99.47	40.88	94.41	38.23	86	34.08	0.711	0.304
VLDL	37.23	15.91	35.82	14.79	32.47	11.87	0.790	0.330

SD, standard deviation

($p = 0.488$) at 4 weeks (mean: 287.70 ± 70.87 mg/dL) when compared with preoperative levels (mean: 305.47 ± 76.81 mg/dL) and a significant improvement ($p = 0.030$) at 3 months (mean: 250.88 ± 63.08 mg/dL). Serum HDL levels showed an improvement ($p = 0.067$) at 4 weeks (mean: 29 ± 5.91 mg/dL) when compared with preoperative levels (mean: 25.23 ± 5.70 mg/dL) and a highly significant improvement ($p = 0.0001$) at 3 months (mean: 38.94 ± 8.16 mg/dL). Serum LDL levels showed a decreasing trend ($p = 0.711$) at 4 weeks (mean: 94.41 ± 38.23 mg/dL) when compared with preoperative levels (mean: 99.47 ± 40.88 mg/dL) and a further fall in levels ($p = 0.304$) at 3 months (mean: 86 ± 34.08 mg/dL). Serum VLDL levels showed a slight decrease at 4 weeks (mean: 35.82 ± 14.79 mg/dL) which was not statistically significant ($p = 0.790$) when compared with preoperative levels (mean: 37.23 ± 15.91 mg/dL), and this trend was consistent at 3 months (mean: 32.47 ± 11.87 mg/dL) but again not statistically significant ($p = 0.330$).

Discussion

Success or failure of any weight-reducing technique is measured by the extent by which body weight is reduced, which is an important parameter of a study. In our study, mean weight loss following bariatric surgery at 4 weeks and 3 months was 8.47 and 22.29 kg, respectively. Out of 17 patients, 16 patients had lost more than 25% of the excess weight at 3 months following surgery with mean percentage of excess weight loss (%EWL) at 4 weeks and 3 months being 12.96 and 36.11%, respectively. There was a significant decrease in BMI at 3 months following LSG in our study group with mean BMI at 4 weeks and 3 months being 43.95 and 38.67 kg/m^2 when compared with the preoperative values of 46.67 kg/m^2.

Similar results were found by Alagna et al.[22] at mean 12 ± 1 months postsurgery, the patients showed a significant decrease in weight, from 132.1 ± 36.9 kg before surgery to 93.5 ± 20 kg ($p < 0.0001$), and BMI, from 47.3 ± 13.1 kg/m^2 before surgery to 33.5 ± 7 kg/m^2 ($p < 0.0001$).

Omana et al.[23] found the same results when studied men undergoing surgery lost weight; the %EWL was 61.48% (confidence interval: 47.3875–75.5725).

Similarly, mean weight loss observed by Bastounis et al.[24] in their study was 70 ± 10 kg for men. The mean body weight and BMI 12 months after vertical banded gastroplasty were 109 ± 20.5 kg and 34.7 ± 6.5 kg/m^2, respectively.

Chowbey et al.[27] reported the Indian experience of' 75 patients who underwent LSG for the treatment of morbid obesity. There was a steady rise in %EWL from 31.2% at 3 months to 52.3% at 6 months, 59.13% at 1 year, and 65% at 2 years.

An important reason for reduction in BMI and %EWL is due to effect of LSG on gastric emptying time. The time required for half of the solid meal to leave the stomach ($T_{1/2}$) gets significantly altered following LSG, indicating that the stomach empties solid foods rapidly and possibly incompletely processed into the duodenum. Excision of the fundus and absence of receptive relaxation, as well as alterations in the contractile activity in the proximal stomach, are possible explanations for the decreased $T_{1/2}$. Laparoscopic sleeve gastrectomy thus induces weight loss by reducing food intake, accelerated gastric emptying, and delivery of nutrients to the small intestine early in the eating cycle which activates small intestine satiety inducing chemoreceptors that modify food ingestion periodicity, inhibit glucagon secretion, and reduce bowel motility and thus reducing appetite and food intake. Postprandial satiety is provoked with significantly less food than preoperatively.

Effect on Biochemical Parameters

Laparoscopic sleeve gastrectomy has been shown to reduce comorbidities and mortality in patients with morbid obesity and most significantly to ameliorate or resolve type II DM. Much of the improvement has been related to the excess weight loss after surgery. However, some effects appear to be independent from weight loss.

In our study, there was a significant reduction in the levels of HbA1c at 4 weeks and 3 months postoperatively in diabetic patients with mean HbA1c at 4 weeks and 3 months being 6.71% and 5.57%, respectively, when compared with the mean preoperative value of 7.14%.

Todkar et al.[25] also showed a decrease in HbA1c levels after LSG. This also proves that LSG has a significant role in improvement and remission of diabetes.

The achievement of normoglycemia after bariatric procedures results from multiple changes that occur postoperatively such as control of diet/dietary modifications, decreased plasma ghrelin levels, which, in turn, leads to an increase in maximal capacity of glucose-induced insulin release by the islet cells. Other causes of normoglycemia include loss of weight, reduction of body fat, and the release of gastrointestinal hormones. These hormones further interfere with the function of pancreatic β-cells (incretins).

Dyslipidemia is a recognized cardiovascular risk factor in obese patients. In our study, there was a significant decrease in serum cholesterol and serum triglycerides levels at 3 months with a significant improvement in serum HDL levels. Serum LDL and serum VLDL levels also showed a decreasing trend, however not statistically significant in this study, citing further follow-up to 1–2 years. Five dyslipidemic patients achieved normal serum cholesterol levels (<240 mg/dL) within 3 months of surgery and thus showed a resolution of dyslipidemia. A study done by Chowbey et al. showed similar results with the resolution of dyslipidemia in 34% of the patients with a significant decrease in mean cholesterol and LDL levels 6 months after LSG.[25] Todkar et al. conducted a study on 20 dyslipidemic patients who underwent LSG. Parameters like serum cholesterol, triglycerides, and LDL levels showed a marked increase in HDL levels.[26] A significant decrease in serum cholesterol, LDL, and serum triglyceride levels with an increase in serum HDL levels following sleeve gastrectomy in 130 obese patients undergoing LSG was documented by Hady et al.[26]

Effect on Anthropometric Parameters

In our study, mean waist circumference of 17 obese patients was 132.94 ± 13.64 cm preoperatively. Postoperatively at 4 week, the mean waist circumference decreased to 126.47 ± 13.24 cm, but waist circumference showed a significant decrease/reduction at 3 months following surgery with the mean values falling down to 106.93 ± 10.84 cm. There was a decrease in waist-to-hip ratio at 4 weeks postoperatively, from mean preoperative value of 1.06 ± 0.06 cm to mean values of 1.05 ± 0.06 cm and a further significant decrease to 0.98 ± 0.05 cm at 3 months, respectively. This signifies that LSG as a sole bariatric procedure decreases the risk of central obesity. In our study, there is no significant change in hip circumference of the patients.

In a study conducted by Hady et al., similar findings were documented in a clinical report which got published in 2012. After 1 year of the surgery, waist circumference in women decreased from 122.8 ± 18.4 cm to 89 ± 8.2 cm and in men from 134.2 ± 27.6 cm to 106 ± 9.66 cm.[27]

Conclusion

Significant weight loss and decrease in anthropometric parameters after bariatric surgery in men results in improved clinical outcomes. Lipid profile and glycemic control also improved in patients over follow-up time. The improvement in these parameters may serve as motivators for obese men considering surgery.

References

1. Barness LA, Opitz JM, Gilbert-Barness E. Obesity: genetic, molecular and environmental aspects. AM J Med Geneft 2007;143(24): 3016–3034. DOI: 10.1002/ajmg.a.32035.
2. Saber AA, El-Ghazaly TH. Early experience with single-access transumbilical adjustable laparoscopic gastric banding. Obes Surg 2009;19(10):1442–1446. DOI: 10.1007/s11695-009-9905-8.
3. NIH consensus statement covers treatment of obesity. Am Fam Physician 1991;44(1):305–306.
4. Sjöström L, Narbro K, Sjöström CD, et al. Effects of bariatric surgery on mortality in Swedish obese subjects. N Engl J Med 2007;357(8): 741–752. DOI: 10.1056/NEJMoa066254.
5. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and meta-analysis. JAMA 2004;292(14):1724–1737. DOI: 10.1001/jama.292.14.1724.
6. Buchwald H, Oien DM. Metabolic/bariatric surgery worldwide 2008. Obes Surg 2009 19(12):1605–1611. DOI: 10.1007/s11695-009-0014-5.
7. Malone M. Medications associated with weight gain. Ann Pharmacother 2005;39(12):2046–2055. DOI: 10.1345/aph.1G333.
8. Ness-Abramof R, Apovian CM. Drug-induced weight gain. Drugs Today (Barc) 2005;41(8):547–555.
9. Gurevich-Panigrahi T, Panigrahi S, Wiechec E, et al. Obesity: pathophysiology and clinical management. Curr Med Chem 2009;16(4):506–521. DOI: 10.2174/092986709787315568.
10. Korner J, Woods SC, Woodworth KA. Regulation of energy homeostasis and health consequences in obesity. Am J Med 2009;122(4 suppl 1):S12–S18. DOI: 10.1016/j.amjmed.2009.01.003.
11. Brolin RE. Update: NIH consensus conference. Gastrointestinal surgery for severe obesity. Nutrition 1996;12(6):403–404. DOI: 10.1016/s0899-9007(96)00154-2.
12. Malt RA, Kral JG. Surgery for obesity. In: Morris PJ, Malt RA. Oxford Textbook of Surgery. New York: Oxford University Press; 1994.
13. Lubrano C, Mariani S, Badiali M, et al. Metabolic or bariatric surgery? long-term effects of malabsorptive vs restrictive bariatric techniques on body composition and cardiometabolic risk factors. Int J Obes (Lond) 2010;34(9):1404–1414. DOI: 10.1038/ijo.2010.54.
14. Weiss R, Appelbaum L, Schweiger C, et al. Shortterm dynamics and metabolic impact of abdominal fat depots after bariatric surgery. Diabetes Care 2009;32(10):1910–1915. DOI: 10.2337/dc09-0943.
15. DeMaria EJ. Bariatric surgery for morbid obesity. N Engl J Med 2007;356(21):2176–2183. DOI: 10.1056/NEJMct067019.
16. Brethauer SA, Hammel JP, Schauer PR. Systematic review of sleeve gastrectomy as staging and primary bariatric procedure. Surg Obes Relat Dis 2009;5(4):469–475. DOI: 10.1016/j.soard.2009.05.011.
17. Demaria EJ, Winegar DA, Pate VW, et al. Early postoperative outcomes of metabolic surgery to treat diabetes from sites participating in the ASMBS bariatric surgery center of excellence program as reported in the bariatric outcomes longitudinal database. Ann Surg 2010;252(3):559–566. DOI: 10.1097/SLA.0b013e3181f2aed0.
18. Mechanick JI, Kushner RF, Sugerman HJ, et al. American association of Clinical Endocrinologists, the Obesity Society, and American Society for Metabolic & Bariatric Surgery medical guidelines for clinical practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. Obesity (Silver Spring) 2009;17(Suppl 1):S1–S70. DOI: 10.1038/oby.2009.28.
19. Birkmeyer NJ, Wei Y, Goldfaden A, et al. Characteristics of hospitals performing bariatric surgery. JAMA 2006;295(3):282–284. DOI: 10.1001/jama.295.3.282-c.
20. Buchwald H, Estok R, Fahrbach K, et al. Trends in mortality in bariatric surgery: a systematic review and meta-analysis. Surgery 2007;142(4):621–632. DOI: 10.1016/j.surg.2007.07.018.
21. Kelly JJ, Shikora S, Jones DB, et al. Best practice updates for surgical care in weight loss surgery. Obesity (Silver Spring) 2009;17(5):863–870. DOI: 10.1038/oby.2008.570.
22. Alagna S, Cossu ML, Gallo P, et al. Biliopancreatic diversion: long-term effects on gonadal function in severely obese men. Surg Obes Relat Dis 2006;2(2):82–86. DOI: 10.1016/j.soard.2006.01.005.
23. Omana JJ, Tamler R, Strohmayer E, et al. Sex hormones in men undergoing bariatric surgery. J Am Coll Surg 2009;209(3):S22–S23. DOI: 10.1016/j.jamcollsurg.2009.06.042.
24. Bastounis EA, Karayiannakis AJ, Syrigos K, et al. Sex hormone changes in morbidly obese patients after vertical banded gastroplasty. Eur Surg Res 1998;30(1):43–47. DOI: 10.1159/000008556.
25. Todkar JS, Shah SS, Shah PS, et al. Long-term effects of laparoscopic sleeve gastrectomy in morbidly obese subjects with type 2 diabetes mellitus. Surg Obes Relat Dis 2010;6(2):142–145. DOI: 10.1016/j.soard.2009.06.008.
26. Hady H, Dadan J, Luba M. The influence of laparoscopic sleeve gastrectomy on metabolic syndrome parameters in obese patients in own material. Obes Surg 2012;22(1):13–22. DOI: 10.1007/s11695-011-0530-y.
27. Chowbey PK, Dhawan K, Khullar R. Laparoscopic sleeve gastrectomy: an Indian experience—surgical technique and early result. Obes Surg 2010;20(10):1340–1347. DOI: 10.1007/s11695-009-9973-9.

ORIGINAL ARTICLE

Evaluation of Various Port Positions for Minimal Access Cardiovascular and Thoracic Procedures

Anwarul Islam[1], Rajneesh K Mishra[2]

Abstract

Background: Video-assisted thoracoscopic surgery (VATS) is used to diagnose or treat diseases of the chest. Most of those procedures traditionally performed with open thoracotomy can be done using smaller incisions with video assistance. Robot-assisted thoracic surgery (RATS) is a technologically upgraded system that uses computers to help surgeons for precise tremor-less instrument control in a confined space with utmost accuracy. For access to the chest minimally, two principles are followed: the baseball diamond principle (BDP) and the triangle target principle (TTP) of port position. Both can be used for minimal access cardiovascular and thoracic surgery. Different manipulation angles (30°, 60°, and 90°) are used to perform the task and find out time, errors, and surgeon's discomfort during the surgery.

Objectives: To evaluate and compare task performance at different port positions during minimal access cardiovascular and thoracic procedures in a swine.

Materials and methods: A prospective experimental animal study was granted and conducted at the World Laparoscopy Hospital, Gurugram, Delhi, India. Three thoracic and two cardiac procedures were selected for this study conducted on 30 swines over 11 months from January 15, 2018, to November 15, 2018. At the end, euthanasia was conducted humanly and carcasses disposed appropriately as per the regulation under the provisions of the Prevention of Cruelty to Animals Act, 1960, and the Acts of 1998 and 2001.

Results: A total of 30 procedures were conducted in this study using TTP of port placement. The procedures are lung resection-6, thymectomy-6, closure of atrial septal defect (ASD)-6, internal mammary artery (IMA) harvesting for totally endoscopic coronary artery grafting (TECABG)-6, and esophagectomy-6. It is to evaluate the execution time (sum of the ports access time and the actual procedure time), error rates, and the surgeon's discomfort for each of the three angles of manipulation. Average timing of all tasks was shorter with 60° manipulation and all were reproducible. All the tasks were difficult at 30° and 90° angle. Closer manipulation of angle to 90° and above takes longer operative time. It may be due to fatigue from shoulder overstretching for increased elevation angle. It was demonstrated that the surgeon's discomfort level was least at the 60° port position.

Conclusion: There is no fixed position for port placement in the cardiovascular and thoracic procedures. The average timing of all tasks was shorter, there were less errors, and surgeon's discomfort was less operating at 60° manipulation angle.

Keywords: Internal mammary artery, Minimal access cardiovascular, Robotic-assisted thoracic surgery.

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Introduction

Most major procedures traditionally performed with open thoracotomy can be done using smaller incisions with video-assisted thoracoscopic surgery (VATS) or robot-assisted thoracic surgery (RATS). In minimal access surgery, the access of entering the body can be minimal but inside the invasiveness does not remain minimal at all. Things we do, like opening the chest, can be done with limited access. The basic principles used in open surgery like exposure, dissection, traction, countertraction, and apposition are followed here too but hand of a surgeon remains outside of body or, in robotic surgery, at a separate console to manipulate the instruments.[1–3] The concept of VATS that greatly reduces the trauma of chest was initiated over two decades ago and has undergone a series of modifications and improvement. A Swedish Hans Christian Jacobeus (1879–1937) is considered as the father of thoracoscopy since he explored and established the practice of thoracoscopy in 1910. Lewis et al. reported 100 consecutive thoracoscopic surgeries in 1992.[4] Since then, VATS has shown significant advancements and currently entered into the era of robotic surgery.[5,6]

In VATS, surgeons hold the instruments while operating, but during RATS, surgeons control the instruments from a dedicated console using a computer for instrumental movement with utmost precision.[1,2] In an appropriately selected patient, the minimal access technique provides safe, effective, and successful surgery with equivalent or improved outcomes having less perioperative morbidity and equivalent oncologic results compared with open surgery. Outcomes may be better in frail and older patients.[3,5] Minimal access thoracic surgeries remove the need for thoracotomy that involves spreading of the ribs or long sternotomy incision, large scar mark, and prolonged postoperative analgesia. Usually, operative costs for minimal access procedures are higher because of costly equipments, although overall costs may be lower due to the shorter length of hospital stay and faster recovery.[7]

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A thoracoscope attached to a video camera passed through ports into the chest cavity via 5–10 mm skin incisions where rod lens transmits the signal to see inside the chest on the monitor (Fig. 1). There are two ergonomic principles [baseball diamond principle (BDP) and triangle target principle (TTP)] for the position and placement of access ports, which helps in task performance and surgeons' comfort.[8,9] Three angles are used to perform the task in each principle. These manipulation angles are to be evaluated to find the ideal position. Besides laparoscopic surgery, the BDP is also applied for VATS as a conventional principle.[1,2] Here the camera port and the target are placed at the opposing vertical angles of the diamond and the other two working instruments are placed perpendicular to that plane at the horizontal angles (Fig. 2).[4,9]

The TTP is relatively a new principle. Here three ports are placed in a triangle keeping the target lesion at the apex. One side of the base becomes the site of the first port for the camera, and the another side becomes the site for the second port for the forceps or the endoscopic stapler. The third port is for the forceps to the target lesion (Fig. 3).[8,10] To explore a prospective experimental animal study was carried out to find out a suitable manipulation angle for the port position in TTP using 30°, 60°, and 90° angles regarding task performance time, error, and comfort of surgeons.

Aims and Objectives

To evaluate and compare task performance at different port positions during lung resection, thymectomy, IMA harvesting for totally endoscopic coronary artery bypass grafting (TECABG), ASD closure, and esophagectomy through minimal access using the TTP and find out which position for port is better and facilitates task performance.

Ergonomic Principle for Minimal Access Surgery

Ergonomics is "the scientific study of individual at work, in terms of equipment design, workplace layout, operating environment, productivity, safety and training." The ergonomic principle governs the position of ports in minimal access surgery to facilitate higher task performance and comfort to the surgeon. It includes the following:

- Port placement to be adjusted according to the specific chest anatomy. Most importantly, the skin incision to be placed directly in the middle of the corresponding intercostal space to avoid unnecessary pressure on the rib by the instrument during manipulation.
- The optical port is placed at the center so that telescope remains in between the operating instruments, which will act as a type I lever with equal length within and outside the thorax.
- The manipulation angle between the two operating instruments would optimally be 60° (elevation angle is 30° and the azimuth angle is 15°–45°)
- The operating instruments would not face or work against the telescope as this results in production of the mirror image and tough task execution with increased error rate.
- Height of the operating table ought to be adjusted between 64 cm and 77 cm higher than the floor level because discomfort and operative difficulty are lowest when working instruments are positioned at the level of the elbow.[9]
- Ergonomically, the monitor image within 25 optimal degrees below the horizontal plane of the eye offers least neck strain.[11]
- To facilitate easy instrument manipulation and proper visualization, the port to be placed in a triangular fashion. Troubles related to depth perception, vision, and loss of peripheral visual fields may be reduced by using 10–15× magnification.[12]
- The target organ ought to be 15–20 cm from the optical port. Generally, the two remaining ports are placed in the same 15–20 cm arc at 5–7 cm on either aspect of the optical port. It makes the instruments to work at a 60–90° angle.[13] If required, additional retracting ports may be placed in the same arc but more laterally to avoid clashing of instruments. If angle between target and instrument is too wide or obtuse, manipulation of the instrument is so tough. That's why surgeons used to customize the port position.
- The most effective task efficiency and performance quality are obtained with a perfect manipulation angle between 45° and 60°, which can be achieved by correct placement of ports. The 90° manipulation angle creates the greatest muscle workload by the deltoid and the trapezius. Manipulation angle starting from

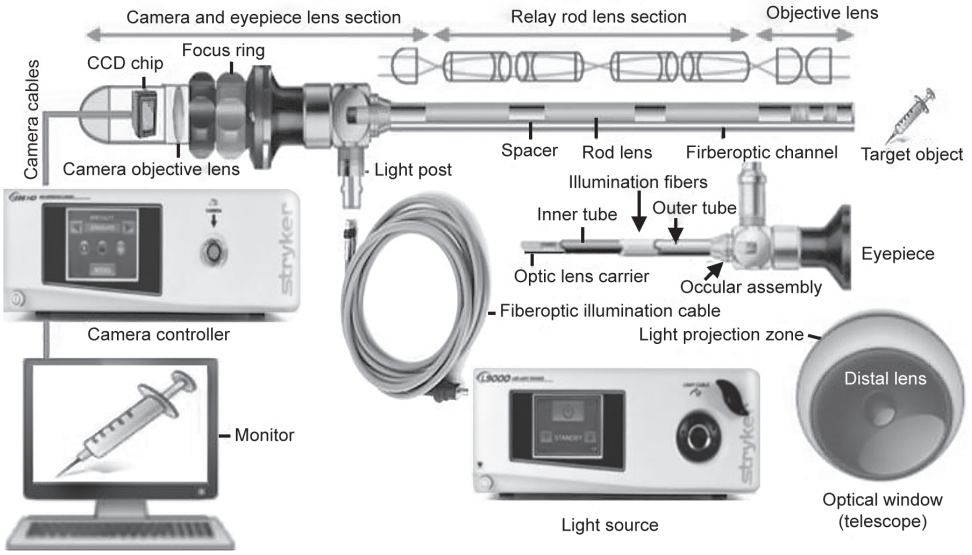

Fig. 1: Basic visual equipment used for minimal access surgery

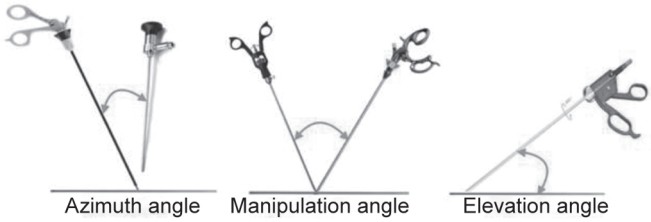

Fig. 2: Different angles required for minimal access surgery (MAS)

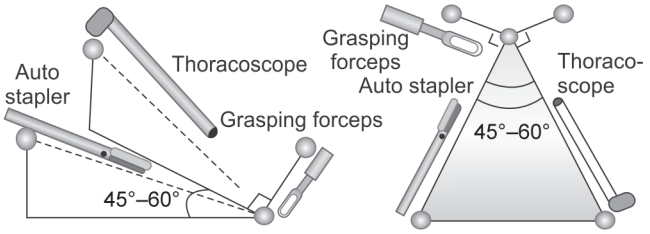

Fig. 3: Port placement using triangle target principle

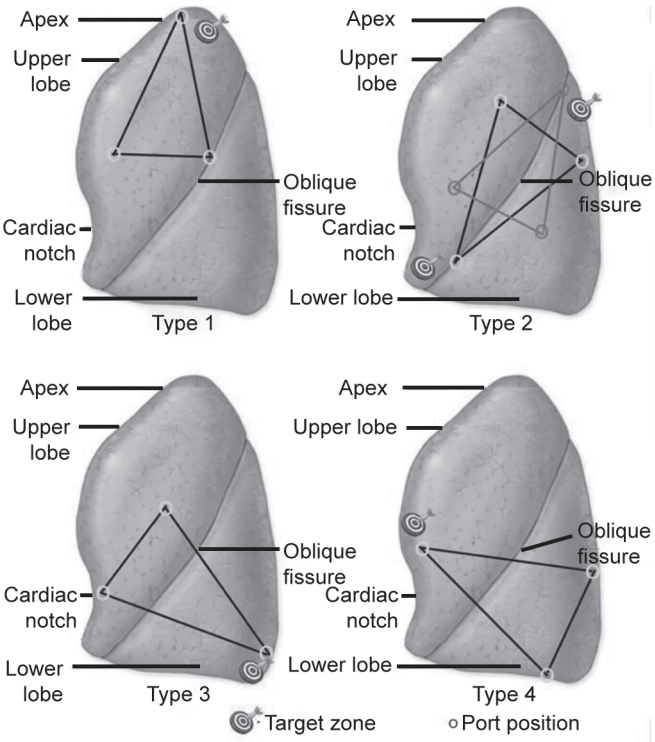

Fig. 4: Triangle target principle based on lesion location

45° to 75° with equal azimuth angles is suggested. Manipulation angles below 45° or higher than 75° are accompanied by increased difficulty and degraded performance.[14]

- It is reported that task efficiency is better with equal azimuth angles than with unequal azimuth angles. Achieving equal azimuth angles might be difficult in practical situations, but as a principle, azimuth inequality ought to be avoided because it degrades task efficiency.[15]
- There may be direct correlation between the manipulation and the elevation angles. A manipulation angle of 60° with optimal elevation angle offers the shortest execution time and optimal quality performance. Wide manipulation angles require wide elevation angles for better performance and higher task efficiency.[15]
- When a 30° manipulation angle is imposed on a patient, the elevation angle ought be also 30° because it carries the shortest execution time. The most effective ergonomic layout for endoscopic surgery consists of a manipulation angle stating from 45° to 75° with equal azimuth angles.[15,16]
- The recommended position of the arm is slightly abduction, retroversion, and rotation inward at the shoulder level. The elbow should be bent at about 90°–120°. The surgeon should primarily be moving and loosening up his hands intermittently to stop buildup of lactic acid and keep off fatigue.[17]

Ports Using in TTP

The experience that BDP could create difficulties in some VATS procedures led an exploration for an alternative principle to ensure higher task performance. Sasaki et al.[18] pointed to the problem they experienced in treating thoracic lesions, particularly peripheral lung lesions, using BDP. So they developed and introduced the TTP to resolve the problem. The TTP involves inserting three ports to create an equilateral triangle between the optical port, the operating instrument, and the target. A third port is usually used for grasping forceps, which is placed close to the target. Application of TTP for ports placement might be used to treat all thoracic lesions.[18]

For lung tumors, the TTP is indicated in peripheral tumors that are not attached to the lateral chest wall and are less than 3 cm in diameter. Because of different positions of the lesion, TTP is modified into four types.

Type I: for lesions of the upper lobe—anterior segments, apex, superior mediastinum.

Type II: for lesions of the upper lobe—posterior segments; middle lobe—right lateral segment; lower lobe—6, 8 segments, lingula, and upper posterior mediastinum.

Type III: for lesions of the lower lobe —9, 10 segments, lower posterior mediastinum, and diaphragm

Type IV: for lesions of the middle lobe—medial segment, anterior mediastinum, pericardium (Fig. 4).

Advantages of TTP

Advantages of TTP in relation to lung lesion include the following:[18]

The possibility of grasping tissue near the lesion via the target port.

Grasping forceps and stapler meeting at right angle, which is the required angle for stapling.

Possibility of palpating a peripheral tumor via the target port and ease in taking a needle biopsy.

Drawbacks of TTP

These are found mostly with type III TTP and are the following:

Difficulty in determining the site of trocar placement because of the proximity of the first operating port and the target port to the lesion leading to crowding and swording of instruments.

Produce mirror imaging too.

Complications of VATS

The complications of VATS include nerve injuries due to pressure from wrong positioning and anesthetic complications, trocar injury to intercostal vessels or internal mammary arteries (IMAs), instrument malfunction or breaking within the thoracic cavity,

intercostal nerve dysfunction due to tight leverage on the chest wall and large vessels injury, hemothorax, perforation of thoracic organs, prolonged air leak, atelectasis, pneumonia, chylothorax, atrial fibrillation, etc.

Anesthesia and Positioning of Patient and Surgeon

In most VATS procedures, general anesthesia with a double-lumen endotracheal tube is employed to confirm collapse of the ipsilateral lung that offers more space inside the thorax.

In majority of the cases, patients are placed in the lateral decubitus position. To make the intercostal spaces wider, the OT table is flexed. This decreases leverage of the instruments on the ribs with reduction in frequency of intercostal nerve compressions and postoperative pain.[6] It also allows better maneuverability of the instruments. Some VATS procedures such as thymectomy can be done in the prone position or the supine position with slight elevation of the ipsilateral shoulder.[9] Alternatively, the supine position with a roll under patient's back to push him up allows access to the thorax from the anterior approach. The positions of the surgeon and the assistant rely on the location of pathology. The surgeon and the camera-holding assistant stand facing the site of pathology. The surgeon, the site of pathology, and the monitor are aligned to permit the surgeon to look straight ahead while operating (Figs 5 and 6).

Lung Resection

As a standard treatment of early-stage lung cancer, minimally invasive lung resection has replaced thoracotomy. Minimally invasive lung resection allows patients a much faster recovery with equivalent oncologic effectiveness and offers more accurate staging that potentially improved survival. About 98% of patients are usually operated successfully using TTP without major complications. Takao et al.[19] reported using TTP. For right VATS, the camera port is inserted at fourth intercostal space along the anterior axillary line (AL), first operating port at sixth intercostal space along the mid-AL, and second operating port inserted at sixth intercostal space along the posterior AL. For left VATS, the camera port is inserted at sixth intercostal space along the posterior AL, the first operating instrument at the sixth intercostal space along the mid-AL, and second operating port at fourth intercostal space along the anterior AL. Depending on the lesion, ports can be shifted one intercostal space below or above (Fig. 3).

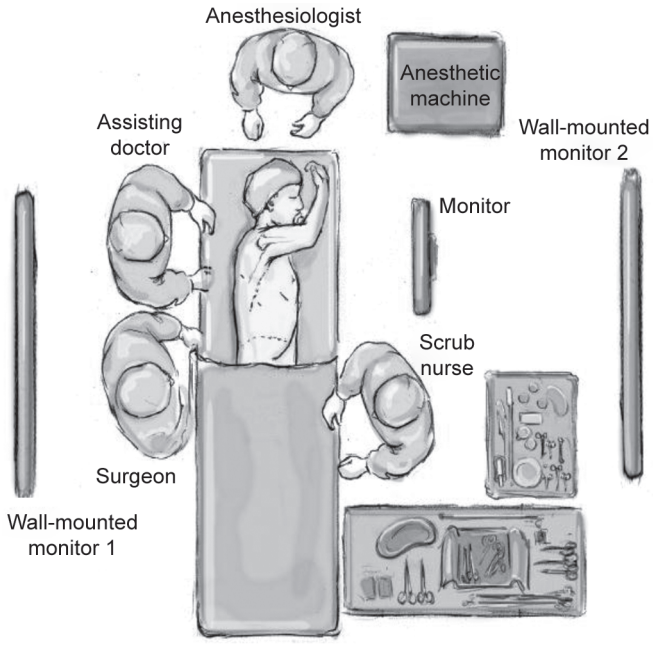

Fig. 5: Theater setup for video-assisted thoracoscopic surgery

Key Technical Points (Applicable To All VATS)

- Insert the instruments into the chest cavity without injuring the chest wall or lung. Division of the posterior pleural reflection greatly improves the ability to perform safe dissection of desired arterial branches.
- There should be no traction on pulmonary artery (PA) and tissue dissected away from PA and its branches. Complications can be prevented by avoiding excessive tension on PA during retraction and dissection. The pulmonary vein and bronchus can tolerate some degree of tension, therefore developing tissue planes between these structures. During dissection around PA, it should be stationary, moving the other structures away from PA.
- Lymph nodes to be cleaned away to facilitate dissection of relevant structures. Endobags to be used for retrieval of the excise tissue to prevent spillage of tumor cells within the thorax.

Thymectomy

Thymectomy is typically indicated for myasthenia gravis (MG), thymoma, and anterior mediastinal tumors.[20] Primary epithelial tumors of the thymus are found in approximately 50% of all anterior mediastinal masses, of which thymoma is foremost common.[21] Thymectomy is an appropriate therapy in the great care of MG and in the undetermined anterior mediastinal lesion.[22] Minimal access thymectomy can be performed in all patients of thymic neoplasm who will tolerate single lung ventilation. Minimally invasive methods include transcervical, thoracoscopic, and robotic thymectomy. They decrease postoperative morbidity and mortality particularly in patients with MG.[23,24]

Port Placement in VATS Thymectomy

Three ports are needed. The first port is made with a 5-mm skin incision along the upper edge of sixth ICS in the mid-AL to create

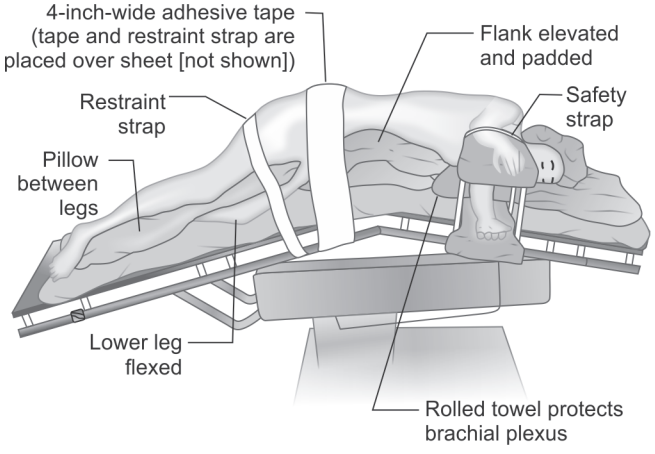

Fig. 6: Standard patient position for video-assisted thoracoscopic surgery

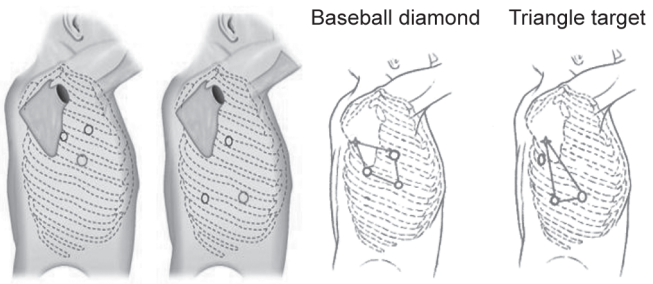

Fig. 7: Ports placement in video-assisted thoracoscopic surgery thymectomy

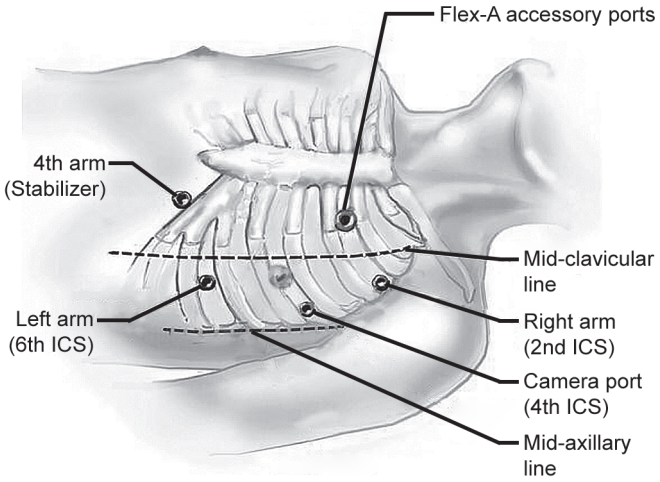

Fig. 9: Port position for endoscopic or robotic CABG

a pneumothorax. A 5-mm port is inserted and 30° thoracoscope is used for inspection of potential adhesions and pathology. CO_2 insufflation to be done using a pressure limit of 6–8 mm Hg. Under vision, a second 5-mm port is inserted in the third intercostal space along the anterior AL and a third 5-mm port is inserted into sixth or seventh intercostal space along the mid-clavicular line (Fig. 7).

ASD Closure

Atrial septal defect is one of the most common congenital heart defects. Currently, many ASDs can be closed with septal occluder devices through cardiac catheterization.[25] But large ASDs may not be appropriate for device closure and require surgical correction.[26] Minimal access surgical approaches are applied to repair ASD to minimize operating trauma and early recovery with better cosmetic results.[27]

Port Placement for ASD Closure

Four trocars to be placed. One 10-mm trocar at fifth intercostal space in the anterior AL for needle holder or knife, one 5-m trocar at third intercostal space in the mid-AL for tissue forceps, one 5-mm trocar at the fifth intercostal space in the mid-AL for camera, and one 5-mm trocar at sixth intercostal space in the mid-AL for sucker (Fig. 8).

IMA Harvesting

Internal mammary artery is the conduit of choice for myocardial revascularization as a result of its higher long-term patency rate and lower occurrence of myocardial infarction and reoperation

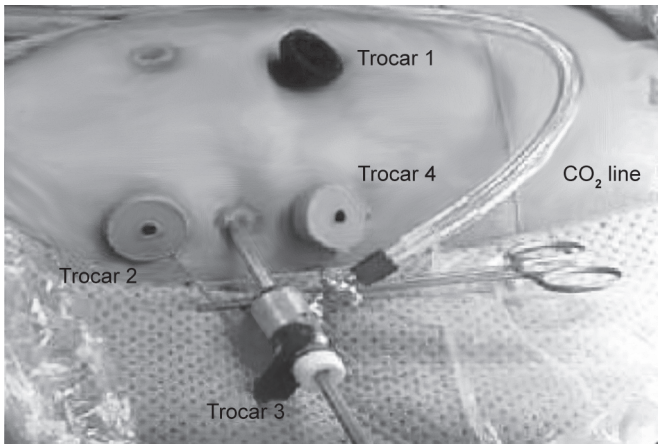

Fig. 8: Trocars position

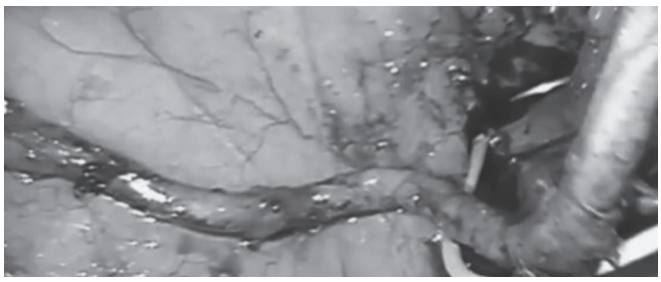

Fig. 10: Thoracoscopically harvested LIMA

compared with vein grafts.[28] Currently, closed chest coronary artery bypass grafting has become reality in several centers worldwide and considered as a safe, secure, less traumatic, and effective alternative to standard open surgery with or without robotic assistance.[29]

Dissection is almost similar to the open technique. In a closed chest environment, instead of a diathermy the harmonic scalpel (HS) is preferable to prevent production of excessive smoke that obscures telescopic vision during dissection.[30] The HS is an ultrasonically activated shaft that vibrates harmonically at 55,500 Hz over a distance of 80 μm.[31] It couples with tissues and mechanically denatures protein by destroying hydrogen bonds among the protein structure.[32] The newly formed disorganized protein creates a sticky coagulum that coapts the vessel walls.

Port Placement (Thoracoscopic Approach)

A 5-mm port at the level of fourth intercostal space for grasper. One 5-mm port at sixth intercostal space on the medial posterior AL for HS. One 10-mm port for the telescope to be placed sixth intercostal space at the level of the anterior AL (Figs 9 and 10).

For Robotic LIMA Harvesting

Robotic assistance greatly enhances the entire harvesting process. The patient has to be placed in the supine position with the left chest slightly elevated and the both arms to be tucked to the chest (Fig. 11).

The daVinci patient cart approaches to the patient from the right side. Deflating the left lung, the camera port is inserted within the fifth intercostal space along the anterior AL. Carbon dioxide is insufflated with a pressure limit between 6 and 8 mm of Hg. The 8-mm right arm port is inserted into the third intercostal space 3 cm anterior to the camera port to avoid conflict of the robotic

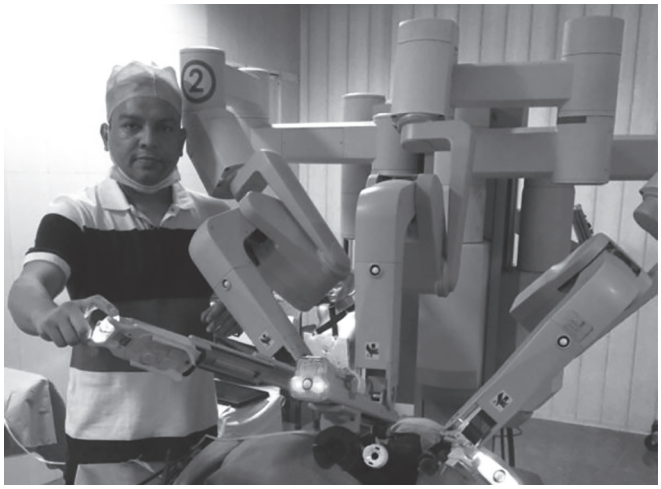

Fig. 11: Positioning daVinci robotic patient cart

arm with the patient's left shoulder. Another 8-mm left arm port is inserted into the seventh intercostal space 3 cm proximal to the camera port. This arrangement provides the triangle principle that is vital for minimal access procedure.

Graft Anastomosis

Time taken to perform the anastomosis is usually 35–45 minutes using the daVinci robot. The number of graft for endoscopic coronary revascularization has to be performed depending on number of lesion, patient clinical status, and comorbidities. The patency of robotic totally endoscopic left internal mammary artery to left anterior descending artery (LIMA-LAD) anastomosis is similar to traditional open procedures.[33–35] Several studies have found the long-term patency is between 92%[34] and 98%.[35] The use of an automated coronary connector like the "Flex-A" stapling device surely reduces endoscopic anastomosis construction time during closed chest off-pump robotic coronary artery bypass grafting (CABG) (Fig. 12).

Esophagectomy

Esophageal cancer is currently the eighth commonest cancer worldwide and also the sixth common reason behind death from cancer.[36] Global incidence of esophageal cancer has increased by 50% within the past two decades.[37] Squamous cell carcinoma is the foremost common esophageal malignancy worldwide; however, the incidence of adenocarcinoma has been increasing rapidly in the Western world.[38] Esophagectomy is the foremost invasive surgery that includes two- or three-compartment dissection, radical lymph adenectomy, and upper gastrointestinal tract reconstruction. As a result, conventional open esophagectomy is related to considerable morbidity and mortality, with complication rates starting from 26 to 41% and perioperative mortality rate is about 4–10%.[39] To overcome these, minimal access techniques came in practice.

Three-stage Mie

The combined thoracolaparoscopic esophagectomy along with cervical anastomosis is a standardized surgical technique to treat esophageal carcinoma through minimal access surgery for better outcome.

The First Stage: Thoracic Phase

VATS Esophageal Mobilization and Lymph Nodes Dissection: The patient is placed in the left lateral prone position leaning forward

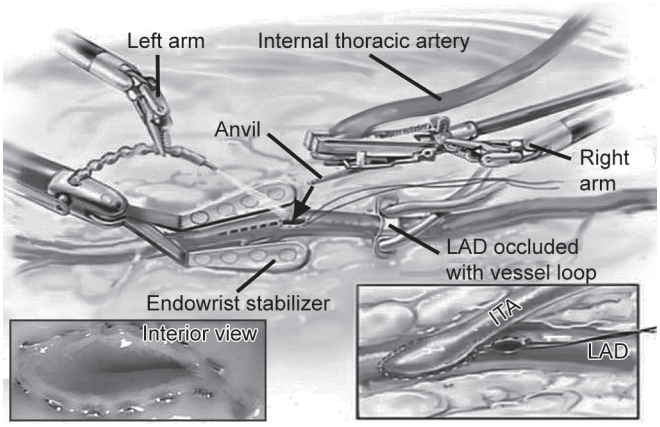

Fig. 12: Technique of anastomosis using a Flex-A device

to 30° with the collapsed right lung. Four trocars to be inserted. A 30° telescope to be introduced through a 10-mm port into seventh/eighth intercostal space along the mid-AL; two 5-mm working ports to be placed in third/fourth and fifth/sixth intercostal space along the anterior AL. One 10-mm working port to be placed in sixth/seventh intercostal space on the subscapular angle line (Fig. 13).

The Second Stage: Abdominal Phase

Laparoscopic Gastric Mobilization and Lymph Nodes Dissection: During the laparoscopic phase, patient to be placed in the supine position. Five ports to be inserted. A 10-mm camera port to be placed below the umbilicus. Pneumoperitoneum established with CO_2 insufflation pressure set at 10–12 cm of H_2O. One 10-mm laparoscope to be used for intra-abdominal inspection. Another 10-mm operating port to be placed at 4 cm above the umbilicus beside the right border of the rectus muscle. A 5-mm operating port to be inserted 2 cm below the right costal margin along the mid-clavicular line. A 10-mm working port to be placed 2 cm above the umbilicus along the left mid-clavicular line. Last, a 5-mm working port to be inserted at the left costal margin along the anterior AL.

The Third Stage: Cervical Anastomosis

Gastric Conduit Formation and Anastomosis: A 3–5 cm incision to be given on the left neck in front of the left sternocleidomastoid and cervical esophagus to be isolated and divided. The dissected tissue then expelled from the thorax outside of the abdomen through subxiphoid incision. A 28–40 cm gastric conduit with 3–4 cm diameter is created using multiple applications of a linear stapler along the lesser curvature starting from right gastric vessels to the stomach fundus. Pulling up the gastric conduit through the posterior mediastinum anastomosis to be done by joining a 24-mm anvil with the end-to-end anastomosis stapler (Figs 14 and 15).

Materials and Methods

This study is a prospective experimental animal study and was conducted at the World Laparoscopy Hospital (WLH) at Gurugram, India

Sample Size Determination

The sample size was calculated using the formula, $n = Z^2pq/d^2$.

Where n = sample size, z = constant at 95% confidence interval = 1.96, p = prevalence = 0.019,[14] $q = 1 - p$ complementary

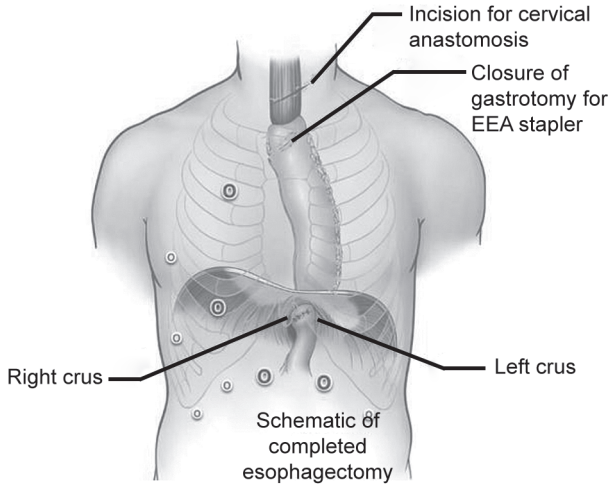

Fig. 13: O-10 and O-5 mm port position and completed task

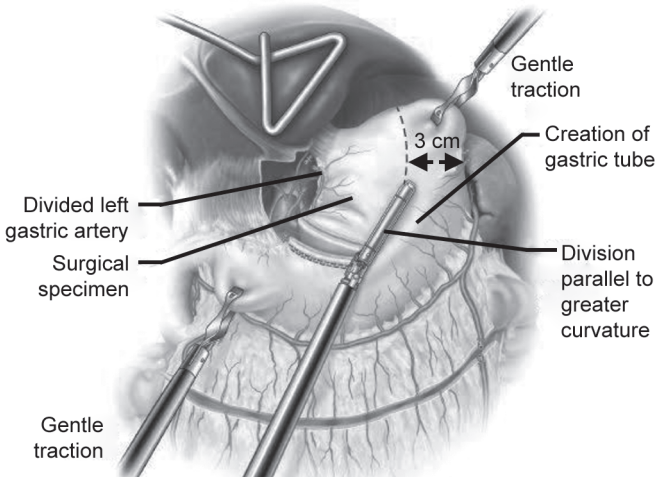

Fig. 14: Preparing gastric conduit

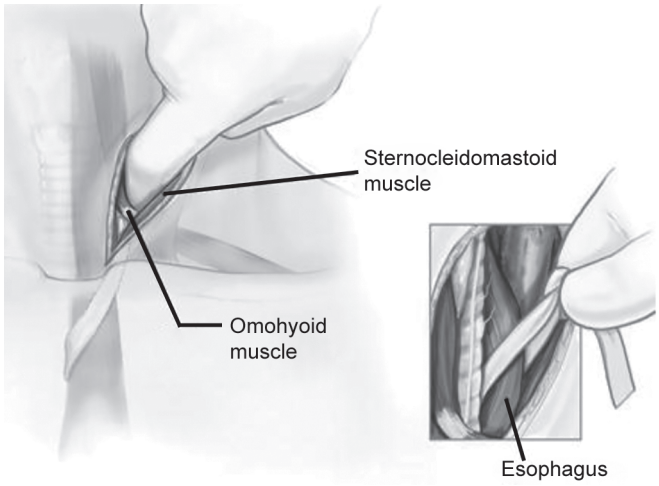

Fig. 15: Cervical incision for anastomosis

probability = 0.991, $d = 0.05$ precision. Thus $n = 1.96^2 \times 0.019 \times 0.991/0.05^2 = 28.93$.

Hence, 30 VATS procedures were done as the sample size.

Data Collection

A total of 30 VATS procedures were conducted on swine at the institute of minimal access surgery, World Laparoscopy Hospital, NCR Delhi, India, over 11 months from January 15, 2018, to November 15, 2018.

Three thoracic and two cardiac surgeries were included. The details of the procedures are: lung resection: 6 (20% of total case), thymectomy: 6 (20% of total case), closure of ASD: 6 (20% of total case), IMA harvesting for TECABG: 6 (20% of total case), and esophagectomy: 6 (20% of total case) on 30 animals through minimal access techniques. Each procedure was done using TTP.

The outcome measures are: the execution time in seconds (port access time plus actual procedure time), error rate (lung perforation, myocardial injury, injury to the great vessels, injury to the phrenic nerve, esophageal perforation, subdiaphragmatic primary trocar entry for esophagectomy and intercostal vessels bleeding for port placement during LIMA harvesting), and the surgeons' discomfort level as analyzed by the visual analogue system (VAS) starting from 110 in increasing the discomfort pattern. These outcome measures recorded for each procedure were entered into a proforma.

The procedures were done after the swine were given general anesthesia. The ports were made using a surgical scalpel and CO_2 insufflation was done to collapse the ipsilateral lung. The camera port was inserted blindly and operating ports were introduced under direct vision. Video-assisted thoracoscopic surgery ASD closure either direct closure or pericardial or PTFE patch using grasper, scissors, retractor, arterial and venous cannula, hook dissector, cardiopulmonary bypass circuit and Heart-Lung machine. The VATS esophagectomy was performed with alternating use of grasper, scissors, and hook dissector. Diathermy and harmonic device were used to perform thymectomy.

Methods of Data Collection and Analysis

The data were recorded in a preconstructed data collection sheet, cleaned and entered into a computer using SPSS version 16 for Windows. The analysis was done using statistical methods such as mean and Chi-square. Results are presented in figures.

Ethical Considerations

The research was an animal study that strictly regulated in India underneath the provisions of Section 15 of the Prevention of Cruelty to Animals Act, 1960, and the principle beneath the Act of 1998 and 2001. It was governed by the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA).[40] For this analysis, the operational guidelines for Observance of good Practices by the CPCSEA were strictly followed. Permission and approval for procurement of the swine and conduct of the research was obtained from CPCSEA-registered animal breeding houses. At the end of the experiments, euthanasia was conducted and therefore the animals' carcasses were properly disposed according to the guidelines.

Result and Observations

A total of 30 procedures were conducted in this study. The TTP of port placement was applied. Three thoracic and two cardiac procedures were included. The procedures are lung resection, thymectomy, closure of ASD, LIMA harvesting, and esophagectomy. It is to evaluate the execution time (sum of the ports access time and

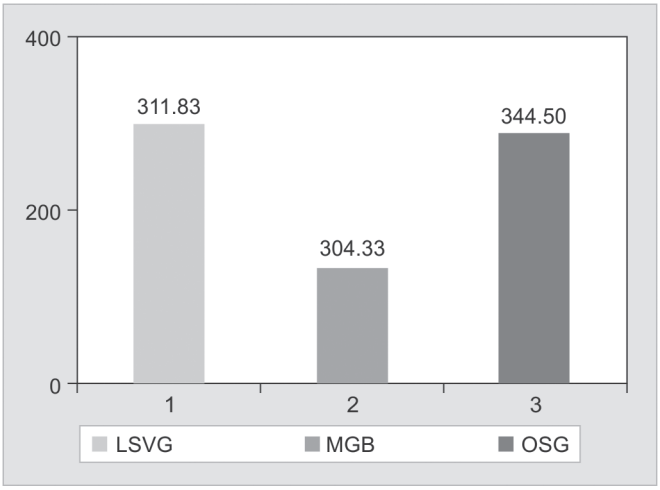

Fig. 16: Average timing in seconds for suturing and tying surgeon's knot in lung resection at 30°, 60°, and 90° port position angles

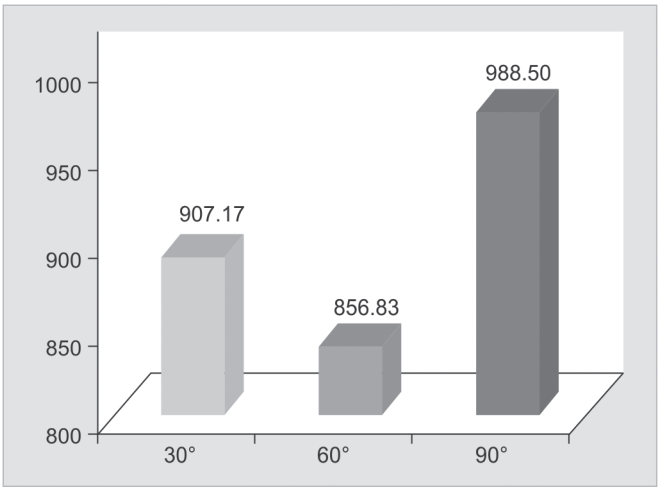

Fig. 18: Average timing for applying an endolinear stapler in lung resection with different manipulation angles

the actual procedure time), error rates. and the surgeon's discomfort for each of the three angles of manipulation.

Lung Resection

Timing for Suturing and Tying Surgeon's Knot in Lung Resection

Average timings (mean time) in seconds for suturing and tying the surgeon's knot in lung resection at 30°, 60°, and 90° angle are 311.83, 304.33, and 344.50, respectively. χ^2 values at those angles are 6.55, 2.73, and 10.84. The lowest time required is at 60° angle manipulation (Figs 16 and 17).

All the readings were reproducible at a *p* value of 30.144 at 5% level of significance. It has been demonstrated that the 60° angle has shorter operative time followed by 30° and then 90°.

Timing for Applying Endolinear Stapler in Lung Resection

Average timings (mean time) in seconds for applying an endolinear stapler in lung resection at 30°, 60°, and 90° angle are 907.17, 856.83, and 988.50, respectively. χ^2 values at those angles are 0.69, 3.94, and 0.74. The lowest time required is at 60° angle manipulation (Figs 18 and 19).

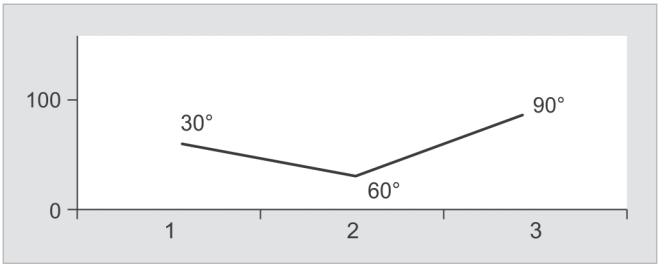

Fig. 17: Surgeon's discomfort level for suturing and tying surgeon's knot in lung resection at 30°, 60°, and 90° port position angles

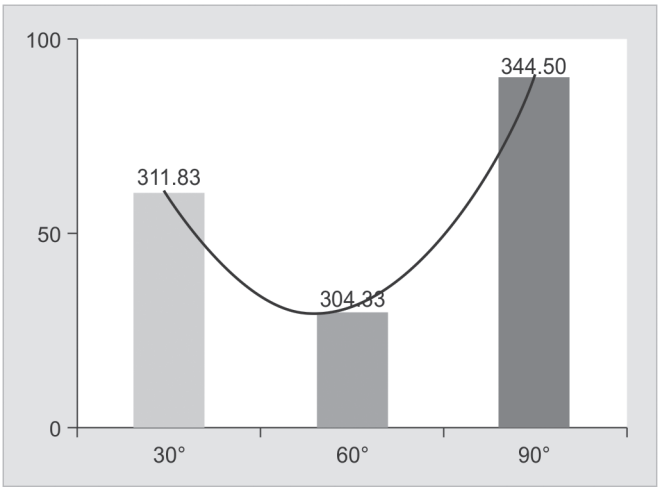

Fig. 19: Surgeon's discomfort level for applying endolinear stapler in lung resection with different manipulation angles

All the readings were reproducible at a *p* value of 30.141 at 5% level of significance. It was found that the 60° angle had shorter operative time followed by 30° and then 90°.

Thymectomy

Timing for Suturing and Tying Surgeon's Knot in Thymectomy

Average timings (mean time) in seconds for suturing and tying surgeon's knot in thymectomy at 30°, 60°, and 90° angle are 222.17, 133.17 and 282.83, respectively. χ^2 values at those angles are 8.39, 7.88, and 8.52. The lowest time required is at 60° angle manipulation (Figs 20 to 23).

Only readings at 30° and 60° were reproducible at a *p* value of 30.141 at 5% level of significance but the χ^2 of readings at 90° was less than the *p* value, indicating nonreproducibility. These suggest that the 60° angle has shorter operative time than 30° and 90° and above.

Timing for clipping in thymectomy.

ASD Closure

Timing For Suturing and Tying Surgeon's Knot in ASD Closure

The average timings in seconds for 30°, 60°, and 90° were 225.67, 128.67 and 293.33, respectively. It was demonstrated that the 60° angle had shorter operative time followed by 30° and then 90°, although all the readings were reproducible at a *p* value of 30.141 at 5% level of significance (Figs 24 and 25).

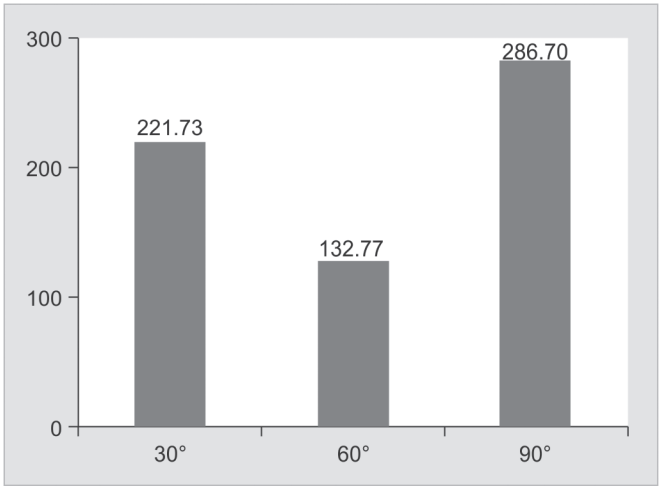

Fig. 20: Average timing for suturing and tying surgeon's knot in thymectomy with different manipulation angles

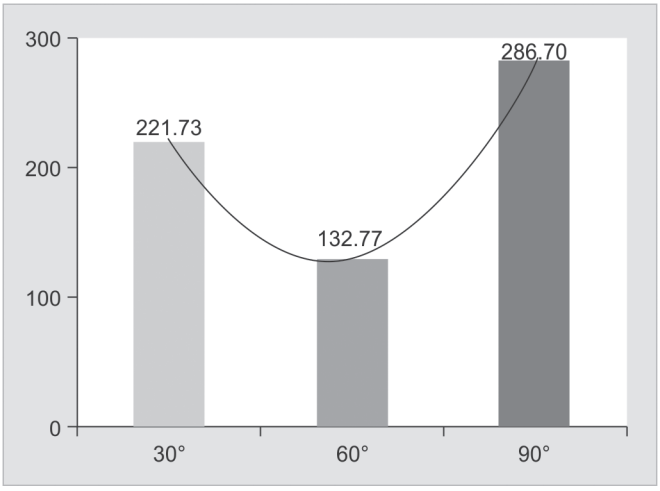

Fig. 21: Surgeon's discomfort level for suturing and tying surgeon's knot in thymectomy with different manipulation angles

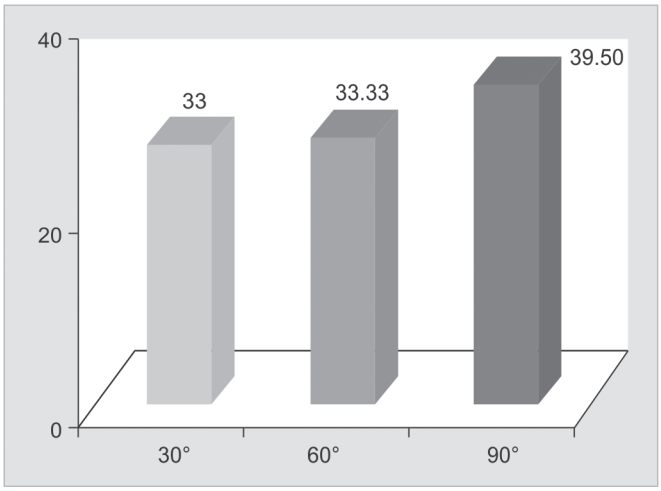

Fig. 22: Average timing for clipping in thymectomy with different manipulation angles

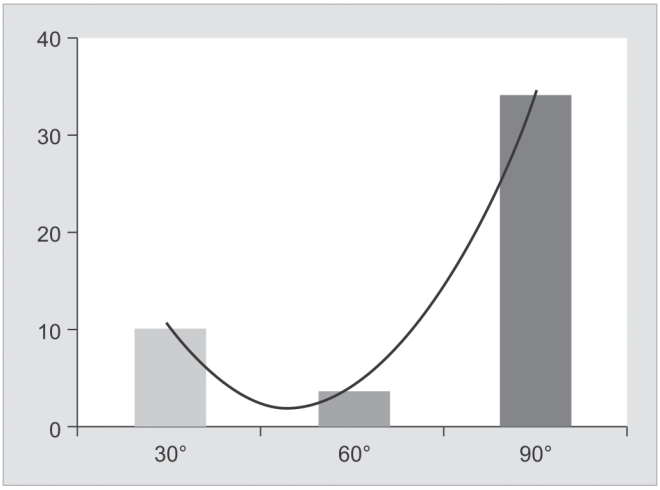

Fig. 23: Surgeon's discomfort level for clipping in thymectomy with different manipulation angles

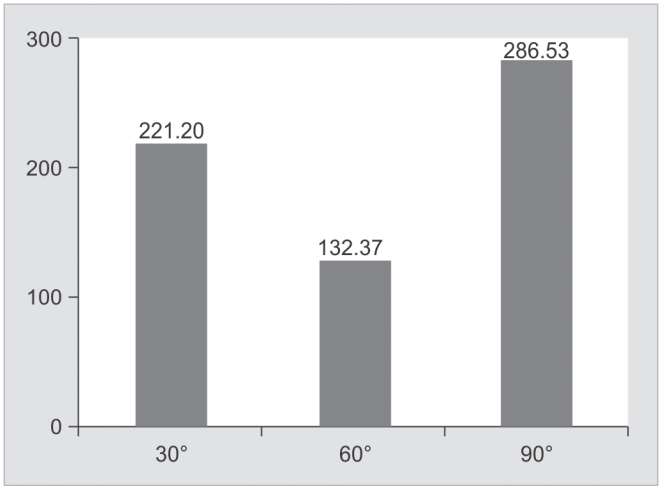

Fig. 24: Average timing for suturing and tying surgeon's knot in atrial septal defect closure with different manipulation angles

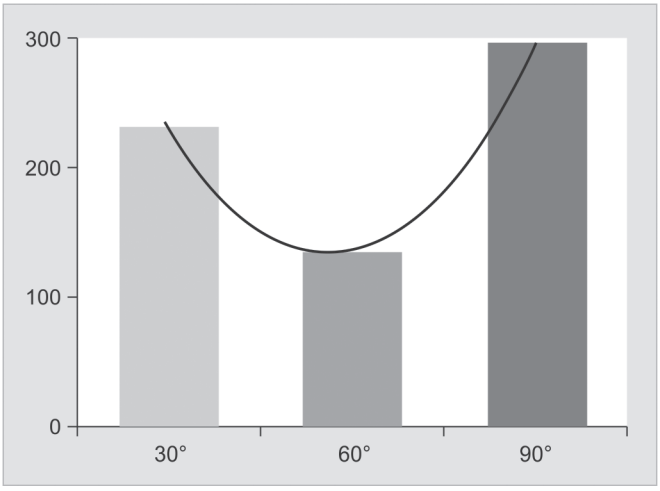

Fig. 25: Surgeon's discomfort level for suturing and tying surgeon's knot in atrial septal defect closure with different manipulation angles

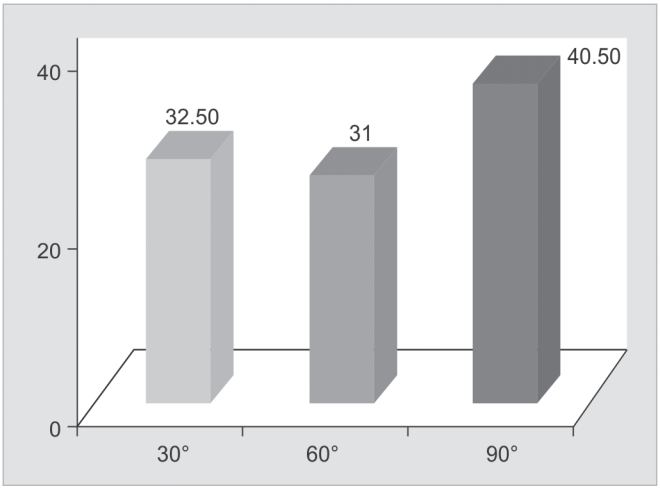

Fig. 26: Average timing for aorta cross-clamping in atrial septal defect closure with different manipulation angles

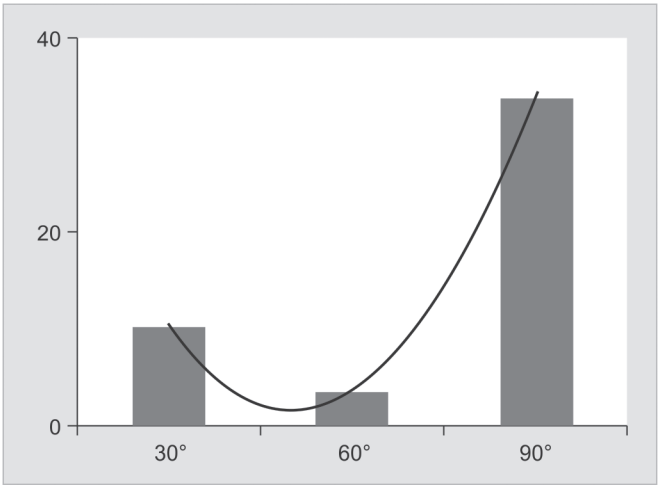

Fig. 27: Surgeon's discomfort level for aorta cross-clamping in atrial septal defect closure with different manipulation angles

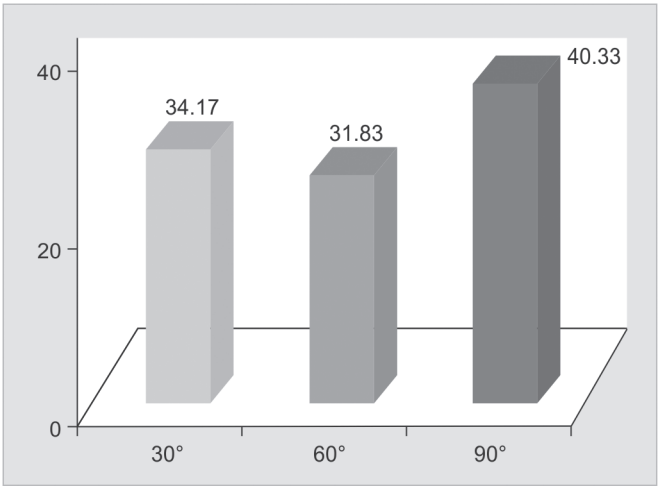

Fig. 28: Average timing for trimming of anastomotic end of LIMA for LAD grafting with different manipulation angles

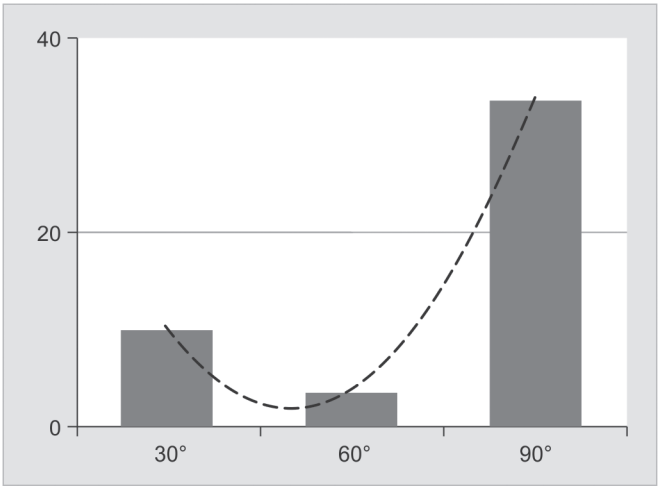

Fig. 29: Surgeon's discomfort level for trimming of anastomotic end of LIMA for LAD grafting with different manipulation angles

Timing for Aorta Cross-clamping in ASD Closure

Average timings (mean time) in seconds for aorta cross-clamping in ASD closure at 30°, 60°, and 90° angle are 32.50, 31.00, and 40.50, respectively. χ^2 values at those angles are 2.88, 1.48, and 1.52. The lowest time required is at 60° angle manipulation (Figs 26 and 27).

The average timings in seconds for 30°, 60°, and 90° were 32.50, 31.00, and 40.50 respectively. All the readings were reproducible at a *p* value of 30.141 at 5% level of significance. It was demonstrated that the 60° angle had shorter operative time followed by 30° and then 90°.

IMA Harvesting

Timing for Trimming of Anastomotic End of LIMA for LAD Grafting

Average timings (mean time) in seconds for trimming of the anastomotic end of LIMA for LAD grafting at 30°, 60°, and 90° angle are 34.17, 31.83, and 40.33, respectively. χ^2 values at those angles are 1.42, 1.28, and 1.52. The lowest time required is at 60° angle manipulation (Figs 28 and 29).

The average timings in seconds for 30°, 60°, and 90° were 34.17, 31.83, and 40.33 respectively. Here it is observed that only the readings at 60° manipulation angle were reproducible at a *p* value of 30.141 at 5% level of significance, which further support any port position that will provide working angle of 60° as the ideal.

Timing for Grafting of Harvested LIMA to LAD in TECABG

Average timings (mean time) in seconds for grafting harvested LIMA to LAD in TECABG at 30°, 60°, and 90° angle are 2110.83, 2097.33, and 2146.17, respectively. χ^2 values at those angles are 0.21, 0.11, and 0.14. The lowest time required is at 60° angle manipulation (Figs 30 and 31).

Esophagectomy

Timing for Suturing and Tying the Surgeon's Knot in esophagectomy

Average timings (mean time) in seconds for suturing and tying the surgeon's knot in esophagectomy at 30°, 60°, and 90° angle are 340.33, 304.50, and 359.33, respectively. χ^2 values at those angles

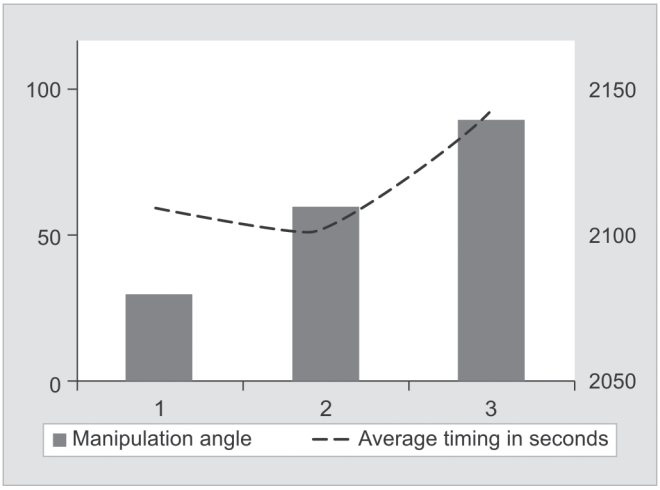

Fig. 30: Average timing for grafting of harvested LIMA to LAD in TECABG

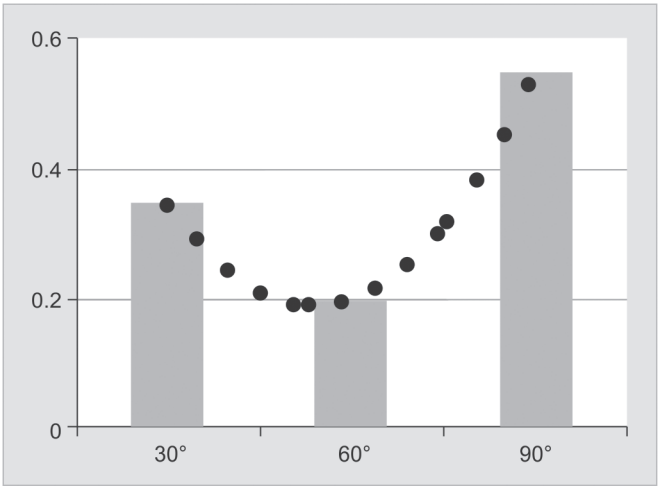

Fig. 31: Surgeon's discomfort level for grafting harvested LIMA to LAD in TECABG

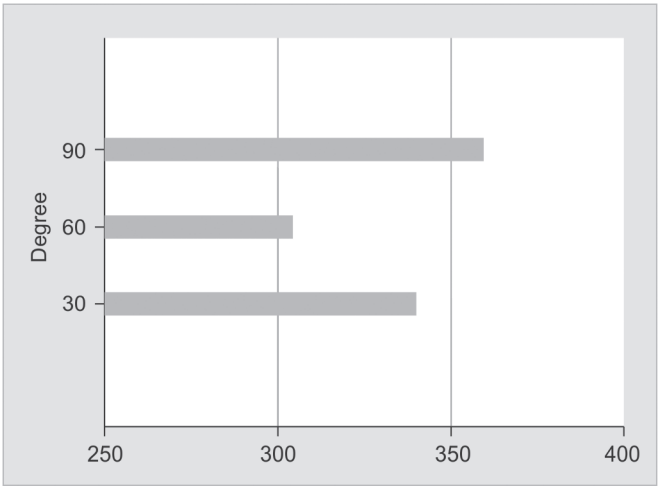

Fig. 32: Average timing in seconds for suturing and tying surgeon's knot in esophagectomy at 30°, 60°, and 90° port position angles

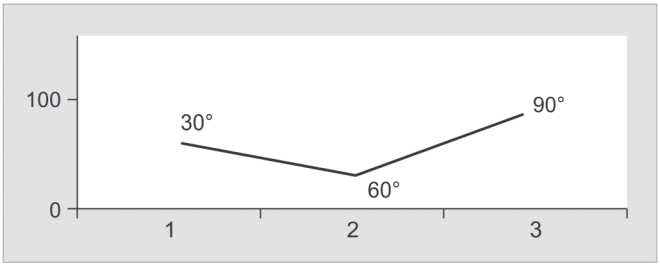

Fig. 33: Surgeon's discomfort level for suturing and tying surgeon's knot in esophagectomy at 30°, 60°, and 90° port position angles

are 1.09, 0.29, and 0.48. The lowest time required is at 60° angle manipulation (Figs 32 and 33).

The average timings in seconds for 30°, 60°, and 90° were 340.33, 304.50, and 359.33, respectively. The first two readings were reproducible at a *p* value of 30.141) at 5% level of significance. It was found that the 60° angle has shorter operative time than that of 30° and 90° angle. It shows increased difficulties and time consumption when ports are placed in such a manner that will give working angles of 90° and above.

Timing for Purse String Suture Placement for a Circular Stapler in Esophagectomy

Average timings (mean time) in seconds for purse string suture placement for a circular stapler in esophagectomy at 30°, 60°, and 90° angle are 635.50, 598.50, and 659.33, respectively. χ^2 values at those angles are 0.34, 0.18, and 0.26. The lowest time required is at 60° angle manipulation.

From above discussions, with 60° manipulation angle the average timings of all tasks were shorter and all were reproducible. All the tasks were difficult and time-consuming when they were followed by 30° and 90° angle. The closer the manipulation angle is to the 90° and above, the more likely it is to take longer operative time. It might be due to fatigue from increased elevation angle and overstretching of the shoulder (Figs 34 and 35).

From above figures and discussion, it is obvious that the surgeon's discomfort level is least at the 60° port position.

Discussion

A total of 30 procedures were done in this prospective experimental animal study. The TTP of port placement was used. Three thoracic and two cardiac procedures were included. The details of the procedures are as follows: lung resection—6 (20% of total case), thymectomy—6 (20% of total case), closure of ASD—6 (20% of total case), IMA harvesting for TECABG—6 (20% of total case), and esophagectomy—6 (20% of total case) on 30 animals through minimal access techniques.

Execution time (sum of the ports access time and the actual procedure time), error rates, and the surgeon's discomfort for each of the three angles of manipulation were evaluated.

Lung Resection

Timing for Suturing and Tying Surgeon's Knot in Lung Resection

In this study, it was found that average timings (mean time) in seconds for suturing and tying surgeon's knot in lung resection at 30°, 60°, and 90° angle are 311.83, 304.33, and 344.50, respectively. χ^2 values at those angles are 6.55, 2.73, and 10.84. The lowest time required is at 60° angle manipulation.

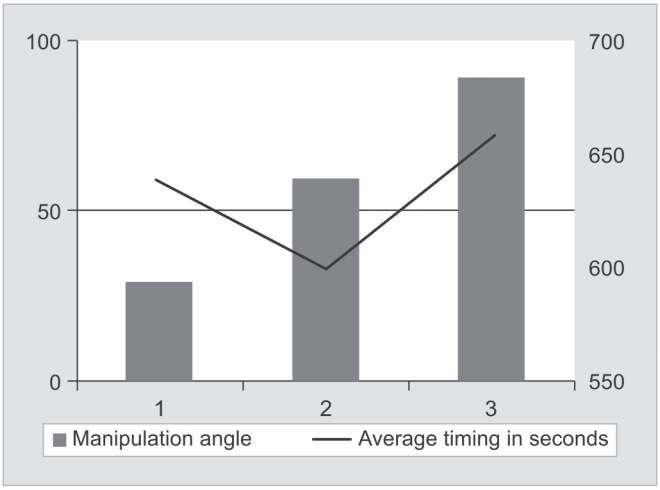

Fig. 34: Average timing for purse string suture placement for a circular stapler in esophagectomy with different manipulation angles

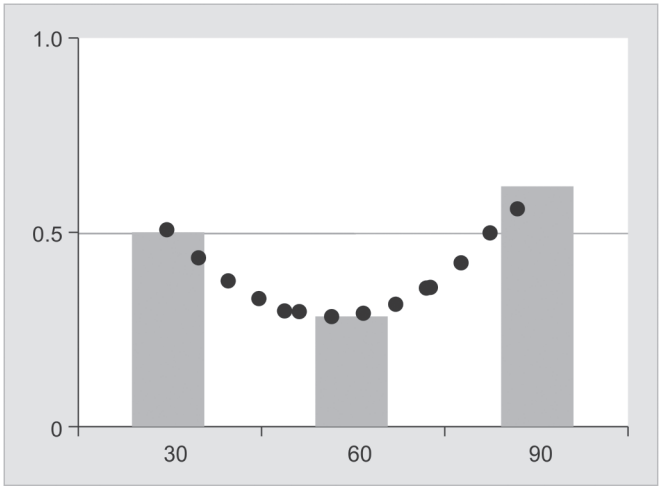

Fig. 35: Surgeon's discomfort level for purse string suture placement for a circular stapler in esophagectomy

Readings of timing obtained while taking a suturing and tying surgeon's knot in lung resection on swine at different manipulation angles (30°, 60°, 90°) were validated and average obtained by χ^2 tests. All the readings were reproducible at a *p* value of 30.144 at 5% level of significance. It was demonstrated that the 60° angle had shorter operative time followed by 30° and then 90°.

These findings were supported by some other studies. Yunusa et al. and Ismail and Mishra also mentioned that 60° angle has shorter operative time followed by 30° and then 90°.

Timing for Applying Endolinear Stapler in Lung Resection

Average timings (mean time) in seconds for applying an endolinear stapler in lung resection at 30, 60°, and 90° angle are 907.17, 835.00, and 988.50, respectively. χ^2 values at those angles are 0.69, 0.58 and 0.74. The lowest time required is at 60° angle manipulation.

Readings of timing obtained while applying an endolinear stapler in lung resection in swine at different manipulation angles (30°, 60°, 90°) were shown, which were validated and average obtained by χ^2 tests. The average timings in seconds for 30°, 60°, and 90° were 907.17, 835.00, and 988.50, respectively. All the readings were reproducible at a *p* value of 30.141 at 5% level of significance. It was demonstrated that the 60° angle had shorter operative time followed by 30° and then 90°.

Similar findings were demonstrated by some other researchers.[8,10]

Thymectomy

Timing for Suturing and Tying Surgeon's Knot in thymectomy

Average timing (mean time) in seconds for suturing and tying surgeon's knot in thymectomy at 30, 60 and 90° angle is 222.17, 133.17, and 282.83, respectively. χ^2 values at those angles are 8.39, 7.88, and 8.52. The lowest time required is at 60° angle manipulation.

Readings of timing taken for suturing and tying a surgeon's knot in thymectomy in swine at different manipulation angles, which were validated by the χ^2 test and average obtained. The average timings in seconds for 30°, 60° and 90° were 222.17, 133.17, and 282.83, respectively. Only readings at 30° and 60° were reproducible at a *p* value of 30.141 at 5% level of significance but the χ^2 of readings at 90 was less than the *p* value, indicating nonreproducibility. These suggest that the 60° angle has shorter operative time than the 30° and 90° and above.

These findings were consistent with some other researchers.[8,10]

Timing for Clipping in Thymectomy

Average timings (mean time) in seconds for clipping in thymectomy at 30°, 60°, and 90° angle are 33.00, 32.33, and 39.50, respectively. The χ^2 values at those angles are 3.03, 0.91, and 1.46. The lowest time required is at 60° angle manipulation.

Similar findings were found by some other researchers.[8,10]

ASD Closure

Timing for Suturing and Tying Surgeon's Knot in ASD Closure

Average timing (mean time) in seconds for suturing and tying surgeon's knot in ASD closure at 30°, 60°, and 90° angle are 225.67, 128.67, and 293.33 respectively. χ^2 values at those angles are 12.33, 10.21, and 11.15. The lowest time required is at 60° angle manipulation.

Readings of timing taken to suturing and tying surgeon's knot in ASD closure in swine at different manipulation angles are shown, which were validated by χ^2 test and means obtained. The average timing in seconds for 30°, 60°, and 90° were 225.67, 128.67, and 293.33, respectively. It was clearly demonstrated that the 60° angle had shorter operative time followed by 30° and then 90°, although all the readings were reproducible at a *p* value of 30.141 and 5% level of significance.

Different studies showed similarity with the present study.[8,10]

Timing for Aorta Cross-clamping in ASD Closure

Average timings (mean time) in seconds for aorta cross-clamping in ASD closure at 30°, 60°, and 90° angle are 32.50, 31.00, and 40.50, respectively. χ^2 values at those angles are 2.88, 1.48, and 1.52. The lowest time required is at 60° angle manipulation.

The average timings in seconds for 30°, 60°, and 90° are 32.50, 31.00, and 40.50, respectively. All the readings were reproducible at a *p* value of 30.141 at 5% level of significance. It was demonstrated that the 60° angle had shorter operative time followed by 30° and then 90°.

Similar findings were observed by some other researchers.[8,10]

IMA (LIMA) Harvesting

Timing for Trimming of Anastomotic End of LIMA for LAD Grafting

Average timings (mean time) in seconds for trimming of the anastomotic end of LIMA for LAD grafting at 30°, 60°, and 90° angle are 34.17, 31.83, and 40.33, respectively. χ^2 values at those angles are 2.42, 1.28, and 1.52. The lowest time required is at 60° angle manipulation.

Readings of timing taken for trimming of the anastomotic end of LIMA for LAD grafting of swine at different manipulation angles are shown, which were validated by the χ^2 test and average obtained. The average timings in seconds for 30°, 60°, and 90° were 34.17, 31.83, and 40.33, respectively. Here it is observed that only the readings at 60° manipulation angle were reproducible at a *p* value of 30.141 at 5% level of significance, which further support any port position that will provide working angle of 60° as the ideal.

Some other researchers found similar findings.[8,10]

Timing for Grafting of Harvested LIMA to LAD in TECABG

Average timings (mean time) in seconds grafting harvested LIMA to LAD in TECABG at 30°, 60°, and 90° angle are 2110.83, 2097.33, and 2146.17, respectively. X^2 values at those angles are 0.21, 0.11, and 0.14. The lowest time required is at 60° angle manipulation.

Similar findings were explored by some other researchers.[8,10]

Esophagectomy

Timing for Suturing and Tying Surgeon's Knot in Esophagectomy

Average timings (mean time) in seconds for suturing and tying surgeon's knot in esophagectomy at 30°, 60°, and 90° angle are 340.33, 304.50, and 359.33, respectively. χ^2 values at those angles are 1.09, 0.29, and 0.48. The lowest time required is at 60° angle manipulation.

Readings of timing of suturing and tying surgeon's knot in esophagectomy of swine at different manipulation angles are shown, which were validated by χ^2 tests and average obtained. The average timings in seconds for 30°, 60°, and 90° were 340.33, 304.50, and 359.33, respectively. Despite the facts that the first two readings were reproducible at a *p* value of 30.141 at 5% level of significance, it was demonstrated that the 60° angle had shorter operative time than that of 30° and 90° angle. It indicates increased difficulties and time consumption when ports are positioned in such a way that will give working angle of 90° and above.

Similarity of these findings were found by some other researchers.[8,10]

Timing of Purse String Suture Placement for Circular Stapler in Esophagectomy

Average timings (mean time) in seconds for purse string suture placement for a circular stapler in esophagectomy at 30°, 60°, and 90° angle are 635.50, 598.50, and 659.33, respectively. X^2 values at those angles are 0.34, 0.18, and 0.26. The lowest time required is at 60° angle manipulation.

Similar findings were found by some other researchers.[8,10]

From above discussions, the average timings of all tasks were shorter with 60° manipulation and all were reproducible. Irrespective of the difficulty of the tasks then, it was followed by 30° and 90° angle. The closer the manipulation angle is to the 90° and above, the more the likely to take longer operative time. It may be due to fatigue from increased elevation angle and shoulder overstretching.

From above figures and discussion, it is obvious that a surgeon's discomfort level is least at the 60° port position.

Fortunately, no errors during surgical procedures occurred. But in some other studies different errors occurred during surgical task performance.[8,10]

Regarding surgeon's discomfort, 30° and 90° angles were revealed as discomfortable port positions, whereas 60° angle of manipulation showed a more comfortable position. Though 60° angle showed some discomfort in a few cases, but it was not significant. In their article, Yunusa et al. mentioned that the BDP is the standard principle for deciding sites of port placement during VATS.[8,10] It is the conventional principle to which other principles are compared. The TTP was discovered as an alternative principle where BDP is associated with difficulties especially in lung procedures.

In a study of VATS pericardial window, Yunusa et al. found similar results. The result showed that using the TTP for ports placement led to a longer execution time with a mean distinction of 93 seconds. Error rates and surgeons' discomfort were almost similar.

They explained the prolonged execution time might be due to the mirror image production when TTP is employed. The scissors and grasping forceps were usually alternated between the operating port and the target port during the procedure to adapt the various orientations for resecting the pericardial segment. The mirror image distorts the visuals, so the orientation causes prolongation of execution time.

They also mentioned that with more experience this problem might be solved by maintaining the grasping forceps in the target port and incise the pericardium with a scissor through the operating port.

They discussed that TTP might have a role when dealing with pericardial lesions requiring digital palpation and stapling in case of pericardial cysts. The manipulation angle between the grasping forceps and the stapler (through the target and operating ports) is then 90° that is the proper angle for stapling. When BDP is employed in this scenario, an alternate access might be needed for the stapler to get this angle.

In that study, they explained that BDP is preferable for ports placement during the VATS pericardial procedure but TTP might have clear advantages when dealing with pericardial lesions requiring digital palpation and stapling.

In this present study, it was also found that the 60° angle of manipulation is advantageous for ASD closure and some other procedures.

In VATS esophagocardiomyotomy, Ismail and Mishra and Yunusa et al. found almost similar results. From the results, the execution time for VATS esophagocardiomyotomy using BDP for ports placement was more than when TTP was used. This is in contrast to the results of the errors rates and surgeons' discomfort that were more when TTP was used.

In the study of Yunusa et al., one episode of esophageal perforation was recorded when using the BDP while two major errors (esophageal perforation and descending aortic injury) were recorded when TTP was employed. This is vital as it translates to 33.3% error rate. But fortunately, no such error occurred in the present study.

They found that the surgeon's discomfort using TTP was worse with an average of 7 compared to 5.83 recorded for BDP, which was contrary with the present study.

They mentioned that the increased error rates and surgeon's discomfort can be explained by the mirror image produced when using TTP and the flimsy nature of the swine tissue giving rise to injury to the esophagus and the encircling structures even with minimal force.

The prolongation of the execution time when BDP was used which is in contrast to the trends of the error rates and the surgeon's discomfort might have been due to the increased error rates in TTP use. When these major errors are encountered, the procedure does not typically proceed and the execution time when using TTP is recorded as shortened. This calls for more data from larger sample size to revalidate this and provide more explanations.

The observed BDP seems to be better than the TTP of ports placement for VATS esophagocardiomyotomy in terms of the error rates and the surgeon's discomfort, although it took longer time to be executed.

They concluded that the TTP might have clear benefit over BDP when treating different esophageal diseases requiring stapling such as esophageal diverticulum or during esophagectomy because of the 90° manipulation angle between the grasping forceps and the stapler. It clearly supports the present study.

Yunusa et al. and Ismail performed study on VATS thoracic sympathectomy in 2014. They had almost similar results and observations, which were consistent with this study where thymectomy was done instead.

They found that the execution time for VATS thoracic sympathectomy when using the TTP was less than when BDP was applied (mean difference of 194 seconds). However, the execution time data are not statistically significant and therefore not reproducible ($\chi^2 = 21.04$ at p value of 11.07). Thus, there might be need for a larger sample to reassess its reproducibility and then objectively compare it with the TTP. The BDP and the TTP are comparable in terms of the error rates and the surgeon's discomfort. I also recommend it.

They concluded that it can also be seen that TTP is comparable or more favorable to BDP when the instrument through the target port is employed for retraction only and not for other manipulations. When used for different purposes, the mirror image produced will lead to reduced task performance and increased surgeon's discomfort. It is also consistent with my observations.

Conclusion and Recommendations

Conclusion

The BDP is the standard principle used to decide sites of port placement during VATS. The TTP was introduced as an alternative principle when problem was observed during some procedures using the BDP particularly in lung procedures. The TTP could provide more benefit when the instruments through the target port are used only for retraction. It might also be preferred in VATS procedures where stapling could be required. The manipulation angle of 60° in TTP is found more favorable than 30° and 90° angles, but it requires further evaluation with a large data.

Recommendations

The TTP should be preferred when the instrument through the target port is employed only for retraction or stapling will be required and BDP should be preferred when stapling might not be required.

The duration for the study is also short. A long cohort should be conducted to have a more reproducible and validated result.

There should be caution when translating this data to humans as the swines have some peculiarities such as flimsy tissues and shortened thoracic space. Surgical simulation using animal models may be the high fidelity method and should be encouraged whenever feasible. Sheep can be an alternative to the swine as they have stronger tissues.

Limitations

The sample size is small. It may affect the extrapolation of the results. This is because the study on animal models is guided by stringent legislations and requirements, which limit the sources.

The swine are smaller and adult VATS instruments were used. So, some ergonomic difficulties are obvious. The appropriate location of the intercostal spaces and ports placement were more challenging. Translation of the data to humans may also be affected by some differences with the swine as the space between the anterior and posterior ALs and the intercostal spaces are narrower than those in human. There could be other confounding variables such as dysfunctional instruments that could have impacted on the measures of outcome.

References

1. Shields T. General Thoracic Surgery. Lippincott Williams & Wilkins; 2004. p. 524.
2. McKenna RJ,Jr, Houck W, Fuller CB. Video-assisted thoracic surgery lobectomy: experience with 1,100 cases. Ann Thorac Surg 2006;81(2):421–425. DOI: 10.1016/j.athoracsur.2005.07.078.
3. De Silva MC, Swanson SJ. Video-assisted thoracic surgery in ACS surgery: principles and practice. 4th ed., ch. 10, Canada: Decker Intellectual Properties; 2010.
4. Lewis RJ, Caccavale RJ, Silver GE, et al. One hundred consecutive patients undergoing video-assisted thoracic operations. Ann Thorac Surg 1992;54(3):421–426. DOI: 10.1016/0003-4975(92)90431-3.
5. Agasthian T. Revisiting the prone position in video-assisted thoracoscopic surgery. Asian Cardiov Thorac Ann 2010;18(4):364–367. DOI: 10.1177/0218492310375857.
6. Swanson SJ, Miller DL, McKenna RJ, Jr, et al. Comparing robot-assisted thoracic surgical lobectomy with conventional video-assisted thoracic surgical lobectomy and wedge resection: results from a multihospital database (Premier). J Thorac Cardiovasc Surg 2014;147(3):929–937. DOI: 10.1016/j.jtcvs.2013.09.046.
7. Bertolaccini L, Rocco G, Viti A, et al. Geometrical characteristics of uniportal VATS. J Thorac Dis 2013.
8. Ismail AJ, Mishra RK. Comparing task performance and comfort during nonpulmonary video-assisted thoracic surgery procedures between the application of the 'baseball diamond' and the 'triangle target' principles of port placement in swine models. World J Lap Surg 2014;7(2):1–6.
9. Manasnayakorn S, Cuschieri A, Hanna GB. Ergonomic assessment of optimum operating table height for hand-assisted laparoscopic surgery. Surg Endosc 2009;23(4):783–789. DOI: 10.1007/s00464-008-0068-9.
10. Yunusa B, Mishra RK, Chowhan JS. Is there an ideal port position for laparoscopic urological procedures? World J Lap Surg 2014;7(2):74–87. DOI: 10.5005/jp-journals-10007-1221.
11. Hansen HJ, Petersen RH, Christensen M. Video-assisted thoracoscopic surgery (VATS) lobectomy using a standardized anterior approach. Surg Endosc 2011;25(4):1263–1269. DOI: 10.1007/s00464-010-1355-9.
12. Menozzi M, von Buol A, Krueger H, et al. Direction of gaze and comfort: discovering the relation for the ergonomic optimization of visual tasks. Ophthalmic Physiol Opt 1994;14(4):393–399. DOI: 10.1111/j.1475-1313.1994.tb00131.x.
13. Hanna GB, Shimi SM, Cuschieri A. Task performance in endoscopic surgery is influenced by location of the image display. Ann Surg 1998;227(4):481–484. DOI: 10.1097/00000658-199804000-00005.

14. Trejo A, Jung MC, Oleynikov D, et al. Effect of handle design and target location on the insertion and aim with a laparoscopic surgical tool. Appl Ergon 2007;38(6):745–753. DOI: 10.1016/j.apergo.2006.12.004.
15. Manasnayakorn S, Cuschieri A, Hanna GB. Ideal manipulation angle and instrument length in hand-assisted laparoscopic surgery. Surg Endosc 2008;22(4):924–929. DOI: 10.1007/s00464-007-9520-5.
16. Ergonomics DeU. And laparoscopy. Indian J Surg 2005;67:164–166.
17. Mishra RK. Textbook of Practical Laparoscopic Surgery. 3rd ed., New Delhi, India: Jaypee Brothers Medical Publishers (P) Limited; 2013.
18. Sasaki M, Harai S, Kawabe M, et al. Triangle target principle for trocar placement during video-assisted thoracic surgery. Eur J Cardiothorac Surg 2005;27(2):307–312. DOI: 10.1016/j.ejcts.2004.10.042.
19. Takao M, Tarukawa T, Shimamoto A, et al. Principle of video-assisted thoracic surgery—letter to the editor. Eur J Cardiothorac Surg 2005;28(4):657–664. DOI: 10.1016/j.ejcts.2005.06.021.
20. Davenport E, Malthaner RA. The role of surgery in the management of thymoma: a systematic review. Ann Thorac Surg 2008;86(2):673–684. DOI: 10.1016/j.athoracsur.2008.03.055.
21. Jaretzki A, Steinglass KM, Sonett JR. Thymectomy in the management of myasthenia gravis. Semin Neurol 2004;24(01):49–62. DOI: 10.1055/s-2004-829596.
22. Keating CP, Kong YX, Tay V, et al. VATS thymectomy for nonthymomatous myasthenia gravis: standardized outcome assessment using the myasthenia gravis foundation of America clinical classification. Innovations (Phila) 2011;6(2):104–109. DOI: 10.1097/imi.0b013e3182165cdb.
23. Keijzers M, de Baets M, Hochstenbag M, et al. Robotic thymectomy in patients with myasthenia gravis: neurological and surgical outcomes. Eur J Cardiothorac Surg 2015;48(1):40–45. DOI: 10.1093/ejcts/ezu352.
24. Rea F, Marulli G, Bortolotti L, et al. Experience with the "da Vinci" robotic system for thymectomy in patients with myasthenia gravis: report of 33 cases. Ann Thorac Surg 2006;81(2):455–459. DOI: 10.1016/j.athoracsur.2005.08.030.
25. DiBardino DJ, McElhinney DB, Kaz AK, et al. Analysis of the US Food and Drug Administration Manufacturer and user facility device experience database for adverse events involving Amplatzer septal occluder devices and comparison with the Society of Thoracic Surgery congenital cardiac surgery database. J Thorac Cardiovasc Surg 2009;137(6):1334–1341. DOI: 10.1016/j.jtcvs.2009.02.032.
26. Doll N, Walther T, Falk V, et al. Secundum ASD closure using a right lateral minithoracotomy five-year experience in 122 patients. Ann Thorac Surg 2003;75(5):1527–1531. DOI: 10.1016/s0003-4975(02)04889-0.
27. Vistarini N, Aiello M, Mattiucci G, et al. Port-access minimally invasive surgery for atrial septal defects: a 10-year single-center experience in 166 patients. J Thorac Cardiovasc Surg 2010;139(1):139–145. DOI: 10.1016/j.jtcvs.2009.07.022.
28. Olearchyk AS, Magovern GJ. Internal mammary artery grafting. clinical results, patency rates and long-term survival in 833 patients. J Thorac Cardiovasc Surg 1983;92(6):1082–1087. DOI: 10.1016/S0022-5223(19)35824-6.
29. Vassiliades TAJr, Cosgriff N, et al. Superiority of using bipolar radiofrequency energy for internal mammary artery Harvesting. Ann Thorac Surg 2007;83(4):1508–1512. DOI: 10.1016/j.athoracsur.2006.08.014.
30. Jatene FB, Pêgo-Fernandes PM, Hayata ALS, et al. VATS for complete dissection of LIMA in minimally invasive coronary artery bypass grafting. Ann Thorac Surg 1997;63(6):S110–S113. DOI: 10.1016/S0003-4975(97)00427-X.
31. Ohtsuka T, Wolf RK, Hiratzka LF, et al. Thoracoscopic internal mammary artery harvest for MICABG using the harmonic scalpel. Ann Thorac Surg 1997;63(6 Suppl):S107–S109. DOI: 10.1016/s0003-4975(97)00292-0.
32. Amaral JF. The experimental development of an ultrasonically activated scalpel for laparoscopic use. Surg Laparosc Endosc 1994;4(2):92–99.
33. Bonaros N, Schachner T, Lehr E, et al. Five hundred cases of robotic totally endoscopic coronary artery bypass grafting: predictors of success and safety. Ann Thorac Surg 2013;95(3):803–812. DOI: 10.1016/j.athoracsur.2012.09.071.
34. Folliguet TA, Dibie A, Philippe F, et al. Robotically-assisted coronary artery bypass grafting. Cardiol Res Pract 2010;2010:175450. DOI: 10.4061/2010/175450.
35. Srivastava S, Gadasalli S, Agusala M, et al. Beating heart totally endoscopic coronary artery bypass. Ann Thorac Surg 2010;89(6):1873–1879. DOI: 10.1016/j.athoracsur.2010.03.014.
36. GLOBOCAN 2012. Online. Accessed at 10.31.2016. Available online address: http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx.
37. Jemal A, Bray F, Center MM, et al. Global cancer statistics. CA Cancer J Clin 2011;61(2):69–90. DOI: 10.3322/caac.20107.
38. Torre LA, Bray F, Siegel RL, et al. Global cancer statistics, 2012. CA Cancer J Clin 2015;65(2):87–108. DOI: 10.3322/caac.21262.
39. Enzinger PC, Mayer RJ. Esophageal cancer. N Engl J Med 2003;349(23):2241–2252. DOI: 10.1056/NEJMra035010.
40. Operational guidelines for observance of good practices in CPC-SEA. An Indian committee for the purpose of promotion and supervision of experiments on animals (CPCSEA) Document.

RESEARCH ARTICLE

Effect of Metatarsus Reflexology Massage in Laparoscopic Cholecystectomy Nausea: A Randomized Clinical Trial

Marzieh Badakhsh[1], Andishe Hamedi[2], Salimeh Azizi[3]

Abstract

Background: Nausea after surgery is an important complication. The incidence of this complication is expressed to be 40–75% in laparoscopy. Due to the risks of nausea following surgery, various methods are used to control it. Metatarsus reflexology is a noninvasive, well-tolerated, inexpensive, convenient, and cost-effective method for treating many diseases. The aim of this study is to identify the effect of metatarsus reflexology massage in laparoscopic cholecystectomy nausea.

Materials and methods: In this randomized clinical trial, 60 patients who were candidates for laparoscopic cholecystectomy were randomly divided into two groups. The control group received common drug therapy and the intervention group underwent foot reflexology massage for 10 minutes after common therapy. In recovery and at 6 and 12 hours after surgery, the severity of nausea, vomiting was evaluated in the two groups. The results were analyzed using independent *t* test, Chi-square, and repeated measures analysis of variance is true.

Results: There were no significant differences between the two groups before intervention in terms of demographic characteristics including age, sex, duration of anesthesia, and severity of pain in recovery, However, during the study period (in both the intervention and control groups), the severity of nausea was decreased (p value < 0.001; $F = 245.24$).

Conclusion: Foot reflexology has an important role in nausea control along with other common treatments and it can be done by nurses due to low cost.

Keywords: Laparoscopic cholecystectomy, Nausea, Reflexology.

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Introduction

Gallstone is one of the most common diseases of the gastrointestinal tract that causes biliary-colic pain by blocking the cystic duct and may cause a person to suffer from related complications, including acute cholecystitis, chronic cholecystitis, cholangitis, a fistula between the gallbladder and part of the intestine, and ultimately ileus.[1]

Currently, laparoscopic cholecystectomy due to fewer complications has been considered as the selected method for the treatment of acute cholecystitis.[2] Although laparoscopy is a new step in surgery, it still has its own adverse effects, including more postsurgery nausea and vomiting compared with other techniques. This leads us to identify the appropriate way to control it.[3] Postoperative nausea and vomiting is an important and common complication, especially in surgeries such as laparoscopy. The incidence of this complication following laparoscopic cholecystectomy is reported to be between 40% and 75%.[4,5]

Nausea is referred to as the second cause of patient's discomfort and complaint. Postoperative nausea is a very bad experience for the patient; often the patient mentions it as a problem worse than pain. This complication can cause problems such as aspiration of the contents of the stomach, wound disclosure, esophageal rupture, and subcutaneous emphysema that can delay the discharge of the patient.[6]

Now, for many patients who develop nausea after surgery, drugs such as dexamethasone and metoclopramide are used. These drugs cause several complications, such as extrapyramidal complications, drowsiness, hypotension, and dysphoria.[7] In addition, intravenous ondansetron is used immediately after anesthesia or orally one hour after surgery, which has side effects such as headache, dizziness, constipation, dry mouth, muscle aches, urinary retention, and rash.[8] Since most anti-nausea drugs have unpleasant adverse effects or are expensive, alternative treatments for this problem are being investigated.[7] Among the various nonpharmacological methods, especially complementary and alternative medicine, acupressure can be used by physicians, nurses, and even patients. Nursing is one of the first professions, which has facilitated the use of complementary and alternative medicine.[9]

Reflexology is one of the complementary and substitute treatment that has a long history and can be used as an all-embracing approach along with medical treatments. Reflexive massage is a noninvasive and simple technique that can be considered as part of nursing care in intensive units.[10] Each metatarsus has more than 7,000 neurons, and experts in the field of reflexology believe that a life force or vital energy extends

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along the canals in the legs to all organs of the body, and any barrier to this flow ultimately leads to illness. Stimulating reflex points in the legs can break these dams in the path of the canal and release energy. These canals from each part of the body are linked with metatarsus through the nerverouts. According to some theories, massage can release endorphins and Enkephalin.[11] Emeset showed that reflexology is effective in reducing nausea and vomiting in patients undergoing general surgery.[12] Tadayon et al. showed that acupressure medicine has an effect on nausea and vomiting of pregnancy.[13] Regarding the fact that nausea following laparoscopic cholecystectomy is one of the most important and common complications among other operations of general surgery, and it has many complications despite the medical interventions and with respect to the fact that metatarsus reflexology massage is an inexpensive, simple, and uncomplicated nonpharmacological intervention, the aim of this study was to determine the effect of foot reflexology massage on postoperative nausea in patients undergoing laparoscopic cholecystectomy.

Materials and Methods

The present study was an interventional (randomized clinical trial), which was performed on patients admitted for laparoscopic cholecystectomy in Imam Ali Hospital and Samen Alaemah Hospital in Bojnurd—2016. This randomized clinical trial was performed on 60 patients aged 20–60 years old under laparoscopic cholecystectomy in Bojnurd Hospitals. Sampling in this research was randomized. In this way, the researcher, referring to the surgery department of Imam Ali Hospital and Samen Alaemah, selected each patient diagnosed with a Colette Cystic and had criteria for entering the research, and selected them after random allocation, in one of the intervention and control groups. Finally, the patients were randomly divided into two groups of 30 controls and intervention. The criteria for entering the study include written consent for participation in the study, reading and writing literacy, diagnosis of cholecystitis by ultrasound, and general surgeon's opinion, ages 20–60 years, general anesthesia for operation, history of gastrointestinal disorders, lack of experience with reflective massage, not having diabetes and diabetic foot, having a healthy limb on foot, having no addiction to any substance or cigarette, the body mass index was less than 30. Patients with neurological and postoperative complications, reluctance to continue the study, surgery for more than 2 hours, drug injection out of the prescribed anesthetic protocol, patients with nasogastric tube (NGT) after surgery and severe pain were excluded from the study. Instruments used in this study were a demographic questionnaire (age, sex, duration of anesthesia) and a list of the severity of nausea and vomiting. Visual analog scale (VAS) was used to measure and evaluate it. Through which a ruler, scaled from 0 to 10, was provided to the patient. Zero is equivalent to no nausea and ten equal to the highest severity of nausea (0–3 is mild nausea, 3–7 moderate and more than 7 severe nausea). To assess the severity of vomiting, the following scores were used: 0–3 mild vomiting, 3–7 moderate vomiting, more than 7 (severe vomiting). To determine the validity of the questionnaire, the content validity method was used under the guidance of the supervisors and counselors, and then five experts in the field of acupuncture and massage therapy. After considering the suggestions and necessary corrections, the final tool is used. In order to determine the validity of the method of acupressure, the first training course was conducted under the supervision of a traditional Chinese medicine specialist and then the method was applied by a researcher on a number of patients. After confirming the application of the acupressure method by the Chinese traditional medicine specialist, the researcher started. Content validity method was used to determine the validity of the visual scale of nausea and vomiting (VAS) and to determine its reliability, Cronbach's alpha test was used. This scale has also been used in various research.[13,14] All patients were operated by an anesthetic team under a general anesthetic procedure and underwent one surgeon. Meanwhile, the technique and type of anesthetic drug were also controlled as a variable, which included, for all patients, anesthetic drugs: (1) Ndodone 2 µg/kg as a preoperative drug. (2) Fentanyl 2 µg/kg. (3) For rapid muscular relaxation of xoxinilcholine and atherocurium at a dose of 0.5 mg/kg body weight. (4) Anesthetizing gas of iso-fluoranes was used during the operation, then CO_2 gas was pressurized to 15 mm Hg in the abdomen. The control group received only commonly used drug therapy and in intervention group in addition to commonly used drug therapy, metatarsus reflexology massage was performed. In such a way that by pushing the region of the solar network or the neural network behind the stomach underwent the foot in the center of the region, at the midpoint of the attachment of the second and third metatarsal bones, while the patient sleeping on the back, tight pressure on the area for 20 minutes (10 minutes right leg and 10 minutes left leg) was performed by Thumbs. Massage was performed at the patient's when they entrance from the recovery to the department and the patient's nausea and vomiting were measured. The severity of nausea and vomiting of patients was measured in recovery after the patient's consciousness (while the patient is completely alert) just prior to the transfer of the patient from recovery to the department, 6 hours after the surgery, and then 12 hours after the surgery. Finally, we used $SPSS_{19}$ software for analyzing the data by using independent *t* test, Chi-square, repeated measures analysis of variance (ANOVA) at a significant level of 0.05% and 95% confidence interval (Flowchart 1).

Results

This clinical trial study was performed on 60 patients aged 20–60 years old under laparoscopic cholecystectomy referred to hospitals in Bojnurd. Patients were randomly divided into two groups of 30 subjects. The mean age of the subjects was 44.96 years. Of the studied individuals, 38.3% were women and 61.7% were men. Demographic characteristics based on the two study groups as shown in Table 1.

In the present study, as shown in Table 1, there was a significant difference between age in the two groups (in both intervention and control groups). We used the logistic regression model to eliminate the age-related confounding effect. However, in the present study, the results show that the mean pain of patients in the recovery room, was not significantly different in both groups. Also, during the study period (in both the intervention and control groups), the severity of nausea was decreased (p value < 0.001; $F = 245.24$). The results indicate the effect of foot reflexology massage on changes in nausea in patients after cholecystectomy ($p < 0.001$; $F = 67.62$). The results of the distribution of changes in severity of nausea and vomiting in the intervention and control groups are shown in Tables 2 and 3. The results of Table 3 show that during the study period (in both the intervention and control groups), the severity of vomiting was decreased ($p < 0.001$; $F = 245/95$). The results indicate that the effect of massage underwent the foot on changes in vomiting in patients after cholecystectomy ($p < 0.001$; $F = 94.11$).

Flowchart 1: The stages of subject selection in this clinical trial study

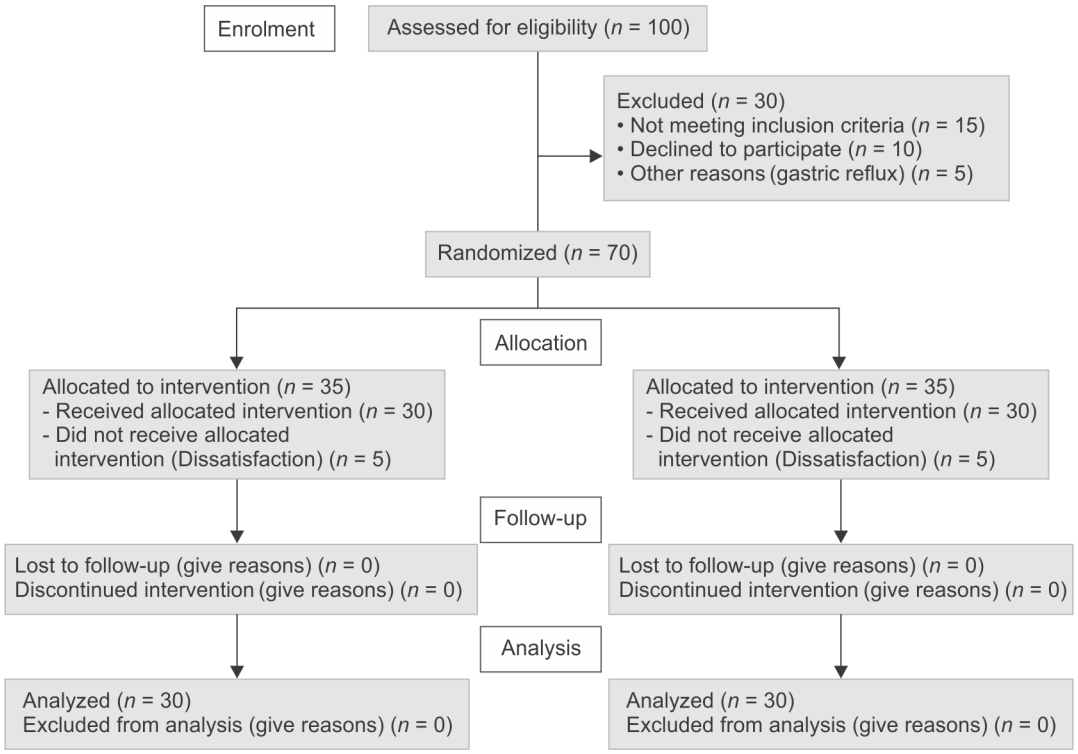

Table 1: Demographic characteristics of patients undergoing laparoscopic cholecystectomy in two groups before intervention

		Groups		
Variables		*M ± SD in intervention groups*	*M ± SD in control groups*	*p value*
Age		94.06 ± 42.7	86.5 ± 47.6	0.003
Duration of anesthesia		37.1 ± 5.5	39.4 ± 5.1	0.11
Severity of pain in recovery		5.03 ± 0.73	5.06 ± 0.73	0.17
Frequency				
Sex	Male	16 (53.3)	21 (70)	0.18
	Female	14 (46.7)	9 (30)	

*Significant at a level of 0.05

Table 2: Distribution of changes in severity of nausea in the intervention and control group during the study period after intervention

Severity of nausea	*M ± SD in intervention groups*	*M ± SD in control groups*	*p value*
In recovery	6.33 ± 0.9	6.06 ± 0.7	0.24
6 hours after surgery	3.63 ± 0.6	5.7 ± 0.6	<0.001
12 hours after surgery	2.7 ± 0.5	3.5 ± 0.6	<0.001

*Significant at a level of 0.05

Discussion

In the present study, the results show that the severity of nausea and vomiting in the recovery room before the intervention in the control and experimental groups were not statistically significant.

Table 3: Distribution of changes in severity of vomiting in the intervention and control group during the study period after intervention

Severity of vomiting	*M ± SD in intervention groups*	*M ± SD in control groups*	*p value*
In recovery	5.97 ± 0.8	5.87 ± 0.73	0.61
6 hours after surgery	3.4 ± 0.62	5.6 ± 0.67	<0.001
12 hours after surgery	2.8 ± 0.6	2.4 ± 0.73	0.04

*Significant at a level of 0.05

However, during the study period (in both experimental and control groups), the severity of nausea and vomiting decreased. The results indicate that the effect of massage underwent the foot on changes in vomiting in patients after cholecystectomy. Such studies have also shown that foot massage had a dramatic effect on pain relief in patients.[9,14]

Nausea is one of the most common postoperative complications of laparoscopic cholecystectomy. In most cases, antinausea drugs are used to reduce this complication and each of them has its own adverse effects and high cost. Therefore, much research has been conducted to find more accessible and cheaper methods with fewer complications. One of the methods for reducing nausea is reflexology medicine, which is a part of the holistic and complementary medicine and is based on the idea of treatment through the massage of the metatarsus. This is a well-tolerated, inexpensive, and easy method and it is believed that it can improve and reduce nausea by reducing stress and improving blood flow to organs.

Various studies have evaluated the effects of reflexology on people with different conditions, and according to the present study, it has been considered effective in reducing nausea.

For example, in the study of Choudhary et al. that was conducted on 60 patients undergoing general surgery, it was found that foot reflexology massage reduced the severity of nausea and vomiting of these patients in the intervention group, which is consistent with the results of the present study.[12]

In this study, the results showed that the severity of nausea significantly decreased in the first 6 hours after surgery in the intervention group (p value < 0.001), which is consistent with the results of the Choudhary et al.[12] In the study by Yoosefian et al. That was conducted on 37 patients undergoing chemotherapy, it was found that foot reflexology massage in the intervention group reduces the severity and frequency of vomiting within 4 hours of chemotherapy, which is consistent with the results of the present study.[12] In the study of Tadayon et al. that was conducted on 100 pregnant women, it was found that foot reflexology massage is effective on improving nausea in patients, which is consistent with the results of the present study.[13] The severity of nausea and vomiting in the intervention group during the 12 hours after surgery reduced compared with the control group. The study by Yoosefian also confirms this result. However, such studies had shown that reflexive massage did not have a positive effect on vomiting in the long time after surgery.[12,14] It has been argued that finger pressure on the points of the reflex in the foot can affect the desired target function and causes the patient to become relaxed and recover.[15] Also, there was no significant relationship between the duration of anesthesia in the two groups. Because all patients were operated by an anesthetic team under a general anesthetic procedure and were operated by one surgeon. As a result, the technique and type of anesthetic was considered as a control variable. Text book showed that increasing the duration of anesthesia can increase the incidence and severity of nausea and vomiting in patients, especially in women.

The results of this study showed that reflexology massage reduced nausea in cholecystectomy patients and it can be used as a treatment method to relieve patients' postoperative nausea along with other drug therapies.

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References

1. Hunter J, Oddsdottir M. Gallbladder and the extra hepatic billiary system. Schwartz's principles of surgery. NewYork: McGraw Hill Company; 2005.
2. Ansaloni L, Pisano M, Coccolini F, et al. 2016 WSES guidelines on acute calculous cholecystitis. World J Emerg Surg 2016;11(1):25. DOI: 10.1186/s13017-016-0082-5.
3. Park A, Lee G, Seagull FJ, et al. Patients benefit while surgeons suffer: an impending epidemic. J Am Coll Surg 2010;210(3):306–313.
4. Doyle SB. Is dexamethasone 4 mg a more effective anti-emetic than dexamethasone 8 mg for the prevention of early post-operative nausea and vomiting in women undergoing laparoscopic gynecological surgery? The University of Southern Mississippi; 2015.
5. Miller Ronald D. Anesthesia, 5th ed., Philadelphia: Churchil Livingston; 2000. pp. 2213–2237.
6. Thompson HJ. The management of post-operative nausea and vomiting. J Adv Nurs 1999;29(5):1130–1136. DOI: 10.1046/j.1365-2648.1999.00998.x.
7. Krobbuaban B, Pitakpol S, Diregpoke S. Ondansetron vs. metoclopramide for the prevention of nausea and vomiting after gynecologic surgery. Med J Med Assoc Thailand 2008;91(5):669.
8. Marthy M, Pouillart P, Pcholl S. Comparison of the 5-hydroxytryptamine (serotonin) antagonist ondansetron (GR38032F) with high-dose metoclopramide in the control of cisplatin-induced emesis. N Engl J Med 1990;322:816–821. DOI: 10.1056/NEJM199003223221205.
9. Chen H-M, Chang F-Y, Hsu C-T. Effect of acupressure on nausea, vomiting, anxiety and pain among post-cesarean section women in Taiwan. Kaohsiung J Med Sci 2005;21(8):341–350. DOI: 10.1016/S1607-551X(09)70132-9.
10. Sadeghi Shermeh M, Bozorgzad P, Ghafourian A, et al. Effect of foot reflexology on sternotomy pain after coronary artery bypass graft surgery. Iran J Crit Care Nurs (IJCCN) 2009;2(2):51–54.
11. Ebadi A, Mahmoudi H. The effect of foot reflexology massage on the level of pain during chest tube removal after open heart surgery. Iran J Crit Care Nurs 2014;7(1):15–22.
12. Emeset SD, Promethazine M. Efficacy of reflexology in prevention of post-operative nausea vomiting.
13. Tadayon M, Salehiyan T, Abbaspour Z, et al. Comparison of the effect of acupressure and vitamin B6 on the severity of nausea and vomiting in pregnancy. Med Sci J 2005;4(3):195–200.
14. Miandoab NY, Ezzati Z, Arbabi F, et al. The effect of reflexotherapy on chemotherapy-induced vomiting of. Adv Nurs Midwifery 2012;22(76):60–68.
15. Wang MY, Tsai PS, Lee PH, et al. The efficacy of reflexology: systematic review. J Adv Nurs 2008;62(5):512–520. DOI: 10.1111/j.1365-2648.2008.04606.x.

RESEARCH ARTICLE

Clipless Laparoscopic Cholecystectomy: Ultrasonic Dissection vs Conventional Method

Laligen Awale[1], Narendra Pandit[2], Shailesh Adhikary[3]

Abstract

Introduction: Laparoscopic cholecystectomy (LC) is now the gold standard treatment of gallstone disease, but with advancement in technology, there is always a scope for improvement. Ultrasonic shears has been shown to seal the duct and small-size vessel adequately but the fear of complication and sleepless nights has always hindered its use as the sole instrument for LC. Proper use of ultrasonic shears can provide improvement or refinement in LC.

Materials and methods: It is a randomized controlled trial conducted at BP Koirala Institute of Health Sciences, Dharan, Nepal, from 2015 to 2016 (1 year). All the patients with symptomatic gallstone disease were assessed thoroughly and randomized into the harmonic scalpel [clipless laparoscopic cholecystectomy (CLC)] or conventional laparoscopic group (CL).

Results: Over a period of 1 year, 112 patients were enrolled into CLC (53) and CL (59) groups. The demography of the patients in both the groups including age, sex, history of previous surgery, comorbid conditions, and history of acute cholecystitis was comparable. The mean operative time in our study was 38.65 ± 13.28 minutes. The operative time in the CLC group (35.91 ± 11.66 minutes vs 41.12 ± 14.23 minutes) was less though it was not statistically significant (*p* 0.054). However, when the "gallbladder (GB) was not perforated," the operative time was significantly less in the CLC group (34.30 ± 9.30 minutes vs 38.70 ± 10.76 minutes, *p* 0.03). In our study, three (2.6%) patients required conversion to open cholecystectomy. One (1.85%) in CLC and 2 (3.2%) in the CL group (*p* 0.63). The visual analog score (VAS) for pain in the first 12 hours and median fall in hemoglobin was significantly less in the CLC group. In our study group, a total of seven (6.25%) patients had morbidity and there was no mortality.

Conclusion: With the development of ultrasonic energy source and its ability to seal the vessel and cystic duct safely, it can be utilized during LC without the need of clips.

Keywords: Harmonic scapel, Laparoscopic cholecystectomy, Symptomatic cholelithiasis.

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Introduction

Laparoscopic cholecystectomy (LC) is now the gold standard treatment of gallstone disease;[1] and no doubt, presently it is one of the most commonly performed laparoscopic procedures worldwide. The advantages of this minimal invasive approach have been widely reported, showing the positive impact on the short- and long-term outcomes. With the rapid advancement in the technology, there is always new scope for improvement in the procedure.

Laparoscopic cholecystectomy is an arguably safe procedure, but there are few issues with the current technology and technique, which have been seen to increase the risk of injuries and postoperative complications.[2] Standard LC is usually performed by instruments such as Maryland dissector, scissors, hook, and/or spatula. Cystic artery and duct is most frequently occluded by simple metallic clips. Common problems include common bile duct (CBD) stone formation due to the migration of suture materials,[3] bile leak due to the inappropriate clip placement or slippage of clips,[4,5] lateral injury to bile duct and/or vessels from heat of monopolar cautery,[6] and possibility of visceral organ injury due to the need for frequent instrumental exchange.[6–8]

Ultrasound shear is the vessel and duct sealing device which tackles the issue related to clips, suture, and lateral thermal injury.[6,9] It can also be used as dissector, hence decreases not only the frequency of instrumental exchange and associated possibility of visceral injury but also the operative time loss during the process. It provides the surgeon with newer armamentarium in LC. Ultrasonic shears adequately seal the vessel and duct, so avoid the need of metallic clips. Minimum bleeding while dissection with this technique keeps the surgical field clear, avoiding misidentification of the structures. Substantial number of studies reports the positive or favorable outcome in closure of cystic artery and duct using the ultrasonically activated shears,[2,9–12] with acceptable rate of complications. In these studies, cases of bile leak associated with this technique were reported but comparable (2–4%) to the standard technique.

Ultrasound shear has been shown to have added benefit over the conventional technique but the fear and hesitancy still exist regarding its widespread acceptance as a sole instrument for LC. Hesitancy and fear of using it as a sole instrument for "cystic duct closure" seem to be the core issue, in spite of the adequate evidence to suggest its effective closure. In our institute, approximately 500

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patients are operated annually by the conventional laparoscopic (CL) method. Through this study, we wanted to see how effective and safe harmonic shear is in dividing the cystic duct in LC, to move forward with time, and to find if it actually confers benefit in relation to operative time, bleeding, reduced postoperative morbidity; and we also planned to embrace a new technology for the better outcome and patient's satisfaction.

Materials and Methods

It was a single institutional randomized controlled trial done at BP Koirala Institute of Health Sciences, Dharan, Nepal, for a period of 1 year (2015–2016). All the patients with symptomatic gallstone disease and between 18 years and 70 years of age were included in the study. Those patients with cholangitis, wide cystic duct >5 mm, CBD stones or dilated CBD, history of jaundice, impaired liver function test, pregnant patients, and suspicion of GB malignancy were excluded from the study. Ethical clearance was taken from the Institutional Review Committee before starting the study.

All the patients presenting to the surgical outpatient department with symptomatic gallstone disease were assessed thoroughly by clinical examination and investigations. History was taken about the duration of the pain and the last episode of pain. Physical examination was done and all patients underwent transabdominal ultrasonography and the details were noted. Liver function test and hemoglobin level were done in all the patients. Other investigations including computed tomography of the abdomen and endoscopic retrograde cholangiopancreatography were done if required.

The procedure was explained in the native language to the patients and informed written consent was obtained in all cases for randomization to clipless laparoscopic cholecystectomy (CLC) or CL. Randomization was done by the person not otherwise involved in the clinical setting. Randomization was undertaken by consecutively numbered opaque sealed envelopes containing the treatment options, which were assigned with computer-generated random numbers.

Each surgeon who was participating in the study had an experience of performing at least 100 successful laparoscopic cholecystectomies. General anesthesia was administered during the procedure. The standard supine position was used for all patient, i.e., reverse Trendelenburg position with right up. Laparoscopic cholecystectomy was performed with uniform technique, including the standard four-trocar ports, a pneumoperitoneum by open method with a maximum pressure of 15 mm Hg, and a 30° optic scope. Dissection of the GB was initiated at the posterior peritoneal fold and the dissection proceeded forward anteriorly to skeletonize the cystic artery and duct in the Calot's triangle.

In the CLC group, the ultracision harmonic scalpel, Ethicon Endo-Surgery, was used for dissecting the triangle of Calot (power level set at 5). For the closure and division of both the cystic duct and artery, the instrument was set at power level 2. Before ligation of cystic duct with ultrasonic shears, the size of the cystic duct and CBD were noted with the help of the jaws of the harmonic shears. After confirming the appropriate size of the cystic duct and artery, they were subsequently closed using the instrument. While closing the duct, it was made sure that the cystic duct was free of calculi by moving the jaws of harmonic scalpel proximally and distally with an intent to swipe any possible stone in cystic duct toward the GB. Then the cystic duct was placed between the jaws of the harmonic scalpel with the care to avoid injury to the CBD. The jaw was then closed till the click sound was heard. The instrument was then activated with the minimum power set at 2, with care not to stretch or rotate the cystic duct, and it was kept activated till the GB was detached from the cystic duct. And finally the cut end of the cystic duct was checked for any possible bile leak. In the CL group, dissection of the Calot's triangle was performed with Maryland's dissector. Closure of the cystic duct and artery was achieved by applying titanium clips and dividing in-between with scissor. Mobilization of the GB from the liver bed was started posteriorly at the Calot's triangle with anterolateral traction and was preceded anteriorly. In the CLC group, dissection of the GB from the liver bed was performed by using the harmonic scalpel. In the CL group, the dissection of the GB from the liver bed was performed by using the monopolar cautery (hook or spatula). Finally, the GB was removed through the subxiphoid port, and a subhepatic tube drain was inserted through the most lateral port whenever indicated (bleed/ooze and/or bile spillage).

The operative time, intraoperative difficulties, postoperative pain scores using the VAS, and analgesic requirement at 6 hours and days 1 and 2 were all noted by an observer who was unaware of the procedure being performed. Postoperative hematocrit and hemoglobin level (postoperative day 1), duration of placement of drain (days), and postoperative complications, if any, were recorded. Gallbladder perforation and the need for placement of drain and its removal were noted. Once discharged, patients were reviewed at the end of the first postoperative week for any evidence of biliary leak (clinical examination and abdominal ultrasound when indicated). Patients were asked to follow-up with histopathological examination report at the end of first month. At the end of the first and sixth postoperative months, the clinical examination was done and abdominal ultrasonography when indicated. In addition, blood was sampled for bilirubin, amino alanine transferase, alkaline phosphatase, and gamma-glutamic transferase levels accordingly.

All the data were entered in computer and descriptive analysis was done manually, using SPSS software. For descriptive statistic percentage, mean, standard deviation, median, and interquartile range (IQR) were calculated along with graphical and tabular presentation. Inference statistics, Chi-square and independent *t* test, was applied to find the significant difference between the groups at 95% confidential index, where $p = 0.05$. For multivariate analysis p valued <0.20, and in bivariate analysis those variables were considered for multivariate logistic regressions to find the combined risk factor for the CLC group.

Results

Over the period of 1 year, a total of 215 patients underwent LC. Forty-nine patients denied consent for randomization and 51 patients were excluded for the following reasons: 12 patients did not meet age criteria (7 patients were <18 years and 5 patients were >70 years), 28 had dilated common duct/cystic duct or stones, 4 each had a recent history of jaundice and impaired liver enzymes, and 3 patients had cholangitis. A total of 115 patients met the criteria and underwent randomization into either CL group or CLC group. Three patients required conversion and were not included in the analysis. We studied a total of 112 patients: 53 in the CLC group and 59 in CL group formed the study subjects.

The mean age of the patients in our study was 45.64 ± 14.84 years, ranging from 20 years to 70 years with a female to male ratio of 5:1. Majority [92 (82.14%)] of the patients had multiple GB calculi. A total of 10 (8.92%) patients were operated for acute calculus

Table 1: Demography of the patients in the clipless laparoscopic cholecystectomy and conventional laparoscopic groups

Variables	*CLC group (n 53) (%)*	*CL group (n 59) (%)*	*p value*
Age (mean)			
<30	13 (24.52)	13 (22.03)	0.54
31–40	10 (18.86)	6 (10.16)	
41–50	12 (22.64)	12 (20.33)	
51–60	8 (15.09)	12 (20.33)	
61–70	10 (18.86)	16 (27.11)	
Sex			
Male	10 (18.86)	8 (13.55)	0.44
Female	43 (81.13)	51 (86.44)	
Previous surgery	6 (11.32)	10 (16.94)	0.39
Comorbid condition	14 (26.41)	18 (30.50)	0.63
Diabetes mellitus	7 (13.2)	5 (8.47)	0.41
Hypertension	5 (9.43)	10 (16.94)	0.24
Cirrhosis	0	2 (3.38)	0.17
COPD	2 (3.77)	1 (1.69)	0.91
USG findings			
Multiple calculi	41 (77.35)	51 (86.44)	0.21
Solitary stone	12 (22.64)	8 (13.55)	0.62
Acute cholecystitis	4 (7.54)	6 (10.16)	

cholecystitis and the rest [102 (91.07%)] were electively operated for gallstone disease. Four (7.54%) patients in the CLC group and 6 (10.16%) in the CL group were operated for acute calculus cholecystitis. The demographics of the patients in both the groups were comparable (Table 1).

The mean operative time was 38.65 ± 13.28 minutes (range 20–85 minutes). The operative time in the CLC group (35.91 ± 11.66 minutes) was less when compared to the CL group (41.12 ± 14.23 minutes), though it was not statistically significant (*p* 0.054). A total of 19 (17%) patients had perforation of GB intraoperatively. The operative time was significantly less in those without GB perforation (*n* 93, mean 36.52 ± 13.28 minutes) than in those with GB perforation (*n* 19, mean 49.05 ± 13.51 minutes) ($p < 0.001$). Seven (13.2%) patients in the CLC group and 12 (20.33%) in the CL group had intraoperative GB perforation (*p* 0.31). The median time taken to remove the GB from its fossa in the CLC group was 6 minutes (IQR of 5–8 minutes), ranging from 3 minutes to 30 minutes; and in the CL group, it was 6 minutes (IQR of 5–10 minutes), ranging from 3 minutes to 26 minutes (Table 2). The time taken to remove GB from the fossa was not statistically significant between the two groups (*p* 0.23).

The operative time when compared between patients "who had GB perforation" in the two groups, the CL group took more time but was not statistically significant (50.58 ± 14.44 minutes vs 46.42 ± 12.85 minutes in CLC group; *p* 0.34). However, when the "GB was not perforated," the operative time was 34.30 ± 9.30 minutes (range 25–80 minutes) in the CLC group and 38.70 ± 10.76 minutes (range 20–65 minutes) in the CL group. The operative time was statistically significantly less in the CLC group (*p* 0.03) when the GB was not perforated (Table 3).

In all 19 (17%) patients required placement of the drain, 6 (11.32%) in the CLC group and 13 (22.03%) patients in the CL group (*p* 0.13). It was kept mainly after difficult dissection which had

Table 2: Intraoperative findings

Variables	*CLC group (n 53)*	*CL group (n 59)*	*p value*
Operative time (mean)	35.91 ± 11.66	41.12 ± 14.23	0.054
Gallbladder perforation (mean)	7 (13.20%)	12 (20.33%)	0.31
GB removal time (median)	6 (5–8)	6 (5–10)	0.23
Drain placement	6 (11.32%)	13 (22.03%)	0.13
Conversion	1 (1.85%)	2 (3.2%)	0.63

Table 3: Operative time in clipless laparoscopic cholecystectomy and conventional laparoscopic groups with and without gallbladder perforation

Operative time	*CLC group*	*CL group*	*p value*
With GB perforation (mean)	46.42 ± 12.85	50.58 ± 14.44	0.34
Without GB perforation (mean)	34.30 ± 9.30	38.70 ± 10.76	0.03

oozing or bile stain and when some collection was anticipated in the postoperative period. The drains were usually removed on second postoperative day (range 1–14 days) and the total days required to remove the drain was not significant (*p* 0.65) between the groups (Table 2). Three (2.6%) patients required conversion to open cholecystectomy in our study, i.e., One (1.85%) in the CLC group and two (3.2%) in the CL group. The one in the CLC group had obscured anatomy with frozen Calot's triangle and an enlarged cystic node. The reason for conversion in the CL group was intraoperative bleeding not controllable laparoscopically and the other one had a dilated CBD with multiple calculi requiring a choledochoduodenostomy.

All the patients (100%) in the study group required an analgesic in the first 12 hours and majority 109 (97.32%) asked for analgesia in the first 24 hours. Fifty-one (96.22%) patients in CLC and 58 (98.3%) in CL group asked for analgesia in the first 24 hours (0.49). The VAS for pain in the first 12 hours postoperatively was significantly ($p < 0.05$) less statistically in the CLC group (Table 4). The VAS for pain at 24 hours postoperatively was also less in the CLC group (2.5 ± 0.8 vs 2.97 ± 0.87) though it was not statistically significant (*p* 0.50); and after the first week, it was comparable in both the groups (CLC 1.16 ± 0.47 vs 1.10 ± 0.30; *p* 0.55).

The amount of blood loss as demonstrated by the median fall in hemoglobin level was significantly (*p* 0.001) less in the CLC group (Table 4). Majority of the cases [88 (78.57%)] were discharged on the first postoperative day following surgery and in both the groups, patients were discharged on the same postoperative days (*p* 0.23). In our study group, a total of seven (6.25%) patients had morbidity following surgery: two (3.77%) in the CLC group and five (8.47%) in the CL group (*p* 0.44). In the CLC group, we had one case (1.88%) each with port site infection and bilious drainage. In the CL group, two cases (3.38%) each with port site infections and bilious drainage followed by one (1.69%) with chest infection. There were three (2.67%) cases of port site infection. All of them required removal of suture and were managed with daily dressings. One in the CL group had deep surgical site infection in the epigastric port, which was managed with wound trimming and irrigation under local anesthesia, allowed to heal by secondary intention, and discharged on the fourth postoperative day. All the patients were without any adverse consequences in the follow-up and the

Table 4: Postoperative parameters in the clipless laparoscopic cholecystectomy and conventional laparoscopic groups

Variables	*CLC group (53)*	*CL group (59)*	*p value*
Analgesic requirement			
12 hours	53 (100%)	59 (100%)	–
24 hours	51 (96.22%)	58 (98.3%)	0.49
VAS (mean)			
12 hours	3.91 ± 0.94	5.31 ± 1.65	<0.001
24 hours	2.5 ± 0.80	2.97 ± 0.87	0.50
1 week	1.17 ± 0.47	1.10 ± 0.30	0.055
Hemoglobin (g/dL)			
Preoperative (mean)	12.50 ± 1.44	12.02 ± 1.42	0.85
Postoperative (mean)	12.12 ± 1.44	11.23 ± 1.34	0.60
Fall in Hb (median)	0.40 (0.20–0.50)	0.70 (0.30–1.20)	0.001
Drain removal (median) days	2 (2–3.75)	2 (2–4.5)	0.52
Hospital stay (median) days	1 (1–1)	1 (1–2)	0.23
Morbidity	2 (3.77%)	5 (8.47%)	0.44
Bilious drain	1 (1.88%)	2 (3.38%)	0.62
Port-site infection	1 (1.88%)	2 (3.38%)	0.62
Chest infection	0 (0%)	1 (1.69%)	0.34

wound gap was closed subsequently in the presence of healthy granulation tissues.

Three (2.67%) patients in our study had bilious drainage, consisting of one in the CLC group and two in the CL group. The one in the CLC group developed abdomen pain, distension, multiple episodes of vomiting along with tachycardia on the first postoperative day. On ultrasound imaging, she had collection in the subhepatic space, and diagnostic aspiration revealed bile and was managed with pigtail catheter and drainage. Her drain was removed on the sixth day and discharged on the seventh postoperative day. The other two patients in the CL group were found to have bile in the drain postoperatively but were managed conservatively as the collection was localized, with no evidence of peritonitis or sepsis. In one patient, the drain output turned out to be serous on the third day and it was removed after ultrasound of no collection. Another patient was found to have bilious drain on the second postoperative day. She continued to have low output (50–70 mL/day) bilious drainage and did not have sepsis and hence discharged with drain on the eighth postoperative day. She was kept on regular follow-up. Her drain was removed on the 14th day when it was dry for 24 hours and also after ultrasound confirmation of no intra-abdominal collection. All three patients were doing well at 1 month follow-up. There was no jaundice or abdominal symptoms. The morbidity was similar in both the groups (p 0.44), without mortality in either group (Table 4).

Discussion

Laparoscopic cholecystectomy has now become the gold standard treatment for gallstone disease but is not without flaws. With the development of new vessel sealing devices, research are done continuously to minimize the shortcomings. In our study, we compared the CL technique with CLC using harmonic scalpel to seal both the cystic artery and the cystic duct.

Cholelithiasis is most reported among the middle-aged fertile female.[2,13,14] According to our study, the mean age-group was 45.64 ± 14.84 years and 83.9% was female, with a female to male ratio of 5:1. Adhesion following previous surgery is a known hurdle during LC, which not only increases the risks of injury but also prolongs operative time by additional need for dissection and bleeding, finally influencing the outcome. In our study, 16 (14.28%) patients had a previous history of surgery, i.e., 6 (11.32%) in CLC and 10 (16.94%) in CL group, which was similar to the study by Jain et al.[12] where harmonic scalpel to CL ratio for "history of previous surgery" was 8:9. In our study, 10 (8.92%) patents underwent emergency surgery for acute cholecystitis, 4 (7.54%) in the CLC group and 6 (10.16%) in the CL group. The low incidence in our study is because we avoided early surgery, though several meta-analysis showed that early LC not only decreases the length of hospital stay but also prevents disease relapse without any increase in the complication rate.[13–17] Several retrospective series, in fact, demonstrated the advantages of the use of harmonic scalpel in acute cases, because of its ability to maintain hemostasis and effectiveness in closure of the duct.[2,17–19] Few (8.92%) of our patients underwent emergency surgery and hence were not included in the study.

The mean operative time in our study was 38.65 ± 13.28 minutes, ranging from 20 minutes to 85 minutes. The operative time in the CLC group (35.91 ± 11.66 minutes) was less than that in the CL group (41.12 ± 14.23 minutes), though it was not statistically significant (p 0.054). It was slightly longer, according to Bessa et al.[20] [Harmonic Scalpel (HS) 18–75 mean 32 vs conventional laparoscopic cholecystectomy (CC) 21–85 mean 40 and $p < 0.001$], but our time was similar to that of Kandil et al.[21] (33.21 + 9.6 vs. 51.7 + 13.79, HS and CL, respectively, p 0.001). This shorter operative time in the CLC group is because of the added benefit of the harmonic ACE: (a) it is the multifunctional device (dissection and closure of artery and duct) and hence minimizes the need for instrumental exchange, thereby minimizing the time loss during the process and the loss of pneumoperitoneum, (b) smokelessness allows to work in clear operative field and also avoids the need for smoke evacuation and loss of pneumoperitoneum, and (c) lower incidence of GB perforation in the CLC group (7 vs 12), thereby avoiding the time loss in retrieving the spilled stone and lavage.

The lateral energy spread is less with ultrasonic shears (1.5 mm vs 0.5 cm in electrocautery);[2] therefore, there is a decreased chance of GB perforation, spillage of gallstone and bile, and biliary peritonitis. After spillage, there is obvious increase in the duration of surgery due to the time take for suction–irrigation, retrieval of spilled stones, and poor field and visibility.[12,20] We had slightly higher rate of GB perforation in the CL group, though statistically not significant; and the mean operative time in patients with GB perforation was shorter in the CLC though it was not statistically (p 0.34) significant. In patients without GB perforation, the operative time was significantly less in the CLC group. When the GB perforation complicated the procedure, it does significantly increases the operative time in both the groups and the time taken is comparable.[12,20] Different studies have reported the incidence of GB perforation during the LC ranging from 10% to 50%.[9,20] In our study, 17% patients had perforated GB. Janssen et al.[9] also had a similar lower incidence of GB perforation with ultracision removal of GB (16 vs 50%, respectively; p 0.001) and also found that the risk of GB perforation with bile (four times higher) and stone (six times higher) spillage was significantly higher in the electrocautery group.

Jain et al.[12] in his prospective randomized control study reported significantly less time to remove GB from its bed using ultrasonic shears (nearly 4 minutes vs 7.36 minutes with electrocautery, *p* 0.001). We had similar experience, though it was not statistically significant in our study. The difference is because ultrasonic shear is all in one tool for the procedure (dissection, ligation of the duct and artery, and removal of GB from the liver bed). Besides, ultrasonic device has been said to produce small vacuoles or cavitation which enlarge and separate the tissue,[13] making it easy to separate the GB from the GB bed. Even in the case of inflammation where the tissue is tougher, vascular, and more fibrous, the ultrasonic energy and its hemostatic ability keep the operative field clear, decreasing the operative time and avoiding inadvertent injuries.

The CLC group demonstrated less need for drainage. The decreased drain placement led to reduced pain scores, early discharge, and decreased morbidity. The drain was placed according to the operative surgeon's preference. It was kept for those who had bleeding/oozing, bile stain, or in difficult dissections. In our study, the drain was removed mostly within 48 hours (median 2 days) though few of our patients required a prolonged drainage. Less need for abdominal drain in the CLC group is also one of the contributing factors for less operative time and morbidity.

The reported conversion to open cholecystectomy rate in the literature is 1.2–8.2%.[13,22–24] We had three (2.6%) conversions, one (1.85%) in the CLC group and two (3.2%) in the CL group. Conversion rate in the prospective study by Hüscher et al.[2] was even lower (0.87%) than that in the literature and showed theoretical benefits of ultrasonic dissection. The reasons for conversion in different studies[2,22,25,26] varied between the two subgroups, i.e., surgeon in training and expert. But, in general, conversion was due to the dense adhesion/frozen Calot's triangle, intraoperative complications, difficult anatomy, or inability to identify the structures. Difficult anatomy of the Calot's triangle was the only reason for 4% conversion rate in the study by Jain et al.,[12] and it was equal in both the groups. Our reason for conversion in the CL group was obscured anatomy and bleeding, and another case had dilated CBD with multiple calculi requiring an open choledochoduodenostomy.

Alexander[23] has extensively described the causes of pain after laparoscopy. The major cause of post laparoscopic pain was attributed to the sudden distension/stretching of the peritoneum, leading to the traumatic traction of the nerves, vessel injury, and release of the inflammatory mediators. In addition, phrenic nerve irritation due to gas used for the pneumoperitoneum was pointed out to be responsible for the prolonged persistence of shoulder tip pain.[27] The use of ultrasonic shear led to (a) minimal lateral thermal injury, minimal damage to the surrounding nerves, and minimal tissue charring, and, therefore, minimal inflammation and less release of inflammatory mediators;[12] (b) decreased operative time contributing to less pneumoperitoneum-related peritoneal distension. This may have accounted for low pain score in the CLC group. The significant difference in pain scores was obtained between the two groups in the first 12 hours and it was more with the CL group ($p < 0.01$). No significant differences were obtained in the pain scores in the first week after surgery. The postoperative analgesic requirement was less in the ultrasonic shear group compared with the electrocautery group (1.89 vs 2.66; *p* 0.001) in the study by Jain et al.,[12] but in our study analgesic requirement in both the groups was similar, which may be because patients were given analgesia even when they had low pain score on their demand.

The postoperative fall in hemoglobin was significantly less in the CLC group (0.40 g/dL vs 0.70 g/dL; *p* 0.001), though there was no incidence of clinically significant (severe) bleeding in either group requiring blood transfusion, the sole reason for conversion. The conversion requirement was more because of the difficult anatomy, not solely because of bleeding. This significant difference may be because of minor to moderate bleeding in the CL group. On the contrary, ultrasonic shear is known for hemostasis. It coagulates before separating the tissue and stays between the planes, so there is decreased bleeding and oozing from the surfaces.

No surgery is without complication. Laparoscopic cholecystectomy is the most common elective surgery being performed worldwide, and research has proved its perfection to avoid associated complications. Clipless laparoscopic cholecystectomy is one of the techniques that needs to be addressed. As with any new procedure, fear and hesitancy to adopt this noble technique can be observed. Hüscher et al.[28] has histologically confirmed the effective sealing of the cystic duct stump by the harmonic shears. Post LC bile leak can give the surgeon sleepless nights. This can be the main reason why most of the surgeons hesitate to perform CLC. This myth has been challenged in the recent days, providing better outcome and sound sleep for surgeons. By using ultrasonic shear closure, division of vessels up to 5 mm can be done safely.[2,14,29–37] We had a total of 6.25% morbidity following the surgery; however, no mortality was reported in either group. Two (3.77%) patients had morbidity in the CLC group and five (8.47%) in the CL group (*p* 0.44). Three (2.67%) patients in our study had bilious drainage, one (1.88%) in the CLC group and two (3.38%) in the CL group. All were managed with drains and none required further interventions. In the present study, one case in the CLC group (1.88%) had port site infection and two cases (3.38%) in the CL group had port site infection and a single case (1.69) had chest infection. Bessa et al.'s[20] finding also did not report any bile leak in either group, demonstrating the effectiveness of harmonic shears in closing the duct as safely as with the application of metallic clips. This capability, safety, and efficacy of harmonic shears in sealing and dividing the cystic duct without increasing the complication rate also have been demonstrated in other studies.[2,10,20] In the present study, as well as in the Westervelt and Bessa et al.[10,20] studies, the harmonic shears were applied to only one side of the cystic duct where sealing and division were achieved, with no bile leaks from the cystic duct stump encountered in any of the two studies. So the double application of the harmonic shears to the cystic duct as explain by Hüscher et al.[2] may be unnecessary and an unsafe practice.[2,10,20] Lateral energy spread is the other mechanism for bile duct injury. Unlike the CL group which witnessed high chances of lateral thermal injury to the bile duct, ultrasonic instruments cause negligible lateral damage.[36,37] In the present study, the low incidence of the bile duct leak or injury in the CLC group (1.88%) is not only comparable to the CL group but also within the acceptable range of bile duct injury following LC. Also, the leak that we had in the CLC group was a minor duct injury, which was managed successfully with pigtail catheter.

Most of the patients in our study were discharged on the first postoperative day following surgery and was not significant between the groups (*p* 0.23), though there was significantly less hospital stay in the ultrasonic group in other studies.[2,12] Shorter duration has been attributable to the less number of patients requiring drainage and less incidence of GB perforation, leading to localized peritonitis and less pain.

Conclusion

Laparoscopic cholecystectomy is now the gold standard procedure for gallstone disease. With the development of ultrasonic energy source and its ability to seal the vessel and cystic duct safely up to 5 mm diameter, it can be safely utilized during LC without the need of clips. It safeguards the complication related to the clips used in the CL technique and decreases the operative time, GB perforation, and immediate postoperative pain and avoids drain requirement and blood loss without increasing the morbidity or mortality.

References

1. Soper NJ, Stockmann PT, Dunnegan DL, et al. Laparoscopic cholecystectomy. The new "gold standard"? Arch Surg 1992;127(8): 917–921. ; discussion 921–923 10.1001/archsurg.1992.01420080051008.
2. Hüscher CGS, Lirici MM, Di Paola M, et al. Laparoscopic cholecystectomy by ultrasonic dissection without cystic duct and artery ligature. Surg Endosc 2003;17(3):442–451. DOI: 10.1007/s00464-002-9068-3.
3. Cetta F, Lombardo F, Cariati A. The role of the content (decreased level of apolipoprotein A1) and of the container (bile duct stricture, sectorial dilatation of the ducts determining bile stasis) in the pathogenesis of hepatolithiasis, either pigment or cholesterol. Hepatology 1994;19(6):1539–1541. DOI: 10.1002/hep.1840190637.
4. Hanazaki K, Igarashi J, Sodeyama H, et al. Bile leakage resulting from clip displacement of the cystic duct stump: a potential pitfall of laparoscopic cholecystectomy. Surg Endosc 1999;13(2):168–171. DOI: 10.1007/s004649900932.
5. Nelson MT, Nakashima M, Mulvihill SJ. How secure are laparoscopically placed clips? An *in vitro* and *in vivo* study. Arch Surg 1992;127(6): 718–720. DOI: 10.1001/archsurg.1992.01420060094014.
6. Gigot J, Etienne J, Aerts R, et al. The dramatic reality of biliary tract injury during laparoscopic cholecystectomy. An anonymous multicenter Belgian survey of 65 patients. Surg Endosc 1997;11(12):1171–1178. DOI: 10.1007/s004649900563.
7. Lillemoe KD, Petrofski JA, Choti MA, et al. Isolated right segmental hepatic duct injury: a diagnostic and therapeutic challenge. J Gastrointest Surg 2000;4(2):168–177. DOI: 10.1016/S1091-255X(00)80053-0.
8. Usal H, Sayad P, Hayek N, et al. Major vascular injuries during laparoscopic cholecystectomy. An institutional review of experience with 2589 procedures and literature review. Surg Endosc 1998;12(7):960–962. DOI: 10.1007/s004649900756.
9. Janssen IMC, Swank DJ, Boonstra O, et al. Randomized clinical trial of ultrasonic vs electrocautery dissection of the gallbladder in laparoscopic cholecystectomy. Br J Surg 2003;90(7):799–803. DOI: 10.1002/bjs.4128.
10. Westervelt J. Clipless cholecystectomy: broadening the role of the harmonic scalpel. JSLS 2004;8(3):283–285.
11. Minutolo V, Gagliano G, Rinzivillo C, et al. Usefullness of the ultrasonically activated scalpel in laparoscopic cholecystectomy: our experience and review of literature. G Chir 2008;29(5):242–245.
12. Jain SK, Tanwar R, Kaza RCM, et al. A prospective, randomized study of comparison of clipless cholecystectomy with conventional laparoscopic cholecystectomy. J Laparoendosc Adv Surg Tech A 2011;21(3):203–208. DOI: 10.1089/lap.2010.0455.
13. Shikata S, Noguchi Y, Fukui T. Early vs delayed cholecystectomy for acute cholecystitis: a meta-analysis of randomized controlled trials. Surg Today 2005;35(7):553–560. DOI: 10.1007/s00595-005-2998-3.
14. Lau H, Lo CY, Patil NG, et al. Early vs delayed-interval laparoscopic cholecystectomy for acute cholecystitis: a metaanalysis. Surg Endosc 2006;20(1):82–87. DOI: 10.1007/s00464-005-0100-2.
15. Gurusamy KS, Samraj K. Early vs delayed laparoscopic cholecystectomy for acute cholecystitis. Cochrane Database Syst Rev 2006;4:CD005440. DOI: 10.1002/14651858.CD005440.pub2.
16. Siddiqui T, MacDonald A, Chong PS, et al. Early vs delayed laparoscopic cholecystectomy for acute cholecystitis: a meta-analysis of randomized clinical trials. Am J Surg 2008;195(1):40–47. DOI: 10.1016/j.amjsurg.2007.03.004.
17. Catena F, Ansaloni L, Di Saverio S, et al. Prospective analysis of 101 consecutive cases of laparoscopic cholecystectomy for acute cholecystitis operated with harmonic scalpel. Surg Laparosc Endosc Percutan Tech 2009;19(4):312–316. DOI: 10.1097/SLE.0b013e3181b16662.
18. Fullum TM, Kim S, Dan D, et al. Laparoscopic "Dome-down" cholecystectomy with the LCS-5 harmonic scalpel. JSLS 2005;9(1): 51–57.
19. Power C, Maguire D, McAnena OJ, et al. Use of the ultrasonic dissecting scalpel in laparoscopic cholecystectomy. Surg Endosc 2000;14(11):1070–1073. DOI: 10.1007/s004640000034.
20. Bessa SS, Al-Fayoumi TA, Katri KM, et al. Clipless laparoscopic cholecystectomy by ultrasonic dissection. J Laparoendosc Adv Surg Tech A 2008;18(4):593–598. DOI: 10.1089/lap.2007.0227.
21. Kandil T, El Nakeeb A, El Hefnawy E. Comparative study between clipless laparoscopic cholecystectomy by harmonic scalpel vs conventional method: a prospective randomized study. J Gastrointest Surg 2010;14:323–328. DOI: 10.1007/s11605-009-1039-8.
22. Targarona EM, Marco C, Balagué C, et al. How, when, and why bile duct injury occurs. A comparison between open and laparoscopic cholecystectomy. Surg Endosc 1998;12(4):322–326. DOI: 10.1007/s004649900662.
23. Alexander JI. Pain after laparoscopy. Br J Anaesth 1997;79(3):369–378. DOI: 10.1093/bja/79.3.369.
24. Alexander JI. Draining intraperitoneal gas after laparoscopy. Anaesthesia 2002;57(6):57618–57619. DOI: 10.1046/j.1365-2044.2002.265817.x.
25. Regoly-Merei J, Ihasz M, Szeberin Z, et al. Biliary tract complications in laparoscopic cholecystectomy. Surg Endosc 1998;12(4):294–300. DOI: 10.1007/s004649900657.
26. Thompson MH, Benger JR. Cholecystectomy, conversion and complications. HPB Surg 2000;11(6):373–378. DOI: 10.1155/2000/56760.
27. Wills E, Crawford G. Clipless vs conventional laparoscopic cholecystectomy. J Laparoendosc Adv Surg Tech A 2013;23(3): 237–239. DOI: 10.1089/lap.2012.0387.
28. Hüscher CG, Lirici MM, Anastasi A, et al. Laparoscopic cholecystectomy by harmonic dissection. Surg Endosc 1999;13(12):1256–1257.
29. Redwan AA. Single-working-instrument, double-trocar, clipless cholecystectomy using harmonic scalpel: a feasible, safe, and less invasive technique. J Laparoendosc Adv Surg Tech A 2010;20(7): 597–603. DOI: 10.1089/lap.2009.0375.
30. Kavlakoglu B, Pekcici R, Oral S. Verification of clipless closure of cystic duct by harmonic scalpel. J Laparoendosc Adv Surg Tech A 2010;20(7):591–595. DOI: 10.1089/lap.2010.0222.
31. Ramos AC, Ramos MG, Galvão-Neto MdP, et al. Total clipless cholecystectomy by means of harmonic sealing. Arq Bras Cir Dig 2015;28(1):53–56. DOI: 10.1590/s0102-67202015000100014.
32. Swanstrom LL. "Clipless" cholecystectomy: evolution marches on, even for lap chole. World J Surg 2011;35(4):824–825. DOI: 10.1007/s00268-011-0974-1.
33. Entezari K, Hoffmann P, Goris M, et al. A review of currently available vessel sealing systems. Minim Invasive Ther Allied Technol 2007;16(1):52–57. DOI: 10.1080/13645700601181414.
34. Kavlakoglu B, Pekcici R, Oral S. Clipless cholecystectomy: which sealer should be used? World J Surg 2011;35(4):817–823. DOI: 10.1007/s00268-010-0819-3.
35. Suo G, Xu A. Clipless minilaparoscopic cholecystectomy: a study of 1,096 cases. J Laparoendosc Adv Surg Tech A 2013;23(10):849–854. DOI: 10.1089/lap.2012.0561.
36. Richardson MC, Bell G, Fullarton GM. Incidence and nature of bile duct injuries following laparoscopic cholecystectomy: an audit of 5913 cases. Br J Surg 1996;83(10):1356–1360. DOI: 10.1002/bjs.1800831009.
37. Shea JA, Healey MJ, Berlin JA, et al. Mortality and complications associated with laparoscopic cholecystectomy. A meta-analysis. Ann Surg 1996;224(5):609–620. DOI: 10.1097/00000658-199611000-00005.

CASE REPORT

Laparoscopic Ureterolysis without Omentoplasty in the Management of the Uropathy Secondary to Idiopathic Retroperitoneal Fibrosis

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Abstract

Introduction: Obstructive uropathy (OU) secondary to idiopathic retroperitoneal fibrosis (IRF) is an infrequent disease, and the standard treatment has not been established. However, ureterolysis with ureteral intraperitonealization is an effective therapeutic alternative. We present the successful management of OU secondary to an IRF by laparoscopic ureterolysis without omentoplasty (LUWO).

Materials and methods: A retrospective descriptive study of 5 patients with IRF treated with LUWO was performed.

Results: The average age was 60.4 years. The average creatinine was 3.86 mg/dL. There were no intraoperative or major postoperative complications. In a follow-up period of 31.2 months, all patients are asymptomatic, with an average creatinine level of 1.52 without dialysis requirement. No patients required corticosteroid therapy after surgery.

Conclusion: Laparoscopic ureterolysis without omentoplasty is a safe and feasible option to treat the OU caused by IRF that provides good results in the medium-term follow-up, as we describe it in our series of cases.

Keywords: Hydronephrosis, Laparoscopy, Retroperitoneal fibrosis, Ureteral obstruction.

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Introduction

Obstructive uropathy (OU) related to idiopathic retroperitoneal fibrosis (IRF) is a rare disease characterized by retroperitoneal fibrosis. The pathology has theorized to be an inflammatory response to oxidized low-density lipoproteins.[1,2] Because IRF has a very low prevalence, no treatments have been standardized.[3–5] Surgical ureterolysis with intraperitonealization (SUWI) has been considered as a definitive treatment for ureteral obstruction caused by IRF. Usually, SUWI has been done open (open ureterolysis with intraperitonealization (OUWI)), with a high success rate, >90%. But, with a high morbidity rate, ≥60%. Laparoscopic ureterolysis with intraperitonealization (LUWI) of the ureter with or without omental wrapping has also shown a high success rate, >90% with a low morbidity rate <30%.[4–9] However, there is still no prospective randomized study comparing both techniques.[7–9]

Materials and Methods

A retrospective multicenter descriptive study of 5 patients with OU secondary to retroperitoneal fibrosis treated surgically with laparoscopic ureterolysis without omentoplasty (LUWO) during the years 2012 and 2017 was performed.

The variables for the study were age, sex, symptoms at the time of pathology's presentation, blood analysis [erythrocyte sedimentation rate (ESR), tumor markers, autoimmune disease markers, creatinine], imaging studies (ultrasound, computed tomography or magnetic resonance, renal scintigraphy, positron emission tomography), corticoids treatment, ureteral catheter or nephrostomy. In addition, the variables related to the surgical intervention were evaluated: surgical time (minutes), intraoperative and postoperative complications (Clavien scale), bleeding (mL), pain management with pain ladder of the World Health Organization (WHO) and time of hospitalization (hour).

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Conflict of interest: None

The follow-up was performed with creatinine and renal scintigraphy 1 month after surgery and then at 6 months. The correct functioning of the kidney was considered an adequate renal function without requiring a urinary neither stent or dialysis treatment.

Surgical Technique

Ureteral stenting was performed preoperatively. The patient was placed in an extended plank position. Four ports sites were placed according to the surgical technique (Fig. 1).

In the first step of the procedure, the line of told was incised, and the colon was deflected. The aorta and the external iliac artery were clearly exposed. Close to the aorta and riding the iliac artery, the encased ureter was identified and released from the fibrotic mass using a blunt instrument (Figs 2 and 3). Once the ureter has been completely released from the fibrotic tissue, along the full length between the renal pelvis and iliac vessels, we proceeded with the intraperitonealization of the ureter (Figs 3 and 4).

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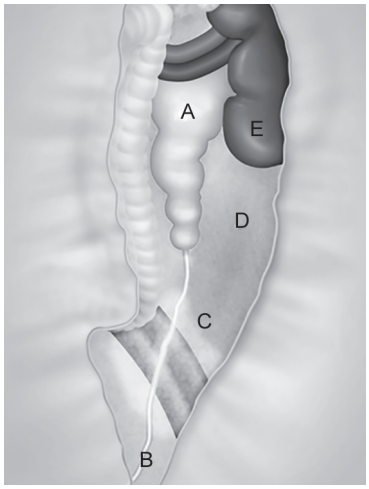
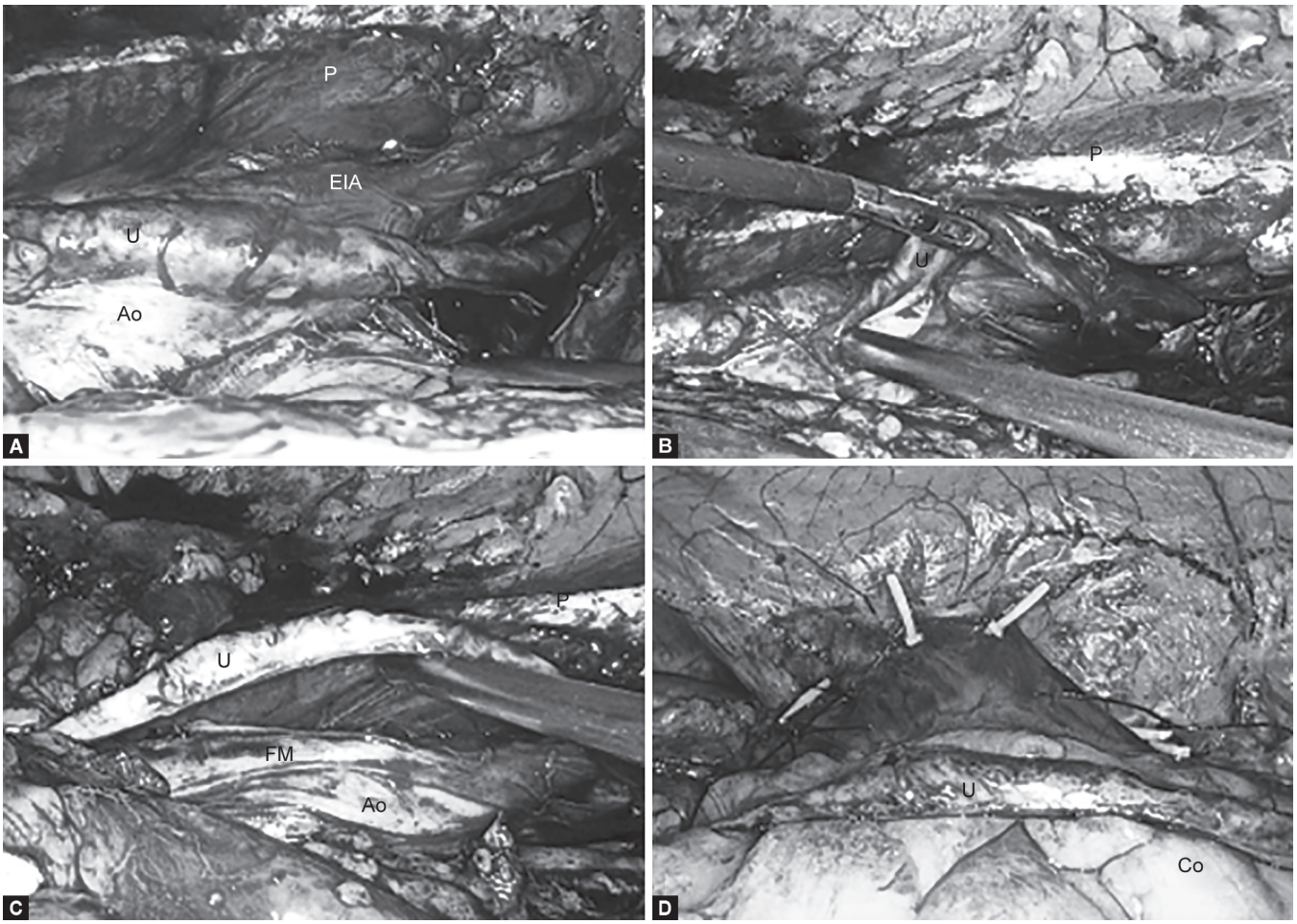
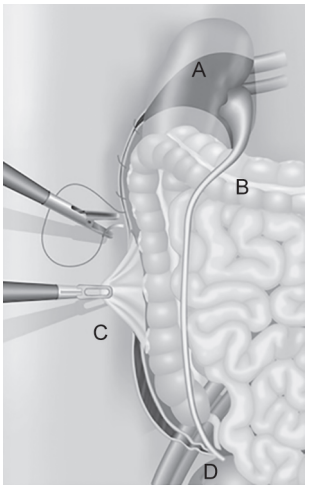
Fig. 1: Disposition of laparoscopic ports in laparoscopic ureterolysis: the initial port of 10 mm is placed pararectal at the level of the umbilicus (laparoscopy). The second port of 10 mm is placed in the iliac fossa. The other two remaining 5 mm ports are placed in the hemiclavicular line and the anterior axillary line in the upper abdominal quadrant



Figs 2A to E: (A) Ectasia of the renal pelvis; (B) Ureter compromised by retroperitoneal fibrosis; (C) Retroperitoneal fibrosis; (D) Muscle psoas; (E) Kidney



Figs 3A to D: (A) Riding the external iliac artery (EIA), the encased ureter was identified; (B and C) Ureter was release from the fibrotic mass using a blunt instrument; (D) Pericolonic fat was interposed between the ureter and the fibrosis. Ao, aorta; Co, colon; EIA, external iliac artery; FM, fibrotic mass; P, psoas muscle; U, ureter



Figs 4A to D: (A) Kidney; (B) Intraperitonealization of the ureter; (C) Interposition of pericolonic fat with its fascia between the ureter and the fibrosis; (D) Bladder

In our cases, the peri-colonic fat was interposed between the ureter and the fibrosis (transposition of the ureter) without an omental wrapping. 6 weeks after surgery, the ureteral stent was removed.

Results

Of the 5 patients analyzed, the average age was 60.4 years (55–67), and 80% were female. Sixty percent of patients had back pain and 40% oliguria. The average creatinine was 3.86 (1.2–8.6). All patients had negative autoimmune disease markers and tumor markers. The patient's characteristics were described in Table 1. All patients underwent ULIP without omentoplasty. There were no intraoperative or postoperative complications major to Clavien 2 (1 patient presented a wound infection that required oral antibiotics). The average surgical time was 137 minutes (97–215) with an average blood loss of 84 (10–110) mL, without requiring transfusions. The average time of hospitalized was 51 hours (36–62), and all had mild pain that was controlled with non-steroidal analgesics.

Table 1: Patient's characteristics

A/S	*CR*	*Symptoms*	*BT*	*DI*	*CTh*	*PBS*	*TTO*	*PA*	*Follow-up*
67* ♂	Left RN (2005)	Back pain, oligoanuria (2013)Ç	Cr 8.6	CT: right RF, OU	No	US	Right LUWI WO	IRF	2018:Ç
			ESR: 80	MRI: IDEM					No symptoms
			TM (–)	RS: OU					Cr 1.9
			MAD (–)						RS: no OU
									No CTh
63* ♀	Cholecystectomy 2014:Ç, right IRF + OU OUWI	Back pain (2016)Ç	Cr 3.7	CT: left RF, OU MRI: IDEM	Prednisone	US	Left LUWI WO	IRF	2018:Ç
			ESR: 95	RS: OU	Intolerance				No symptoms
			TM (–)	PET: PAM					Cr 2.1
			MAD (–)						RS, no OU
									No CTh
52* ♀	AH	Back pain (2015)Ç	Cr 1.3	CT: right RF, OU. MRI: IDEM	Prednisone	US	Left LUWI WO	IRF IG4 (+)	2018:Ç
			ESR: 78	RS: OU	Tamoxifen				No symptoms
			TM (–)	PET: PAM					Cr 1
			MAD (–)						RS: no OU
									No CTh
65* ♀	Cholecystectomy	Oligoanuria (2016)Ç	Cr 4.5	CT: bilateral RF, OU. MRI: IDEM	Prednisone	US	Left LUWI WO	IRF	2018:Ç
			ESR: 87	RS: OU	Intolerance				No symptoms
			TM (–)	RK no RP					Cr 1.7
			MAD (–)						RS, no OU
									No CTh
55* ♀	No	Asthenia weight loss (2017)Ç	Cr 1.2	CT: right RF OU. MRI: IDEM	Prednisone	US	Left LUWI WO	IRF	2018:Ç
			ESR: 90	RS: OU	Tamoxifen				No symptoms
			TM (–)						Cr 0.9
			MAD (–)						RS, no OU
									No CTh

A/S, age and sex of the patients; CR, clinical record; BT, blood test; DI, diagnostic image; *, age; ♂, male; ♀, woman; RN, radical nephrectomy; AH, arterial hypertension; Ç, year; Cr, creatinine (mg/dL); ESR, erythrosedimentation rate (mm/hour); TM, tumor markers; MAD, markers of autoimmune disease; CT, computed tomography; MRI, magnetic resonance imaging; RS, renal scintigraphy; PET, positron emission tomography; OU, obstructive uropathy; RK, right kidney; LK, left kidney; RF, retroperitoneal fibrosis; IRF, idiopathic retroperitoneal fibrosis; LUWI, laparoscopic ureterolysis with intraperitonealization; LUWI WO, laparoscopic ureterolysis with intraperitonealization without omentoplasty; OUWI, open ureterolysis with intraperitonealization; US, ureteral stent; CTh, corticosteroids therapy; PBS, procedure before surgery; RE, renal ectasia; TTO, treatment; PA, pathological anatomy; RP, renal parenchyma

In an average follow-up period of 31.2 months (25–63), all patients are asymptomatic, with an average creatinine of 1.52 (0.9–2.1) with a renal scintigraphy without an obstructive pattern. No patients required neither corticosteroid therapy nor dialysis after surgery.

Discussion

Obstructive uropathy related to IRF is an uncommon but severe disease that may cause renal loss with dialysis requirement. Prompt diagnosis and appropriate treatment may prevent terminal kidney disease.[1,2] However, there is no standardized treatment.[3,4]

In patients with OU associated with IRF, as discussed in our cases, there are two treatment options: medical treatment (corticosteroids or methotrexate or tamoxifen or the combination of these drugs) with or without urinary stent or urinary stenting followed by a SUWI with or without corticosteroid therapy.[4,10,11]

Medical treatment with urinary stenting demonstrated a success rate between 53% and 75%. Fry et al.[10] reported a success rate of 75% in 24 patients treated with prednisone associated with a urinary stent for 13.7 months. But, after a follow-up of 60.9 months, Ilie et al.[11] reported that only 54% of the patients were either free of corticosteroids therapy or urinary stent. These data indicate that patients treated medically require a urinary stent for long periods of time, which is associated with huge morbidity.

Open ureterolysis with intraperitonealization or LUWI has shown success rates between 83% and 100%.[3–9] O'Brien and Fernando[4] performed a prospective analysis of 50 patients who underwent OUWI and showed a 94% success of urinary stent free without corticosteroid therapy a year after surgery. Duchene et al.[5] evaluated 73 patients who performed LUWI in a multicenter study and showed an 83% success rate 17.7 months after surgery with or without adjuvant corticosteroid therapy. Simone et al.[6] with a few patients who underwent LUWI showed a success rate of 100% at 37.7 months after surgery without adjuvant corticosteroid therapy.

When LUWI and OUWI were compared, Elashry et al.[7] showed that patients treated with LUWI had less morbidity, less blood loss, and less hospitalization with similar functional results than OUWI. Srinivasan et al.,[8] in a series of 70 patients, showed that there were no differences between the two techniques in the resolution of OU, but patients who underwent LUWI had less blood loss and less hospitalization. However, Styn et al.,[9] in his comparative study did not see differences between the two groups in terms of complications or transfusion requirements, but the success rate was 87.5% after OUWI, and 93.8% after LUWI.

Even though this report is a retrospective study and the number of cases is low, it shows that LUWI without omentoplasty is feasible with good results in the medium-term follow-up.

Conclusion

Laparoscopic ureterolysis with intraperitonealization without omentoplasty is a safe and feasible surgical option and provides good results in medium-term, follow-up in patients, with IRF as we described in our case series.

References

1. Tzou M, Gazeley DJ, Mason PJ. Retroperitoneal fibrosis. Vasc Med 2014;19(5):407–414. DOI: 10.1177/1358863X14546160.
2. Miller OF, Smith LJ, Ferrara EX, et al. Presentation of idiopathic retroperitoneal fibrosis in the pediatric population. J Pediatr Surg 2003;38(11):1685–1688. DOI: 10.1016/S0022-3468(03)00590-6.
3. Hernández Fernández C, Subirá Rios D, Moralejo Gárate M, et al. Laparoscopic treatment of retroperitoneal fibrosis. Arch Esp Urol 2017;70(4):468–474.
4. O'Brien T, Fernando A. Contemporary role of ureterolysis in retroperitoneal fibrosis: treatment of last resort or first intent? An analysis of 50 cases. BJU Int 2017;120(4):556–561. DOI: 10.1111/bju.13915.
5. Duchene DA, Winfield HN, Cadeddu JA, et al. Multi-institutional survey of laparoscopic ureterolysis for retroperitoneal fibrosis. Urology 2007;69(6):1017–1021. DOI: 10.1016/j.urology.2007.02.004.
6. Simone G, Leonardo C, Papalia R, et al. Laparoscopic ureterolysis and omental wrapping. Urology 2008;72(4):853–858. DOI: 10.1016/j.urology.2008.06.011.
7. Elashry OM, Nakada SY, Wolf Jr JS, et al. Ureterolysis for extrinsic ureteral obstruction: a comparison of laparoscopic and open surgical techniques. J Urol 1996;156(4):1403–1410. DOI: 10.1016/S0022-5347(01)65601-5.
8. Srinivasan AK, Richstone L, Permpongkosol S, et al. Comparison of laparoscopic with open approach for ureterolysis in patients with retroperitoneal fibrosis. J Urol 2008;179(5):1875–1878. DOI: 10.1016/j.juro.2008.01.030.
9. Styn NR, Frauman S, Faeber GJ, et al. University of Michigan surgical experience with ureterolysis for retroperitoneal fibrosis: a comparison of laparoscopic and open surgical approaches. Urology 2011;77(2):339–343. DOI: 10.1016/j.urology.2010.03.036.
10. Fry AC, Singh S, Gunda SS, et al. Successful use of steroids and ureteric stents in 24 patients with idiopathic retroperitoneal fibrosis: a retrospective study. Nephron Clin Pract 2008;108(3):213–220. DOI: 10.1159/000119715.
11. Ilie CP, Pemberton RJ, Tolley DA. Idiopathic retroperitoneal fibrosis: the case for nonsurgical treatment. BJU Int 2006;98(1):137–140. DOI: 10.1111/j.1464-410X.2006.06210.x.

CASE REPORT

Single-port Splenectomy after Splenic Cyst Aspiration for Huge Splenic Cyst with High CA 19-9 Levels: The State of the Art

Borja Camacho Fernández-Pacheco[1], Eudaldo López-Tomassetti Fernández[2], David Fernández-San Millán[3], Juan Ramón Hernández Hernández[4]

Abstract

Aim: Description of a patient with an elevation of CA 19-9 levels caused by a giant benign splenic cyst, which was completely laparoscopically resected through a single port, despite the large size of the lesion. An increase in CA 19-9 in this type of cystic tumors does not indicate malignancy.

Background: The cystic tumors of the spleen are rare diseases that may present a CA 19-9 increase, without indicating malignancy. There is a tendency to perform surgical intervention as less invasive and aggressive as possible. The current trend in the management of splenic cysts with a CA 19-9 increase and benign radiological characteristics, is a minimally invasive surgery, whenever possible.

Case description: We present a case of a young patient with a giant splenic cyst of 20.5 × 14.5 × 23 cm and elevated CA 19-9 levels. Spleen was completely laparoscopically resected through a single port after the cyst puncture and aspiration, using the advantages of laparoscopic surgery and single port. Had a favorably postoperative course with resolution of the symptoms up to the current date.

Conclusion: There is an actual tendency to perform minimally invasive surgical interventions. In pathologies such as the clinical case provided, we should try to make a surgical intervention as less invasive as possible, despite the large size of the lesion. In our case, we successfully performed the resection of a giant splenic cyst, using the advantages of laparoscopic surgery and the single port, which helped us in the extraction of the piece.

Clinical significance: When facing this pathology, we must bear in mind that benign epithelial and mesothelial cysts can produce an increase of CA 19-9 blood levels, without indicating malignancy. So, we should try to make a surgical intervention as less invasive as possible.

Keywords: CA 19-9, Laparoscopy, Mesothelial cyst, Single-port, Splenic cyst.

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Background

Splenic cystic tumors are rare diseases, with an estimated incidence of 0.07%. Benign epidermoid and mesothelial cysts may present a CA 19-9 increase, without indicating malignancy, which is why they usually cause the clinician to be confused. We present a case of a young patient with a giant splenic cyst and elevate CA 19-9, which was completely laparoscopically resected through a single port after the cyst puncture and aspiration.

Case Description

A healthy 19-year-old woman with no personal history of interest presented pain in the left hypochondrium of 2 months of evolution accompanied by dyspepsia, anorexia, and weight loss. On physical examination, a palpable mobile mass was observed. Abdominal CT (Fig. 1) showed a splenic cyst of 20.5 × 14.5 × 23 cm with a marked mass effect towards the stomach without infiltration of adjacent organs. Blood analyses were normal, without portal hypertension or hypersplenism data, but CA 19-9 blood level of 2,496 U/mL was highlighted.

Because of the patient's symptoms, a laparoscopic splenectomy was performed through a single transumbilical port, extending the incision to the supraumbilical midline about 3 cm. As the first step, the umbilical trocar ring was introduced, and a controlled aspiration of the cyst content was made prior to splenectomy. After aspiration and cyst collapse, the hermetic seal of the single trocar was locked, and pneumoperitoneum performed. The pericystic adhesions were released with the help of the ultracision (Fig. 2B) and subsequent section of short vessels. The vessels of the splenic hilum were sectioned with endoGIA (Covidien, USA) 60 mm vascular load (Fig. 2A), and the piece was extracted through the single port.

Definitive pathological anatomy of the surgical specimen was a benign epidermoid cyst (Fig. 3). The cytology of the cyst content was negative for malignancy.

After the surgical intervention, the patient progressed favorably, with resolution of the symptoms up to the current date. Analysis performed after the intervention showed normalization of CA 19-9 levels.

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Discussion

Splenic cysts are rare diseases, with an estimated incidence of 0.07%. The incidence is higher in young women between 18 years and 46 years.

They are classified as parasitic and nonparasitic. The nonparasitic are subdivided into true or primary cysts (25%) and pseudocysts or secondary cysts (75%) depending on the presence of a coating of epithelial cells inside the cyst.[1]

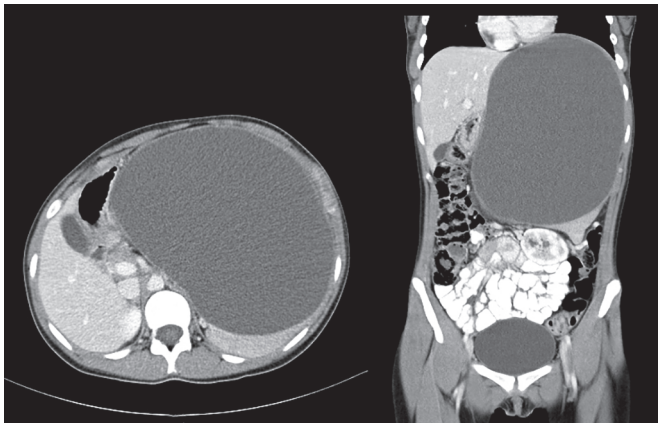


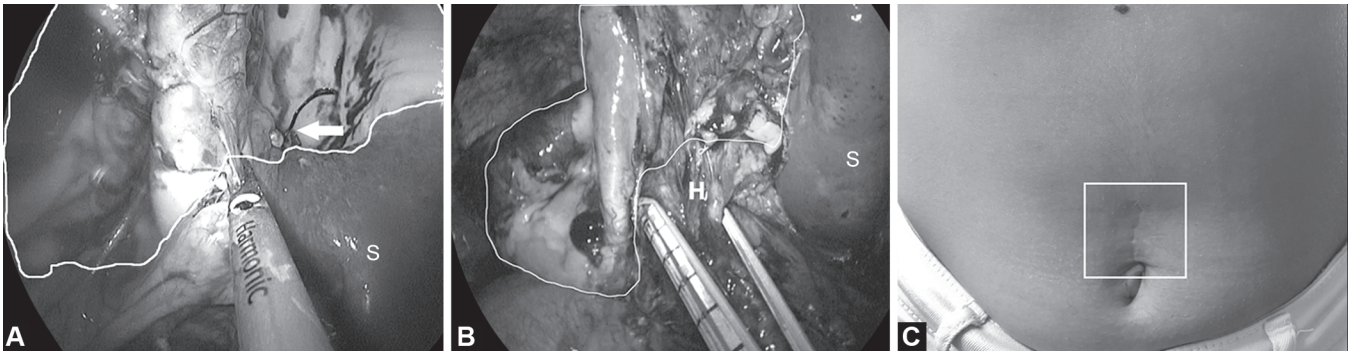
Fig. 1: Abdominal CT shows the splenic cyst of 20.5 × 14.5 × 23 cm with a marked mass effect towards the abdominal organs

They are usually asymptomatic, but when they are large, as in our patient, can produce symptoms such as abdominal pain, postprandial discomfort due to compression of the stomach, sensation of a palpable mass, hemorrhage, infection or spontaneous rupture.[2]

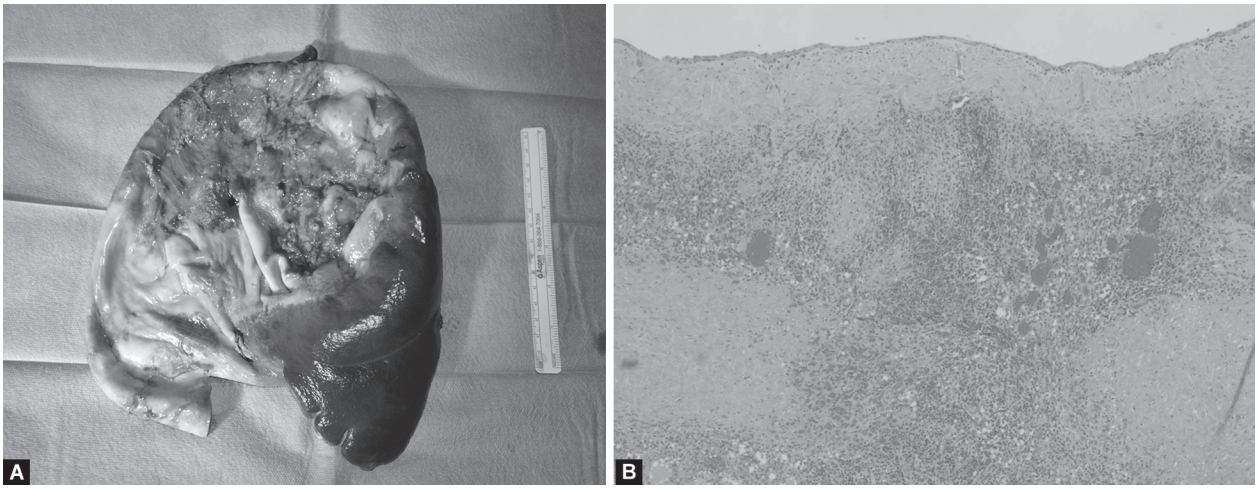
The diagnosis is usually done with imaging tests: Abdominal ultrasound shows the cystic lesion that may have septa inside; CT scan can show calcifications in the cystic wall; the NMR reveals a hyperintensity signal in the T1 and T2 sequences.[3] In addition, 11% of cases are diagnosed when a complication occurs, such as bleeding, rupture, and infection.

CA 19-9 is a glycoprotein produced in the epithelial cells of the ducts of the salivary glands, pancreatic duct, bile, and metaplastic mesothelial cells. It can be elevated in gastrointestinal, pancreatic, and biliary carcinomas, so it is used as a tumor marker, although we can find false positives in benign diseases such as cholangitis, pancreatitis, liver cirrhosis, cystic fibrosis, and idiopathic pulmonary fibrosis.[4]

An increase in CA 19-9 level does not indicate malignancy in this type of cystic tumors, although the surgeon must be alert to dismiss the possibility of a cystic pancreatic tumor. There are similar cases reported in the literature with a CA 19-9 blood level normalized after splenectomy and the anatomopathological result of benignity.[5] The epithelial cysts can elevate this tumor marker without a correlation between the size of the cyst and



Figs 2A to C: (A) The release of pericystic adhesions. The arrow points to the silk thread of the aspiration point; (B) The section of the splenic hilum with endoGIA (Covidien, USA) 60 mm vascular load; (C) Single postoperative scar. H, splenic hilum; S, spleen; white line, marks the outline of the splenic cyst



Figs 3A and B: (A) Macroscopic pathological anatomy; (B) Microscopic image of the splenic cyst (hematoxylin–eosin): the wall of the cyst is lined by mature nonkeratinized squamous epithelium without atypia

CA 19-9 blood levels.[6] For this reason, the current trend for these tumors with a CA 19-9 increase is the least invasive surgery instead of laparotomic access given the benignity of the similar cases reported with a CA 19-9 elevation.[5]

Differential diagnosis should be made with congenital cysts, infection by parasites, cystic neoplasms of the tail of the pancreas, and previous splenic trauma.[7] There are described some cases of primary splenic cystadenocarcinomas[8] and splenic lymphomas[9] that course like a splenic cyst. Although they usually look like solid lesions, hemorrhagic phenomena and necrotic degenerations can cause them to acquire a cystic appearance.[10]

Surgical treatment is indicated when they are symptomatic, have a size greater than 5 cm or complications appear.[11] The gold standard is total splenectomy[12] although, partial splenectomy, marsupialization or fenestration of the cyst, can also be performed.[13] Partial splenectomy could be performed for maintaining immunity against encapsulated bacteria although, the incidence after splenectomies has decreased due to vaccination against these pathogens;[14] however, this procedure presents some risks such as intraoperative and postoperative hemorrhage and cystic recurrence.[14] For asymptomatic splenic cyst smaller than 5 cm, a close follow-up is recommended, since cases of spontaneous cystic regressions have been described.[15]

There are cases of splenic cysts resected by open laparotomy or by laparoscopic access if they are not large.[16] Laparoscopic splenectomy has proven to be a safe procedure, with advantages over open approaches, such as a reduction in hospital stay, less postoperative pain, and a faster postoperative recovery.[17]

Therefore, the current trend in the management of splenic cysts with a CA 19-9 increase and benign radiological characteristics is minimally invasive surgery whenever possible. In this case, we adopted a combined approach with the aspiration of the cyst and subsequent splenectomy by a single port, which becomes a valid approach for most of the cysts with these characteristics. In the literature review, we have not found splenic cyst cases handled with the help of the single port.

Conclusion

There is a tendency to perform surgical interventions less invasive due to the lower surgical aggressiveness and a decrease in the associated morbidity. In pathologies such as the clinical case provided, we should try to make a surgical intervention as less invasive as possible, despite the large size of the lesion. In our case, we successfully performed the surgical intervention of a giant splenic cyst, using the advantages of laparoscopic surgery and a single port, which helped us in the extraction of the piece.

Clinical Significance

When facing this pathology, we must bear in mind that benign epithelial and mesothelial cysts can produce an increase of CA 19-9 blood levels, without indicating malignancy. So, we should try to make a surgical intervention as less invasive as possible.

References

1. Robbins FG, Yellin AE, Lingua RW, et al. Splenic epidermoid cysts. Ann Surg 1978;187(3):231–235. DOI: 10.1097/00000658-197803000-00002.
2. Qureshi MA, Hafner CD. Clinical manifestations of splenic cysts study of 75 cases. Ann Surg 1965;31:605–608.
3. Rabushka LS, Kawashima A, Fishman EK. Imaging of the spleen: CT with supplemental MR examination. Radiographics 1994;14(2): 307–332. DOI: 10.1148/radiographics.14.2.8190956.
4. Ito S, Gejyo F. Elevation of serum CA19-9 levels in benign diseases. Intern Med. 1999;38(11):840–841. DOI: 10.2169/internalmedicine.38.840.
5. Ingle SB, Hinge Ingle CR, Patrike S. Epithelial cysts of the spleen: a minireview. World J Gastroenterol 2014;20(38):13899–13903. DOI: 10.3748/wjg.v20.i38.13899.
6. Terada T, Yasoshima M, Yoshimitsu Y, et al. Carbohydrate antigen 19-9 producing giant epithelial cyst of the spleen in a young woman. J Clin Gastroenterol 1994;18(1):57–61. DOI: 10.1097/00004836-199401000-00014.
7. Brauner E, Person B, Ben-Ishay O, et al. Huge splenic cyst with high level of CA 19-9: the rule or the exception? Isr Med Assoc J 2012;14(11):710–711.
8. Morinaga S, Ohyama R, Koizumi J. Low-grade mucinous cystadenocarcinoma in the spleen. Am J Surg Pathol 1992;16(9): 903–908. DOI: 10.1097/00000478-199209000-00009.
9. Takabe K, Al-Refaie W, Chin B, et al. Can large B-cell lymphoma mimic cystic lesions of the spleen? Int J Gastrointest Cancer 2005;35(1): 83–88. DOI: 10.1385/IJGC:35:1:083.
10. Kaza RK, Azar S, Al-Hawary MM, et al. Primary and secondary neoplasms of the spleen. Cancer Imaging. 2010;10(1):173–182. DOI: 10.1102/1470-7330.2010.0026.
11. Kenney CD, Hoeger YE, Yetasook AK, et al. Management of nonparasitic splenic cysts: does size really matter? J Gastrointest Surg 2014;18:1658–1663. DOI: 10.1007/s11605-014-2545-x.
12. Meimarakis G, Grigolia G, Loehe F, et al. Surgical management of splenic echinococcal disease. Eur J Med Res 2009;14:165–170. DOI: 10.1186/2047-783X-14-4-165.
13. Hansen MB, Moller AC. Splenic cysts. Surg Laparosc Endosc Percutan Tech 2004;14(6):316–322. DOI: 10.1097/01.sle.0000148463.24028.0c.
14. Palmieri I, Natale E, Crafa F, et al. Epithelial splenic cysts. Anticancer Res. 2005;25(1B):515–522.
15. Stoidis CN, Spyropoulos BG, Misiakos EP, et al. Spontaneous regression of a true splenic cyst: a case report and review of the literature. Cases J 2009;2:8730. DOI: 10.4076/1757-1626-2-8730.
16. Bresadola V, Pravisani R, Terrosu G, et al. Elevated serum CA 19-9 level associated with a splenic cyst: which is the actual clinical management? Review of the literature. Ann Ital Chir 2015;86(1):22–29.
17. Mitolo CI, Vincenti L, Stabile-Ianora AA, et al. Total cyst excision by laparoscopic splenic resection. Surg Endosc 2001;15:219.

CASE REPORT

Femoral Hernioscopy: A Minimally Invasive Procedure to Evaluate Bowel Viability

Shafquat Zaman[1], Mona Kamal[2], Peter Waterland[3]

Abstract

We highlight an important surgical technique that can be utilized to prevent unnecessary laparotomies in patients undergoing emergency femoral hernia repair. A 79-year-old female presented to our unit with an increasingly painful left-sided groin swelling. She was subsequently taken to the operation theater for an emergency operation and found to have a spontaneously reduced femoral hernia after induction of anesthesia. Femoral hernioscopy was performed successfully with the patient positioned in a steep Trendelenburg position. This allowed us to perform a diagnostic laparoscopy and assess bowel viability. Consequently, further unnecessary procedures were avoided together with their associated short- and long-term morbidity. Hernioscopy is a safe, feasible, and valuable technique that is potentially underutilized. We feel that this is a cornerstone in the application of minimal access surgery for a common general surgical emergency, and hence further research with application of this technique is required in this field.

Keywords: Femoral hernia, Hernioscopy, Laparoscopy, Laparotomy.

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Case Description

A 79-year-old lady was referred from primary care with an increasingly painful left groin swelling over several months. Her past surgical history included a left-sided total hip replacement. Clinical examination revealed a 3 × 3 cm hard, fixed swelling below and lateral to the pubic tubercle. This was extremely tender on palpation.

An ultrasound of the left groin showed a 2.6 cm thick-walled cystic structure with no changes noted on the Valsalva maneuver. There was no free fluid or discrete collections seen on imaging. The patient was subsequently taken to the theatre for groin exploration.

Surgical Technique

A left-sided groin crease incision was made, and a femoral hernia identified. The hernia sac contained hemoserous fluid only. In order to further inspect the retracted bowel, a blunt 12 mm balloon port was introduced via the hernial sac into the abdominal cavity (Fig. 1). Standard insufflation with carbon dioxide was performed, maintaining an intra-abdominal pressure of 14 mm Hg. The patient was repositioned in a steep Trendelenburg position, and pneumoperitoneum was established.

Laparoscopy showed a mildly congested but viable small bowel loop. Constriction markings were seen on this segment of the bowel and were consistent with entrapment within the hernia sac (Fig. 2). As the loop of bowel was completely viable, no resection was required. The laparoscope was withdrawn, the port was removed, and a standard mesh repair of femoral hernia was performed. Postoperatively the patient made an excellent recovery and was discharged home the following day.

Discussion

Femoral hernia is the protrusion of a peritoneal sac through the femoral ring into the femoral canal. Less common than inguinal hernias, it is seen most frequently in older females. It is associated with higher rates of acute complications such as incarceration and strangulation.

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Femoral hernioscopy is a particularly useful technique in the emergency setting as it can potentially avoid a further explorative laparotomy. It allows the contents of a spontaneously reduced hernia to be fully inspected.

It is relatively quick to perform (approximately 10 minutes), and the technique can be adapted depending on the clinical context such as inguinal sac hernioscopy. In our case, a single port, in combination with the Trendelenburg position, provided excellent views of the reduced hernial sac contents. A single incision laparoscopic port (SILS) can also be used to allow the introduction of further instruments to obtain better views.

There are limited reports in the literature especially, on femoral hernioscopy as a technique for evaluating incarcerated hernias that retract under anesthesia. One study involving five patients with inguinal and femoral hernias showed that the technique was simple and may prevent unnecessary laparotomies.[1] Kneessy and Weinbaum[2] described a similar approach undertaken to examine a loop of incarcerated bowel, which had spontaneously retracted back into the abdomen. It appears that their patient positioning was not modified, and so an additional 5 mm port was required to manipulate and handle bowel.

Valderrama et al.[3] used a smaller single 5 mm port for the insertion of a 0° laparoscope in the management of an incarcerated right femoral hernia causing small bowel obstruction.

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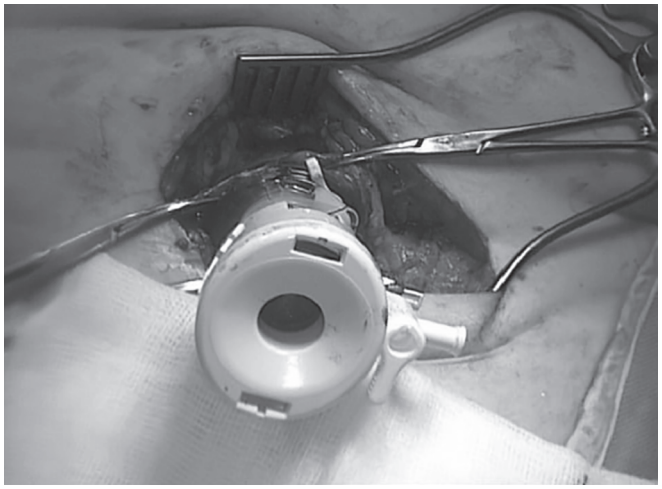

Fig. 1: 12 mm laparoscopic port inserted into the peritoneal cavity via the femoral canal

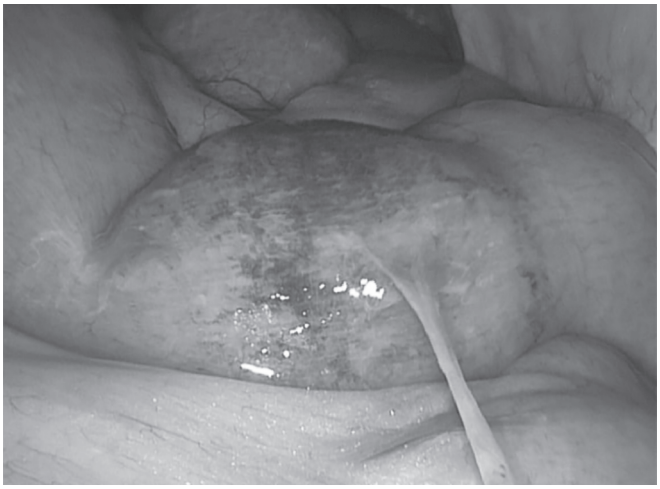

Fig. 2: Laparoscopy showing a segment of entrapped small bowel with visible constriction markings

They demonstrated that this was a safe and useful technique in the treatment of such cases.

Romain et al.[4] assessed the prognostic factors associated with postoperative morbidity and mortality following strangulated groin hernia repairs. They compared explorative laparotomy, laparoscopy, and hernioscopy and noted that explorative laparotomy was a major cause of postoperative complications.

Potential drawbacks of this technique include inadequate mobilization of bowel necessitating the introduction of additional ports. However, this problem can be addressed by the use of a SILS port. In addition, in some cases, views may be obscured in the presence of dense intra-abdominal adhesions or gross ascites.

Nevertheless, hernioscopy without additional trocar placement is a valuable technique that can be utilized by skilled and experienced laparoscopic surgeons to prevent unnecessary laparotomies.[4,5] This will help to reduce the many complications associated with major surgery. Amongst the benefits include reduced risk of infection, postoperative pain, length of stay, wound dehiscence, incisional hernias, earlier mobilization, and reduced thromboembolic events.

In addition, inspection via the laparoscope may provide additional useful information such as the presence of ascitic fluid or tumors.

Conclusion

In situations where the contents of a hernial sac have reduced spontaneously under anesthesia prior to inspection, we advocate the use of hernioscopy. In skilled hands, the technique is safe and simple and can prevent unnecessary laparotomies and their associated complications.

Clinical Significance

There have not been sufficed case reports on this technique for a formal case series to be undertaken to look into the precise complications of femoral hernioscopy postoperative and long-term follow-up. We feel this is a cornerstone in application of minimal access surgery for a common general surgical emergency, and hence further research with the application of this technique is required in this field.

References

1. Morris-Stiff G, Hassn A. Hernioscopy: a useful technique for the evaluation of incarcerated hernias that retract under anesthesia. Hernia 2008;12(2):133–135. DOI: 10.1007/s10029-007-0296-2.
2. Kneesy K, Weinbaum F. Hernioscopic retrieval of bowel for evaluation of viability during repair of a Richter's-type incarcerated femoral hernia. Surg Laparosc Endosc 1997;7(2):171–172. DOI: 10.1097/00019509-199704000-00023.
3. Valderrama AR, Ruiz D, Malik M, et al. Femoral hernia sac laparoscopy: a case report. Minim Invasive Ther Allied Technol 2014;23(1):55–57. DOI: 10.3109/13645706.2013.831108.
4. Romain B, Chemaly R, Meyer N, et al. Prognostic factors of postoperative morbidity and mortality in strangulated groin hernia. Hernia 2012;16(4):405–410. DOI: 10.1007/s10029-012-0937-y.
5. Lin E, Wear K, Tiszenkel HI. Planned reduction of incarcerated groin hernias with hernia sac laparoscopy. Surg Endosc 2002;16(6):936–938. DOI: 10.1007/s00464-001-8242-3.

CASE REPORT

Portomesenteric Venous Thrombosis with Bowel Ischemia after Laparoscopic Sleeve Gastrectomy

Mubarak Alkandari[1], Samir Abdulaziz[2], Mohamed Alsulimy[3], Nagy Ismaeil[4], Mohamed Mohsen[5]

Abstract

Laparoscopic sleeve gastrectomy has become an increasingly popular surgical option for morbidly obese patients. Portomesenteric venous thrombosis, as a complication of laparoscopic sleeve gastrectomy, has been rarely reported. We report one case of thrombosis of the portal vein and the superior mesenteric vein after sleeve gastrectomy. It is confirmed by CT scan. Thrombosis of the portomesenteric veins after bariatric surgery is a diagnosis that one should know how to raise in front of any postoperative abdominal pain. An obese patient with a history of thrombosis should receive a complete etiology of these thromboses before bariatric surgery. Abnormal blood dirt, an active smoking fat woman having oral contraceptive, or a patient with a history of recurrent venous thrombosis may be a relative contraindication against a complex bariatric surgery with digestive bypass.

Keywords: Bowel ischemia, Diagnostic laparoscopy, Laparoscopic sleeve gastrectomy.

World Journal of Laparoscopic Surgery (2019): 10.5005/jp-journals-10033-1385

Introduction

Bariatric surgery is being used with increased frequency for effective weight loss in patient with morbid obesity.[1] However, although rare, life-threatening complications such as mesenteric ischemia and pulmonary embolism occur.[2] The incidence of deep vein thrombosis (DVT) after bariatric surgery varies from 1.2 to 1.6%.[3] Portomesenteric venous thrombosis (PMVT) is a rare vascular event but is associated with high mortality rates (20–45%).[3,4]

Case Description

A 35-year-old patient underwent a laparoscopic sleeve gastrectomy for the treatment of obesity (BMI 41 kg/m^2). The patient was not a smoker and she was not having any chronic debilitated diseases. The surgical procedure was simple with an operative time of 45 minutes. The immediate postoperative course was simple and uneventful, and the hospitalization ended on the 3rd day. The patient was again admitted to emergency on the 14th postoperative day for severe epigastric abdominal pain associated with nausea and persistent repeated vomiting of 2 days' duration. On examination, she was vitally stable with BP: 110/60 mmHg, temp.: 36.8°C, and pulse: 90b/m. The abdomen was tender with guarding, while the patient was tachycardic but febrile. X-ray abdomen showed dilated small bowel loops. The investigations were found without abnormalities apart from positive ketonuria and high serum lactate. The computed tomography (CT) found a thrombosis of both the portal vein (Fig. 1) and the superior mesenteric vein (Fig. 2) associated to the thick enedjejunal loop with extensive collection. An emergency laparoscopy was done after anesthesia consultation and informed consent from the patient as regard to risk, benefits, and outcomes of the surgery that revealed intra-abdominal free fluid and a gangrenous small bowel segment and then conversation laparotomy was performed. A 100 cm of ischemic small bowel segment that began at the 20 cm from the Treitz ligament was resected (Fig. 3). The gastrointestinal continuity was provided by an end-to-end anastomosis. The patient's postoperative course was uneventful. On the 4th postoperative day, oral fluids were started.

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He was discharged on the 7th postoperative day. Pre- and postoperative activated partial thromboplastin time (aPTT) and international normalized ratio (INR) values were observed; other blood tests, protein C and S deficiency, and phospholipid enzymes assessment had been requested. The patient underwent in the postoperative hospitalization period low molecular weight

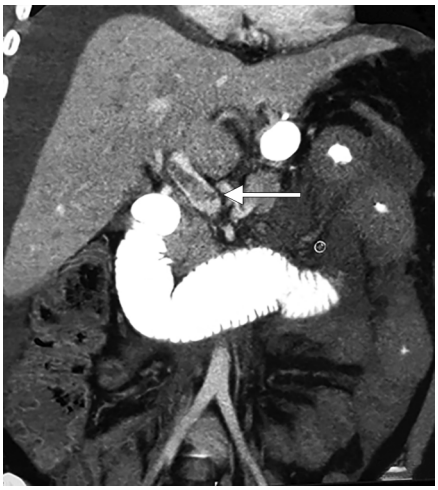

Fig. 1: Abdominal CT scan with contrast showing portal vein thrombosis (white arrow)

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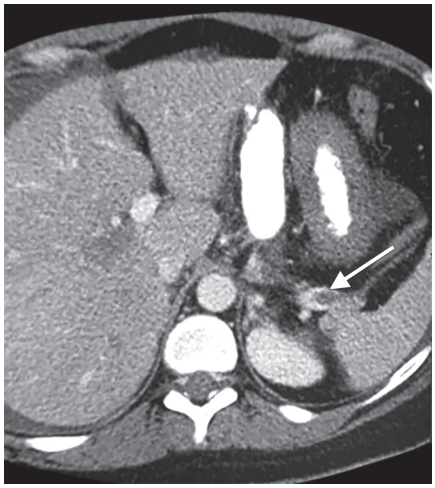

Fig. 2: Abdominal CT scan with contrast showing superior mesenteric vein thrombosis (white arrow)

Fig. 3: Small bowel gangrenous segment

heparin (LMWH) (enoxaparin 80 mg twice/daily) followed by oral anticoagulation after discharge (warfarin 5 mg/day) for up to 6 months. Histopathological examination revealed gangrenous necrosis with mesenteric vascular thrombosis in the resected jejunal segment.

Discussion

The most frequent complications following sleeve gastrectomy are fistula and hemorrhage. Thrombosis of the superior mesenteric vein is exceptional, potentially severe.[5] In this case described above, the diagnosis was made on the 14th postoperative day. There are multiple risk factors such as genetic predisposition and hematological factors (factor V Leiden deficiency, protein C and S deficiency), malignancy, immobilization, varicose veins, atrial fibrillation, and venous stasis due to intra-abdominal pressure, intraoperative manipulation, and/or damage at the splanchnic endothelium, which can lead to PMVT. Diabetes mellitus (DM) is an important causing factor in the development of atherothrombosis by dysregulation of several signaling pathways resulting in enhanced adhesion, activation, and aggregation of the platelets.[6] Overt hyperthyroidism is also associated with venous thrombosis particularly in cerebral and splanchnic veins.[7] The clinical signs of mesenteric venous ischemia are variable and nonspecific. In the presence of abdominal pain of unknown etiology, we shall know how to suggest the diagnosis of a portal vein thrombosis. In case of intestinal ischemia, pain, which is always present, contrasts the absence of physical signs.[8,9] It can be associated with nausea, vomiting, diarrhea, and high or low gastrointestinal hemorrhage.[10] The presumptive diagnosis is often that of perforated ulcer or acute pancreatitis.[11] Biology may not show leukocytosis in half of patients.[10] In obese patients, the reference radiological examination is the CT with vascular injection.[12,13] Familiarity with this dangerous entity is important. Prompt diagnosis and care, initiated by a high index of suspicion, is crucial . The treatment of acute intestinal ischemia of the venous origin has evolved in the last years.[14] It is now mainly medical; in case of early diagnosis and an abdomen that is "not acute" and presented no infarction, two nonoperative treatments may be considered: thrombolysis and systemic heparin.[8,14] Surgical exploration by laparoscopy is useful in acute abdomens but remains of rare use and is still being discussed in this indication because the hypertension associated within sufflation could theoretically worsen venous ischemia.[15] Surgical exploration consents the lesions assessment with two possible outcomes: (1) in cases of localized intestinal necrosis, treatment consists of a resection and immediate restoration of digestive continuity; (2) when the ischemic or infarcted intestine segment is extended, the limits of resection are difficult to predict. In all cases, the resection should be efficient to avoid "short bowel syndrome." Some teams are partisans of a resection followed by a gastrointestinal bypass, associated with an immediate heparin treatment ensued by a second laparotomy 12–24 hours later.[10]

Conclusion

Portomesenteric vein thrombosis is a complication that has potentially life- threatening consequences following laparoscopic bariatric surgery. It should be of clinical suspicion as it presents with nonspecific symptoms. In cases with nonspecific abdominal pain after bariatric surgery, possible portal vein thrombosis (PVT) diagnosis should be kept in mind, and necessary radiological procedures should be used for early diagnosis and treatment.

References

1. Çetinkünar S, Erdem H, Aktimur R, et. al. The effect of laparoscopic sleeve gastrectomy on morbid obesity and obesity related comorbidities: a cohort study. Ulus Cerrahi Derg 2015;31(4):202. DOI: 10.5152/UCD.2015.2993.
2. Bajardi G, Ricevuto G, Mastrandrea G, et al. Postoperative venous thromboembolism in bariatric surgery. Minerva Chir 1993;48(10):539.
3. Acosta S, Alhadad A, Svensson P, et al. Epidemiology, risk and prognostic factors in mesenteric venous thrombosis. Br J Surg 2008;95(10):1245–1251. DOI: 10.1002/bjs.6319.
4. Westling A, Bergqvist D, Bostrom A, et al. Incidence of deep venous thrombosis in patients undergoing obesity surgery. World J Surg 2002;26(4):470. DOI: 10.1007/s00268-001-0251-9.
5. Swartz DE, Felix EL. Acute mesenteric venous thrombosis following laparoscopic Roux-en-Y gastric bypass. JSLS 2004;8(2):165–169.
6. Vazzana N, Ranalli P, Cuccurullo C, et al. Diabetes mellitus and thrombosis. Thromb Res 2012;129(3):371–377. DOI: 10.1016/j.thromres.2011.11.052.
7. Franchini M, Lippi G, Targher G. Hyperthyroidism and venous thrombosis: a casual or causal association? A systematic literature

review. Clin Appl Thromb Hemost 2011;17(4):387–392. DOI: 10.1177/1076029610364521.
8. Cohen J, Edelman RR, Chopra S. Portal vein thrombosis: a review. Am J Med 1992;92(2):173–182. DOI: 10.1016/0002-9343(92)90109-O.
9. Abdu RA, Zakhour BJ, Dallis DJ. Mesenteric venous thrombosis 1911 to 1984. Surgery 1987;101(4):383–388.
10. Rhee RY, Gloviczki P, Mendonca CT, et al. Mesenteric venous thrombosis: still a lethal disease in the 1990s. J Vasc Surg 1994;20(5):688–697. DOI: 10.1016/s0741-5214(94)70155-5.
11. Case records of the Massachusetts General Hospital. Weekly clinicopathological exercises. Case 51-1984. A 45-year-old man with abdominal pain and abnormal CT scan. N Engl J Med 1984;311(25): 1622–1628. DOI: 10.1056/NEJM198412203112508.
12. Parvey HR, Raval B, Sandler CM. Portal vein thrombosis: imaging findings. AJR Am J Roentgenol 1994;162(1):77–81. DOI: 10.2214/ajr.162.1.8273695.
13. Verbanck JJ, Rutgeerts LJ, Haerens MH, et al. Partial splenoportal and superior mesenteric venous thrombosis. Early sonographic diagnosis and successful conservative management. Gastroenterology 1984;86(5 Pt 1):949–952.
14. Bradbury AW, Brittenden J, McBride K, et al. Mesenteric ischaemia: a multidisciplinary approach. Br J Surg 1995;82(11):1446–1459. DOI: 10.1002/bjs.1800821105.
15. Henry C, Smadja C, Vons C, et al. Results of laparoscopic treatment of abdominal emergencies. Ann Chir 1998;52(3):223–228.