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Editorial

The widespread introduction of laparoscopic techniques in general and gynecological surgery during the last decade of the 20th century was one of the most prominent changes in modern surgical practice. Many open surgical procedures, such as cholecystectomy, inguinal hernia repair and esophageal reflux surgery, have been reduced to minimally invasive interventions. This has a great benefit for the patient in a shorter postoperative stay in hospital, less pain, a better cosmetic result and a faster return to normal activity.

Despite a growth in the range of laparoscopic procedures, surgeons and gynecologist remain hampered by the limitations imposed by remote operating. The recent introduction of computer-aided instruments, such as da Vinci robotic surgery systems, has the potential to revolutionize endoscopic surgery by allowing surgeons to use their traditional open surgery skills for laparoscopic operations.

During minimal access, the problem of working with long instruments through fixed entry points and looking at a screen greatly reduces this feedback. The hand-eye coordination is further reduced by the loss of the eye-hands-target axis, compromising normal oculovestibular input. Basic surgical maneuvers like suturing, therefore, demand highly developed technical skills that the surgeon needs to learn.

Looking at a two-dimensional screen, surgeons are handicapped by the loss of the visual perception of depth and, additionally, by the need for a human assistant to hold and move the camera. World Journal of Laparoscopic Surgery is now giving due attention to keep surgeon aware of these ergonomic problem and now article related to a Vinci Robotic Surgery, SILS, NOTES, TEM and MALS are included in WJLS.

I hope the readers will like these new advancements and they will give their valuable feedback.

RK Mishra
Editor-in-Chief

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ORIGINAL ARTICLE

Veress Needle: A Safe Technique in Modern Laparoscopic Era

Shailesh Kumar, Shubhendu Bhaduri, Abu Masood Ansari, Suchita Tripathi, Priyadarshi Dikshit

ABSTRACT

Background: Prospective analytical study to evaluate the Veress needle technique for creating pneumoperitoneum in terms of safety profile.

Materials and methods: A total of 4,014 patients undergoing laparoscopic surgery for different reasons in which Veress needle was the technique to create pneumoperitoneum were included in the study during the period of January 2008 to September 2012.

Results were evaluated by analysing the data through SPSS version 16.

Results: Total 27 patients developed complications in terms of abdominal wall emphysema 12 (44%), omental injury 11 (40.7%), small bowel injury 2 (7.4%) and mesenteric vascular injury 2 (7.4%).

Among these complications majority of patients were having BMI > 30 (78%).

All the complications were managed by simple measures laparoscopically.

Conclusion: Veress needle technique for creating pneumoperitoneum is comparable with open technique, particularly in patients with BMI < 30.

Keywords: Veress needle, Pneumoperitoneum complications, BMI.

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INTRODUCTION

Gaining access into the abdomen has been a challenging issue in terms of complications. Access is associated with injuries to the gastrointestinal tract and major blood vessels, and at least 50% of these major complications occur prior to commencement of the intended surgery.[1,2]

Laparoscopy is widely used for different surgical and gynecological procedures. Access to the peritoneal cavity and creation of pneumoperitoneum is the first and foremost important step.[3]

Among the different methods of primary access in laparoscopy, the popular ones being the Veress needle and Hasson's technique.[4] The Veress needle technique is still being used by many surgeons and gynecologist as an gold standard technique[5,6] while others recommend the open method of access as gold standard. Some studies have shown that almost 50% of complications in laparoscopic surgery are related to primary access.

Some complications like gas embolism, major vascular injury and visceral injuries are underreported as advocated by some authors.[5,7]

In high volume center there are similar bowel injury but no, major vascular injury with the open technique. Some studies have shown even more complications with open technique compared to closed technique.[8]

In our study we used Veress needle in most of our cases and found it to be more convenient than open technique. Complications rate were found quiet comparable and even lower, particularly in patients with BMI <30 in comparison to open technique. Open technique were reserved for the patients having history of abdominal surgery for any other reasons and in case of failure of Veress needle technique.

Our experience with 4,014 patients undergoing laparoscopic surgery during the period of January 2008 to September 2012 in which Veress needle technique was used for primary access to abdominal cavity. Patients who were converted into open method due to some or other reasons were not included in our study.

MATERIALS AND METHODS

In our study, total of 4,014 patients were included who underwent laparoscopic surgery for different reasons. The surgeries were performed by the surgeons and gynecologists having experience of more than 5 years in the field of laparoscopic surgery. This study was conducted at PGIMER Dr RML Hospital New Delhi between the period of January 2008 and September 2012.

In all these patients Veress needle technique was used for primary access. The Veress needle was introduced through the umbilical scar by giving a supraumbilical curvilinear skin incision. In all patients abdominal wall was lifted with nondominant hand or by the assistant to facilitate safe and easy introduction of Veress needle. The entry into the abdominal cavity was confirmed by double click sound and later on by Drop test.

CO_2 insufflation was confirmed by the obliteration of liver dullness on percussion and tympanitic sound of the abdominal cavity. All the complications which occurred during primary access were recorded and analyzed with the help of SPSS version 16.

RESULTS

Among the total 4,014 patients who underwent laparoscopic surgery, 3,211 (80%) were females and 803 were males (20%) (Fig. 1 and Table 1). Average age of our patients was 40 years. These patients were divided into two groups depending upon their BMI: group A having BMI ≤ 30 and (total no of patients: 70%) and group B (total no of patients: 30%) (Table 2). The procedures done were laparoscopic cholecystectomy for symptomatic gall stone disease in 2,810 patients (70%), gynecological procedures in 803 patients (20%) and other surgical procedures like TAPP, laparoscopic appendectomy, diagnostic laparoscopy and bariatric procedures, such as sleeve gastrectomy in 401 patients (10%) (Fig. 2).

Entry time for the primary access was taken from the skin incision to the insertion of first trocar. In our study the total entry time was in the range of 4.1 to 7.2 minutes. Mean entry time were recorded in relation to the BMI of the study group. Entry time was broadly divided into two groups <5 minutes and >5 minutes. It was observed that entry time <5 minutes were in 90% patients in group A compared to 40% in group B. Similarly entry time >5 minutes were observed in 10% patients of group A compared to 60% in group B (Table 3). The most probable cause of greater entry time in patients with BMI > 30 are thick pad of fat in the abdominal wall and comparable laxity of the abdominal musculature. On statistical analysis it was found that there was a significant association between entry time required for Veress needle entry and BMI of the patient (p-value < 0.05).

The complications observed were abdominal wall emphysema in 12 patients (44.2%), omental injury in 11 patients (41%), small bowel injury in two patients (7.4%) and mesenteric vascular injury in two patients (7.4%).

Among the 12 patients who developed abdominal wall emphysema, nine (75%) patients were having BMI > 30. They were managed conservatively. Similarly omental injury which was observed in 11 patients, 8 (73%) were having BMI > 30 (Table 4). They were also managed conservatively. All the two cases of small bowel injury and mesenteric injury were reported in patients of BMI > 30. All the two cases of small bowel injury were in the form of simple laceration of the bowel and were managed by simple intracorporeal suturing. The two cases of mesenteric injury were in the form of small contusion in the mesenteric arcade which was managed conservatively.

DISCUSSION

There has been a tremendous development and technological changes in laparoscopic surgery since the past few years. The number of laparoscopic surgeons and number of procedures being performed with laparoscopically are on rise.[9,10]

The most crucial in laparoscopic surgery is creation of pneumoperitoneum. Different methods have been described for primary access but none is found to be free from

Table 1: Gender distribution of study group

Gender	*Freq*	*%*
Female	3,211	80
Male	803	20
Total	4,014	100

Table 2: Distribution of BMI in the study group

BMI	*Freq*	*%*
<30	2,810	70
>30	1,204	30
Total	4,014	100

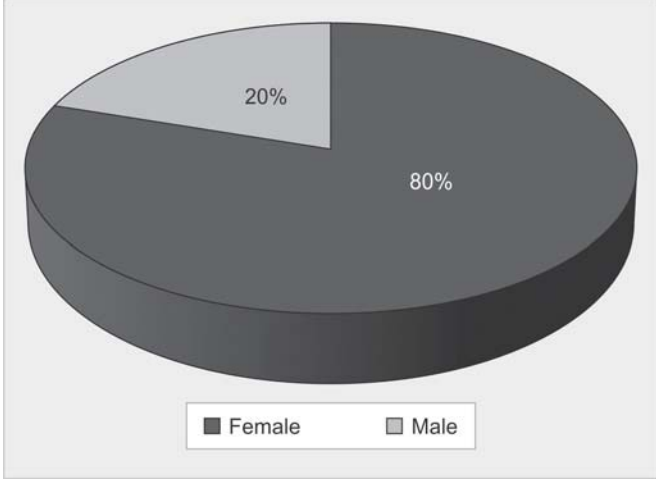

Fig. 1: Gender distribution of study group

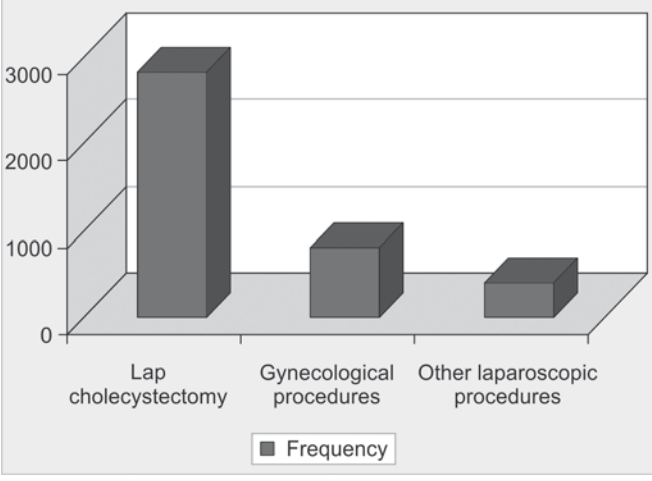

Fig. 2: Distribution of procedures in study group

Table 3: Distribution of entry time according to BMI

	BMI				
	Group A (<30)		Group B (>30)		
Entry time	*Freq*	*%*	*Freq*	*%*	*Total*
<5 minutes	2,529	84	481	16	3,010
>5 minutes	281	28	723	72	1,004
Total	2,810	70	1,204	30	4,014

Table 4: Distribution of complications in relation to BMI

	BMI				
	Group A (<30)		Group B (>30)		
Complications	*Freq*	*%*	*Freq*	*%*	*Total*
Abdominal wall emphysema	3	25	9	75	12
Omental injury	3	27	8	73	11
Small bowel injury	0	0	2	100	2
Mesenteric vascular injury	0	0	2	100	2
Total	6	22	21	78	27

complications. Roal Palmer in 1974 introduced the Veress needle for creation of pneumoperitoneum[11] and very soon it became a very popular method. This method is called closed method as the Veress needle and the first trocar afterward are introduced blindly, whereas in Hasson's technique first trocar is introduced under vision. Different type of trocars like optical trocars and shielded trocars have also been introduced but none have been proved to be superior to others, but these are even more expensive.[12,13] Many studies have reported more number of complications with Veress needle as compared to open method but as per the available evidence open technique has not eliminated the complications.[14,15] Many studies have shown that there is no difference of bowel injury in the two above mentioned method but vascular injury in open method is reported to be very very low.[8]

There are reports from general surgeons for demand of Hasson's technique in all circumstances[16] but cohort studies reported by gynecologist like Swiss Association of Laparoscopic and Thoracic Surgeons (SALTS) showed no superiority of open method over the closed method regarding the primary access related complications.[17]

There are some studies which have highlighted that the number of entry related complications was higher in open technique compared to closed ones and hence the closed technique should not be abandoned.[2] Jansen et al in a study on 25,764 patients found that 83 out of 145 complications were related to primary access and there was no significant reduction of complications with open methods.[2] Although there is no consensus regarding the best method of gaining access to the peritoneal cavity to create a pneumoperitoneum, the Veress needle insertion is the most frequently used technique.[27]

In our study there was not any major vascular injury whereas different comparative studies have shown vascular injury in 0.04% of cases with closed primary access 0.01% with open primary access. Visceral injury was reported to be 0.07% in closed and 0.05% in open method[5,20,26] but in our study it was 0%. Different authors have reported the rate of trocar related injury (mesenteric, small bowel and omental injury) as high as 1%[1,3,17] but in our study it is 0.37%. Out of these complications, 80% occurred in group B and only 20% in group A. Most of the trocar-related injury occur during the first trocar insertion as others are inserted under vision.[27] Champault et al in a French survey of 103,852 laparoscopic surgeries found that 83% of vascular injuries, 75% of bowel injuries and 50% of local hemorrhages were caused during primary trocar insertion.[18] Jared et al described an approach by giving incision on left side of umbilicus and the abdomen is opened at the point where base of umbilicus joins linea alba and claimed that it reduces the incidence of visceral and vascular injury.[19] HJ Bonjer in his review favored the open technique conforming the low incidence of injury with open technique and claimed that it is safe, simple and cost-effective as it can be performed with a reusable trocar.[20] Studies conducted by Ballem RV, Bonjer HJ, Sigman HH, et al compared open to closed access techniques, found open technique to be superior with respect to less complications than closed.[20-22]

A meta-analysis by Larobina et al of 760,890 closed laparoscopy and 22,465 open laparoscopy concluded that the open (Hasson) technique eliminate the risk of vascular

injury and gas embolism and reduces the risk of bowel injury and recommend the open technique to be adopted for primary laparoscopic entry.[26]

Argesta favors direct trocar insertion in nonobese patient rather than Veress needle insertion as if has a higher feasibility rate and is associated with fewer minor complications but seems to be no different in both techniques regarding the major complications.[10]

In a retrospective analytical, multicentric study conducted by Muhammad Sajid et al to evaluate closed technique for creating pneumoperitoneum in terms of procedural safety on 5,244 patients undergoing laparoscopic surgery, authors concluded that closed technique using Veress needle for creating pneumoperitoneum is as safe as Hasson's technique and no method has advantage over the other.[23] Merlin et al reported in a systematic review of the various methods used by general surgeons and gynecologists to establish access for laparoscopic surgery that risk of bowel injury in nonrandomized studies was higher with the open technique than with closed technique, although bias introduced through patient selection may have been a factor.[7]

Chapron et al in a nonrandomized comparison of open versus closed laparoscopic entry concluded that open laparoscopy does not reduce the risk of major complications during laparoscopic access.[24]

Hasson had concluded that there is no evidence to support abandoning the closed entry technique in laparoscopy; however, the selection of patients for an open or alternative procedure is still recommended.[25]

Jansen et al, Gary and most of the gynecologists continue to use closed laparoscopic entry and concluded that none of the method is superior or inferior to others.[2,14,15]

It is not only the technique of primary access to abdominal cavity that matters in respect of the complications but also the other factors like proper selection of patients, BMI, history of previous abdominal surgeries, obesity and lastly the expertize of the surgeons.

CONCLUSION

Based on the above mentioned discussion we conclude that the Veress needle technique of primary access is quiet comparable or even superior to open one in terms of primary access related complications. It is recommended that Veress needle technique is still a safe, easy and cost effective technique, but surgeon must continue with the primary access technique in which they feel more comfortable and confident.

REFERENCES

1. Jansen FW, Kapiteyn K, Trimpos T, Herman J. Complication of laparoscopy: A prospective multicentre observational study. Br J Obstet Gynaecol 1997;104:595-600.
2. Jansen FW, Kolkman W, Bakkum EA, de Kroon CD, Trimbos-Kemper TCM, Trimbos JB. Complications of laparoscopy: An inquiry about closed versus open-entry technique. Am J Obstet Gynecol 2004;190;634-38.
3. Hashizume M, Sugimachi K. Needle and trocar injury during laparoscopic surgery in Japan. Surg Endosc 1971;11:1198-201.
4. Hasson HM. Open laparoscopy as a method of access in laparoscopic surgery. Gynaecol Endosc 1999;8:353-62.
5. Moberg AC, Montgomery A. Primary access related complications with laparoscopy. Surg Endosc 2005;19:1196-99.
6. Samsal PK, Tantia O, Jain M, et al. Primary access related complications in laparoscopic cholecystectomy via the closed technique: Experience of a single surgical team over more than 15 years. Surg Endosc 2009;23:2407-15.
7. Merlin TL, Hiller JE, Maddern JG, Jamieson GG, Brown AR, Kolbe A. Systemic review of the safety and effectiveness of methods used to establish pneumoperitoneum in laparoscopic surgery. Br J Surg 2003;90:668-79.
8. Neudecker J, Sauerland S, Nengebauer F, et al. The European Association for Surgery Clinical Practice Guidelines on the pneumoperitoneum for laparoscopic surgery. Surg Endosc 2002;16:1121-43.
9. Philips PA, Amaral FA. Abdominal access complications in laparoscopic surgery. J Am Coll Surg 2001;192:525-36.
10. Argresta F, DeSimone P, Ciardo LF, Bedin N. Direct trocar insertion vs Veress needle in nonobese patients undergoing laparoscopic procedures. Surg Endosc 2004;18:1778-81.
11. Palmer R. Safety in laparoscopy. J Reprod Med 1974;13:1-5.
12. Schoonderwoerd L, Swark DJ. The role of optical access trocars in laparoscopic surgery. Surg Technol Int 2005;14:61-67.
13. McKernan JB, Finley CR. Experience with optical trocar in performing laparoscopic procedures. Surg Laparosc Endosc Percutan Tech 2002;12:96-99.
14. Garry R. Towards evidence based laparoscopic entry techniques: Clinical problems and dilemmas. Gynaecol Endosc1999;8: 315-26.
15. Viols GA, Vilos AG, Abu-Rafea B, et al. Three simple steps during closed laparoscopic entry may minimize major injuries. Surg Endosc 2009;23:758-64.
16. Rosen DM, Lam AM, Chapman M, Cario GM. Methods of creating pneumoperitoneum: A review of techniques and complications. Obstet Gynecol Surv 1998;53(3):167-74.
17. Schafer M, Lauper M, Krahenbuhl L. Trocar and Veress needle injuries during laparoscopy. Surg Endosc 2001;15:275-80.
18. Champault G, Cazacu F, Taffinder N. Serious trocar accidents in laparoscopic surgery: A French survey of 103,852 operations. Surg Endosc 1996;6:367-70.
19. Jared L, Bhoyrul S, Mathew E, Mark A, Nayan D. Safe and Rapid laparoscopic access-a new approach. World J Surg 2005; 29:800-03.
20. Bonjer HJ, Hazebrek EJ, Kazemier G, Giuffrida MC, Meijer WS, Lange JF. Open vs closed establishment of pneumoperitoneum in laparoscopic surgery. Br J Surg 1997;84:599-602.
21. Sigman HH, Fried GM, Garzon J, Hinchey EJ, Wexler MJ, Meakins JL, et al. Risk of blind versus open approach to celiotomy for laparoscopic surgery. Surg Laparosc Endosc 1993;3:296-99.
22. Ballem RV. Technique of pneumoperitoneum. Surgical Lap Endosc 1993;3:42-43.
23. Sajid M, Lateef AU, Misbah J, Rehman S. Veress needle related complications in Laparoscopic surgery: Our experience. APMC 2010 Jan-Jun;4(1);72-76.

24. Chapron C, Cravello L, Chopin N, Kreiker G, Blanc B, Dubuisson JB. Complications during set-up procedures for laparoscopy in gynecology: Open laparoscopy does not reduce the risk of major complications. Acta Obstet Gynecol Scand 2003:82:1125-29.
25. Hasson HM. A modified instrument and method for laparoscopy. Am J Obstet Gynecol 1971;110:886-87.
26. Larobina M, Nottle P. Complete evidence regarding major visceral injuries during laparoscopic access. Surg Laprosc Endosc Tech 2005;5(3):119-23.
27. Toro A, Mannino M, Cappello G, Stefano AD, Carlo ID. Comparison of two entry methods for laparoscopic port entry: Technical point of view. Diagnostic Therapeutic Endosc 2012; Article ID: 305428.

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ORIGINAL ARTICLE

Efficacy and Safety of Single Port Laparoscopic Cholecystectomy: A Single Institute Experience

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ABSTRACT

Background: Over the past 5 years, minimal access surgery has been moved toward a new less invasive single port access surgery. Like any new technique, there is a need to ensure that basic tenets of safety and efficacy are maintained. In this study, we demonstrate the efficacy and safety of single port laparoscopic surgery for cholecystectomy in 22 consecutive cases in single institution.

Materials and methods: It is a case series of 22 patients (20 females/2 males) who underwent single port laparoscopic cholecystectomy (SPLC) a single laparoscopic surgeon at Barts and the Royal London NHS Trust performed all surgeries using straight conventional instruments from July 2009 to May 2011.

Results: In our series, the operations were performed by SPLC successful in 21 patients. In one case an extra-port was added due to inadequate exposure. The mean age was 37.27 years (24-70). The mean BMI was 25.25 kg/m^2 (21.1-35). The mean operative time was 69.21 minutes (30-90). Gallbladder perforations were recorded in three cases. Minor bleeding was found in one case. The mean hospital stay was <24 (10.05) hours. Visual analog scale was used to record pain severity and the mean was less than one. All patients had uneventful recovery.

Conclusion: The results from current series show SPLC to be a promising technique. We established in this series that SPLC is a safe, efficacious and feasible technique, but it took longer to perform than standard surgery. It can be performed using straight instruments. However, routine application of this novel technique requires evaluation of its safety and effectiveness in large randomized studies.

Abbreviation: SILS: Single incision laparoscopic surgery; SIMPLS: Single incision multiport laparoscopic surgery; OPUS: One port umbilical surgery; TUES: Transumbilical endoscopic surgery; SPAS: Single port access surgery, are acronyms of LESS: Laparoendoscopic single site surgery.

Keywords: Single incision laparoscopic, Cholecystectomy, Single port access surgery, Laparoendoscopic single sit.

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INTRODUCTION

Gallbladder surgery has developed from most invasive open surgery with extensive tissue trauma; prolonged recovery period and high morbidity to minimal invasive surgery. Minimal invasive surgery has very limited tissue trauma and potentially less pain and wound complications, short hospital stay and faster return to work, no or minimum pain postoperatively and excellent cosmoses.[1-5] It also costs less. Therefore, it has crossed all traditional boundaries to specialties and disciplines.

On the other hand there are limitations of minimal access surgery, it has no tactile feedback, and surgeons depend on two-dimension images instead of three and lack of depth perceptions. Furthermore, in laparoscopic procedure surgeon might find it difficult to control bleeding and more chance to injure nearby structure due to hand eye in coordination or loss of triangulation. Moreover, longer operating time due to instruments crashing and crowding and training requirements might cause conversion to open surgery.[5]

With more experiences gained and further developments in surgical innovation and instrumentation, surgeons over the last few years made an effort to further minimize tissue invasiveness and access trauma and therefore results in less pain, quick recovery and better cosmoses results.[6-9] In this new approach one skin incision is to be made almost always in the umbilicus and then either single or multiple facial incisions are made through which one multichannel port inserted. The Transumbilical technique for cholecystectomy, without additional incisions, was described first by Navarre et al in 1997 and later by Piskun et al in 1999, but failed to gain popularity due to lack of proper instrumentation.[10,11]

According to some surgeons, single port laparoscopic cholecystectomy (SPLC) should only be offered to those with favorable anatomy and pathology similar to other indication of standard laparoscopic cholecystectomy.

The aim of single port is to minimize the access trauma, better cosmoses, less postoperative pain and at the same time maintain the dissection principles and safety issue and get the same outcome of standard laparoscopic cholecystectomy.

In SPLC, special skills are needed to be mastered to overcome some difficulties like working in limited spaces with few instrument, loss of triangulation and poor visibility due to instrument camera interface, there is little doubt that this procedure lacks clear evidence about patient's eligibility and common techniques and instruments to make it the standard way of laparoscopic cholecystectomy.

Like any other procedure, techniques, SPLC procedure requires proof to support the claim and the safety and efficacy offered in this approach in addition to its feasibility and its cost effectiveness. Another issue that needs to be addressed is how the patient feels about it and if it meets the patients' expectations, because what seems good and satisfactory is not necessarily shared by patients and social situations.

Safety and efficacy can be evaluated by carefully and continuously monitoring the results of the published studies. By following the principle of evidence base medicine, evidence should be obtained from large clinical trials in multiple centers in addition to series studies. This evidence can be then presented as proof of safety and efficacy of the approach. Maintaining continuous medical education and transparent communication to patients about their experience, outcomes and potential risks is an addition measure to support application of this procedure.

Our aim is to demonstrate the safety and efficacy of SPLC by presenting the outcomes of our initial experience.

MATERIALS AND METHODS

Inclusion Criteria

A group of 22 nonselected cases with symptomatic gallbladder diseases underwent single incision laparoscopic cholecystectomy at Brats and Royal London NHS Trust between July 2009 and May 2011, 21 patients had a completed successful procedure and one case had extra-port added to be completed. There were 20 female patients and two males. Data was collected from both clinical case notes and electronic database of the hospitals and reviewed retrospectively.

There were no restrictions on age, pathology and associated comorbidity. This study presents our institute's initial experience of SPLC. It obtained the necessary approval from the health authority of the trust. All operations were performed by one experienced laparoscopic surgeon (BP). One case was excluded due to extensive intra-abdominal adhesion. Only conventional straight instruments were used in this study including 5 mm 30º laparoscope. Preoperative blood tests and abdominal ultrasound were routinely examined for all patients who were to have the operation.

Exclusion Criteria

Two criterias were considered as exclusion from our study. One is patient with previous upper abdominal surgery and another is BMI more than 40 kg/m^2.

No acute cholecystitis cases were involved in this series however, there was no intention to exclude these cases.

DATA COLLECTION

The data was extracted from patient's electronic health records and operative notes. We used NICE audit support guidelines of SPLC in addition to the defined outcomes of laparoscopic cholecystectomy. Both demographic and operative characteristics were collected.

The defined outcomes were recorded based on previous systematic reviews and published papers. Patients were informed in great detail about the operative strategy of having single incision in the umbilicus with possibility of several more incisions or a conversion to an open technique prior to the surgery. Operative time is defined as the time from incision to time of closure. Pre- and postoperative outcomes (operative time, complications, hospital stay, estimated blood loss, conversion and pain score) were recorded.

Patient satisfaction and postoperative complications were also recorded by answering questionnaire on telephone conversation directly with the patients or their relatives in non-English speaker patients.

SINGLE INCISION LAPAROSCOPIC CHOLECYSTECTOMY TECHNIQUE

Single incision in length of 12 to 15 mm was made through umbilicus down to the midline fascia. A stay suture was placed on each side of the facial incision. The peritoneum was tented up and opened under direct vision. Then multichannel port (Covidien SILS, Triport or Gelport) was introduced into the abdominal cavity (open method access). Stay sutures were tightened around the port to ensure effective pneumoperitoneum. Carbon dioxide (CO_2) was insufflating at high flow rate to less than 12 mm Hg pressure. Two to three 5 mm trocars were put through the port along with 5 mm 30º laparoscopy. Straight conventional instruments were used in all procedures.

An endoloop was introduced in the right hypochondrium to retract gallbladder for good exposure of Calot triangle and cystic artery, duct and identify biliary anatomy. Critical view of safety was achieved by demonstrating both structure entering the gallbladder and the cystic—common bile duct relationship underneath liver in all cases. We do not usually carry out intraoperative cholangiogram as routine practice in our hospitals. After good exposure and dissection, cystic duct and artery were clipped separately. Division of both structures were performed by endo scissors.

Gallbladder was then dissected away from liver bed by monopolar electrocautery. Meticulous hemostasis was performed and saline washout before retrieving the gallbladder from abdominal cavity by endo-bag through umbilical incision. 0 Vicryl stitches was used to close

facial defect and 3/0 Vicryl stitches was used to close the umbilical skin.

RESULTS

Most of patients were female (F/M = 20/2) with average age 37.27 (24 to 70) years. All patients have symptomatic cholelithiasis with no emergency cases included. The mean BMI was 25.25 kg/m^2. General health state of all patients were assessed using American Society of Anesthologist (ASA) scoring system 1 and 2.

The mean operative time for 19 patients was 69.21 minutes (30-90). No records of operative time were found in three cases due to missing data. All cases underwent laparoscopic cholecystectomy using single port through umbilicus except one patient who had an extra-port for inadequate exposure. All patients had cholelithiasis. Straight conventional laparoscopic instruments including 5 mm 30º laparoscopes were used.

There was no conversion to conventional laparoscopic or open cholecystectomy. Some of the missing data was extracted either from electronic record of the patients or from the operating surgeon notebook.

There were five minor complications in this series (Table 1). We had three gallbladder perforations by electrocautery. One case had bleeding intraoperatively which was controlled easily by diathermy. One patient was readmitted for abdominal pain which got controlled conservatively. Operative time appear to decline significantly after the first 18 cases and was around 30 minutes in the last four procedures (Table 2). All patients discharged on the same day except two patients. One patient was discharged on the second day. The other one stayed for 48 hours for social issue. The average blood loss during procedures was minimal and there was no need for blood transfusion.

No vascular or bowel injuries were seen on entering the peritoneal cavity. No intraoperative complications were found. No extension of primary incision was performed. Surgical principle of exposure and dissections were followed. Critical view of safety was demonstrated in all cases. There was no need for routine intraoperative cholangiogram as this is not the trust policy. Postoperative pain was assessed using visual analog scale and the mean was less than one. Patients were given simple oral analgesia which succeeded to control their mild-to-moderate postoperative pain. Most patients said that there was no need to take regular analgesia after being discharged from

Table 1: Operative outcomes of SPLC

Operative time (min)	69.21 (30-90)
Complication	All minors: Total 5 (22.7%) • 3 gallbladder perforations (13.6%) • 1 bleeding: No transfusion needed • 1 readmission for pain control
Critical view of safety	Demonstrated in all cases
Conversion	None One extra-port added due to inadequate exposure
Hospital stays (hours)	<24 hours (the mean 10.05 hours)
Pain score (VAS)	<1
Blood loss	Minimum
Patient satisfaction	Satisfied 100% (14 patients surveyed)
Success rate	95.45%

Table 2: Summary of perioperative outcomes of SPLC

Patients	*Operative time*	*Cri v safety*	*Complication*	*Pain*	*Hosp stay*	*Conversion*
1	90	Yes	No	0	Same day	No
2	85	Yes	No	0	Same day	No
3	90	Yes	No	0	Same day	No
4	50	Yes	No	0	Same day	No
5	90	Yes	No	0	Same day	No
6	65	Yes	No	0	24 hours	No
7	80	yes	Bleeding	2	readmission	No
8	50	Yes	No	0	Same day	No
9	75	Yes	No	0	Same day	No
10	60	Yes	No	0	Same day	No
11	90	Yes	No	2	Same day	No
12	90	Yes	GB perforation	0	48 hours	No
13	70	Yes	No	0	Same day	No
14	Missing	Yes	No	NR	NR	One extra-port
15	90	Yes	GB perforation	0	Same day	No
16	Missing	Yes	No	NR	NR	No
17	Missing	Yes	No	NR	NR	No
18	80	Yes	GB perforation	0	Same day	No
19	45	Yes	No	0	Same day	No
20	35	Yes	No	0	Same day	No
21	30	Yes	Pain	2	Same day	No
22	50	Yes	No	0	Same day	No

Cri v safety: Critical view of safety; GB: Gallbladder; NR: Not recorded

hospital. Patients were surveyed between 1 month and 2 years postoperatively (Table 3). Fourteen patients were surveyed by telephonic conversations (63.63%) about pain, readmission and lumps in site of surgery, after being discharge from hospital or whether or not they sought help from general practitioner or emergency medical help. All 14 patients were satisfied with the results (100%). No contact details were found in three cases. There was no reply in five cases. The mean time for analgesia usage was 4.14 days, simple analgesia was taken on need only.

DISCUSSION

The same surgical principles and instruments of standard laparoscopic cholecystectomy were used in SPLC.

Although, the operative time was longer than the average standard approach but it has reduced significantly after the first 18 cases. The learning curve reduced from 90 minutes to become less than 50 minutes in the last four cases. We have used a multichannel port to complete all procedures.

No significant morbidity was reported and there was no mortality or conversion to standard or open surgery. One patient had one extra-port to complete the procedure due to inadequate exposure. No bowel, vascular or biliary injuries were encountered. By reviewing our series results, we have noticed that the majority of our patients were safely sent home on the same day of the surgery, the level of the pain on the lower margin of the scale and consequently less analgesia were taken, and all has shown a quick recovery.

Patients who underwent this approach in hospitals have expressed their satisfaction with the results months after being discharged from the hospital by answering some questions about the need for analgesia and development of complications and hospital readmission and finally the overall satisfactions with results of this approach.

All these benefits of the reduced port surgery, in addition to the fact that minimal scar and excellent patient's satisfaction, has encouraged us to carry on performing more cases. The limitations of this series are small number involved, single institute and all cases were performed by one surgeon and it is a retrospective study for single pathology. It would be of great benefit if we compare its results to that of conventional laparoscopic cholecystectomy to see how different it is in term of operative and postoperative outcomes in relatively similar groups, demographically and pathologically. In case of limited enrolment number, the chance of developing the morbidity is narrowed and the statistical significance is reduced. Therefore, larger numbers of multicenters and wider range of pathology and techniques are needed to determine long-term safety and continued monitoring of these parameters will only make us confident in adopting this approach worldwide.

This series demonstrated clearly that laparoscopic cholecystectomy by single port access is safe, feasible and reproducible procedure with few complications. The hospital stay and need for analgesia was minimal. The patient satisfaction is very good with no single negative response about this type of surgery.

CONCLUSION

The high success rates (95.45%) with no mortality or morbidity make us conclude that this technique is safe and efficacious in patients with symptomatic cholelithiasis. The patients were satisfied with the final results with no short- or long-term morbidity. The operative time was longer than but comparable to that of conventional laparoscopic cholecystectomy. The learning curve reduced after the first 18 operations. The same surgical principles of conventional

Table 3: Postoperative survey of 14 patients who underwent SPLC

Patients	*How long did you use painkiller for regular and what type did you use?*	*Have you sought any medical help for your pain? NHS directs, GP or hospital A&E?*	*Have you noticed any swelling or lump at site of operation?*	*Have you been readmitted due to an issue with your operation?*	*Are you satisfied with the results of your operation*
1	N	N	N	N	Y
2	N	N	N	N	Y
3	N	N	N	N	Y
4	7D/simple/PRN	N	N	N	Y
5	N	N	N	N	Y
6	14/simple/PRN	GP	N	N	Y
7	N	N	N	N	Y
8	14D/simple/PRN	A&E	N	N	Y
9	N	N	N	N	Y
10	N	GP	N	N	Y
11	N	N	N	N	Y
12	4D/simple/PRN	N	N	N	Y
13	5D/simple/PRN	N	N	N	Y
14	14D/simple/PRN	N	N	N	Y

N: No; D: Day; Y: Yes; PRN: As required; Simple: Simple Nonopoid analgesia

four-port laparoscopic cholecystectomy were applied in all cases and there was no need for conversion to open surgery or standard surgery. The majority of patients left the hospital on the same day. Just simple analgesia was taken for the first few hours after the surgery.

Despite the potential benefits of the SILS, like minimizing the tissue trauma, postoperative pain and hospital stay and great cosmetic advantages, its application on a wide range of patients and wide spectrum of intra-abdominal surgeries need convincing clear evidence about the safety and efficacy of this approach by conducting large randomized trials in different centers in future.

REFERENCES

1. Leggett PL, Churchman-Winn R, Miller G. Minimizing ports to improve laparoscopic cholecystectomy. Surg Endosc 2000;14: 32-36.
2. Lee P-C, Lai I-R, Yu S-C. Mini laparoscopic (needlescopic) cholecystectomy. A study of 1011 cases. Surg Endosc 2004;18: 1480-84.
3. Sarli L, Costi R, Sansebastiano G. Mini-laparoscopic cholecystectomy vs laproscopic cholecystectomy. Surg Endosc 2001;15:614-18.
4. Novitsky Y, Kercher K, Czerniach D, et al. Advantages of mini-laparoscopic vs conventional laparoscopic cholecystectomy: Results of a prospective randomized trial. Arch Surg 2005; 140:1178-83.
5. Macintyre IMC 1994. Practical laparoscopic surgery for general surgeons butterworth-heinemann. The University of Michigan.
6. Romanelli JR, Roshek TB 3rd, Lynn DC, Earle DB. Single-port laparoscopic cholecystectomy: Initial experience. Surg Endosc 2009;24(6):1374-79.
7. Ma J, Cassera MA, Spaun GO, et al. Randomized controlled trial comparing single-port laparoscopic cholecystectomy and 4-port laparoscopic cholecystectomy. Ann Surg 2011;1-6.
8. Tacchino R, Greco F, Matera D. Single-incision laparoscopic cholecystectomy: Surgery without a visible scar. Surg Endosc 2009;23(4):896-99.
9. Cuesta MA, Berends F, Veenhof AA. The invisible cholecystectomy: A transumbilical laparoscopic operation without a scar. Surg Endosc 2008;22(5):1211-13.
10. Navarra G, Pozza E, Donini I. One Wound laparoscopic cholecystectomy. Br J Surg 1997;84(5):695.
11. Piskun G, Rajpal S. Transumbilical laparoscopic cholecystectomy utilizes no incisions outside the umbilicus. J Laparoendoscopic Adv Surg Tech A 1999;9(4):361-64.

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ORIGINAL ARTICLE

A Comparative Study of Laparoscopic *vs* Open Surgery for the Management of Duodenal Ulcer Perforation

PN Sreeramulu, TS Venkatachalapathy, CS Supreet, S Prathima

ABSTRACT

Approximately, 10 to 20% of patients with peptic ulcer suffer a perforation of stomach or duodenum in which chemical peritonitis develop initially from gastric and duodenal secretion but in a few hours bacterial contamination superimpose the disease. The disease could be life-threatening, early diagnosis and treatment is extremely important. The mortality will increase up if perforation exists more than 24 to 48 hours. Usually the only surgical procedure that is necessary is simple closure with omental patch. When repair of perforated ulcer can be achieved by suture closure, laparoscopic approach seems to be appropriate. This study aims at evaluating efficacy, safety and outcome of laparoscopic surgery for perforated duodenal ulcer. Patients admitted with perforated duodenal ulcer perforation, during the period of January 2010 to January 2011 at RL Jalappa Hospital and Research Center were evaluated. A total 61 cases were diagnosed as peritonitis secondary to duodenal perforation were involved in study. Thirty underwent laparoscopic closure and 31 underwent open surgeries which were nonrandomized. The results of study revealed lesser antibiotic open: lap (5:4.03 days; p = 0.001), analgesic requirement (7:4.87 days; p = 0.001) and lesser hospital stay (8:6.17 days; p = 0.001) and reduced postoperative complications open-three (9%): lap-one (3%) patients. The duration of surgery was more with laparoscopic surgery (open-56: lap-62.17 minutes; p = 0.003) since we are at initial stages at laparoscopic management for DU perforation, also depend on skill of surgeon but it had no effect on the overall outcome. Three (9.6%) patients in lap group were needed conversion to open surgery.

Keywords: Laparoscopy, Peritonitis, Duodenal ulcer perforation.

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INTRODUCTION

Laparoscopic repair of perforated peptic ulcers is now technically feasible[1-3] and, in the small series reported to date, carries many of the minimal access advantages apparent in other upper gastrointestinal (GI) and biliary procedures.[2] With the establishment of the role of *Helicobacter pylori*[13] eradication making simple over sewing of perforated ulcers an effective long-term solution, the laparoscopic procedure is increasingly within the compass of surgical trainees and, as the role of routine laparoscopy in the diagnosis and management of peritonitis becomes accepted,[4] it is in danger of being seen as the procedure of choice without prior evaluation or evidence of benefit. Unlike many of the procedures that have established the role of laparoscopy in elective upper GI surgery, however, it is performed in patients with generalized peritonitis[5] and the often severe physiological disturbances which may accompany this. The pathophysiological insult of a 'tension CO_2 pneumoperitoneum' during laparoscopy may be exaggerated in such patients, while the effect on the immune system and its mediators is unpredictable. The balance of exchanging the obvious postoperative benefits of rapid recovery,[6-8] reduced wound complications, improved respiratory function and improved cosmetic appearance for an increase in intraoperative physiological compromise may be in favor of laparoscopic surgery in relatively fit elective patients, but may be considerably more marginal in ill patients at risk of multiple organ dysfunction syndrome (MODS).[9] To examine the risks and benefits of laparoscopic surgery for perforated peptic ulcers, this nonrandomized cohort comparison compared a consecutive series of laparoscopic repairs of perforated peptic ulcers (lap group)[10-12] with a concurrent series of consecutive open repairs (open group).

MATERIALS AND METHODS

All patients diagnosed clinically with perforated peptic ulcers were prospectively nonrandomized to undergo either conventional open or laparoscopic suture omental patch repair[13-16] (consent and cafeteria approach) who are admitted to RL Jalappa Hospital and Research Center attached to Sri Devaraj Urs Medical College, Tamaka, Kolar. The study protocol was approved by the hospital ethics committee before the trial began from January 2010 to January 2011. Informed consent for randomization to laparoscopic or open omental patch repair was obtained from all patients. A total of 61 patients were included in the study with 30 in lap group and 31 in open group.[17-20] Patients with a surgical diagnosis other than perforated peptic ulcer and previous abdominal surgery were excluded at surgery. Following parameters were noticed: operative duration, analgesics and antibiotics requirement (pre- and postoperative), postoperative hospital stay,[21] local and systemic complications. All the cases underwent preoperative assessment, the decision to operate laparoscopic or open surgery depending on the patient presentation.[22] Their preoperative and intraoperative, postoperative findings and complications were meticulously recorded as per protocol.[23]

SURGICAL PROCEDURE

A pneumoperitoneum was created using Hasson open technique, insufflation pressure was maintained at 11 mm Hg. Four ports were inserted,[24] the upper port in subxiphoid area used for irrigation and suction, retraction of liver. An umbilical port was used for camera and two remaining ports were placed on each side of camera port in triangular position. Surgeon stands on left of patient, with assistant on each side.[25] The gallbladder was retracted upward and held by assistant. Inflammatory adhesions were released and suctioned. The perforation area isolated and tip of the suction tube is used as to measure the size of perforation. The next step was irrigation and thorough suction of intra-abdominal fluid using normal saline. All the quadrants were cleaned in clockwise fashion. The perforation was closed using the classical omental patch with 2 to 3 stitches of absorbable sutures before tying the knot intracorporealy. Pelvic and subhepatic drains were placed at the end of procedure. The open surgery was conducted by midline incision and followed the same technical guidelines. All the data expressed as median and in quartile range unless stated. Comparison between two groups was made using nonparametrical methods. Comparison was done using independent samples t-test, $p < 0.05$ taken as statistically significant.

RESULTS

There was male preponderance with 80% of patients, and 57% of the cases in 4, 5 and 6th decade of life the mean age is 50 years. The mean duration of surgery in open group is 56 minutes compared with 62 minutes in lap group which was statistically significant ($p = 0.003$). The mean number of antibiotic used in open group was 5 days compared with 4 days in lap group ($p = 0.001$). The mean usage of analgesics in open group was 7 days as compared with 5 days[5,17,22] ($p = 0.001$). The mean duration of hospital stay for open surgery was 8 days as compared with 6 days in lap group ($p = 0.001$). There was wound infection in three (9%)[25-27] patients in open group as compared with one (3%) in lap group, one patient had wound dehiscence[16] in open group (3%). Two patients had died in open group (6%), no mortality in lap group. No leakage in either of the groups. Three (9.6%)[23] of lap group were needed to be converted to open surgery due to large perforation and extensive adhesions (Figs 1 to 4 and Tables 1 to 3).

DISCUSSION

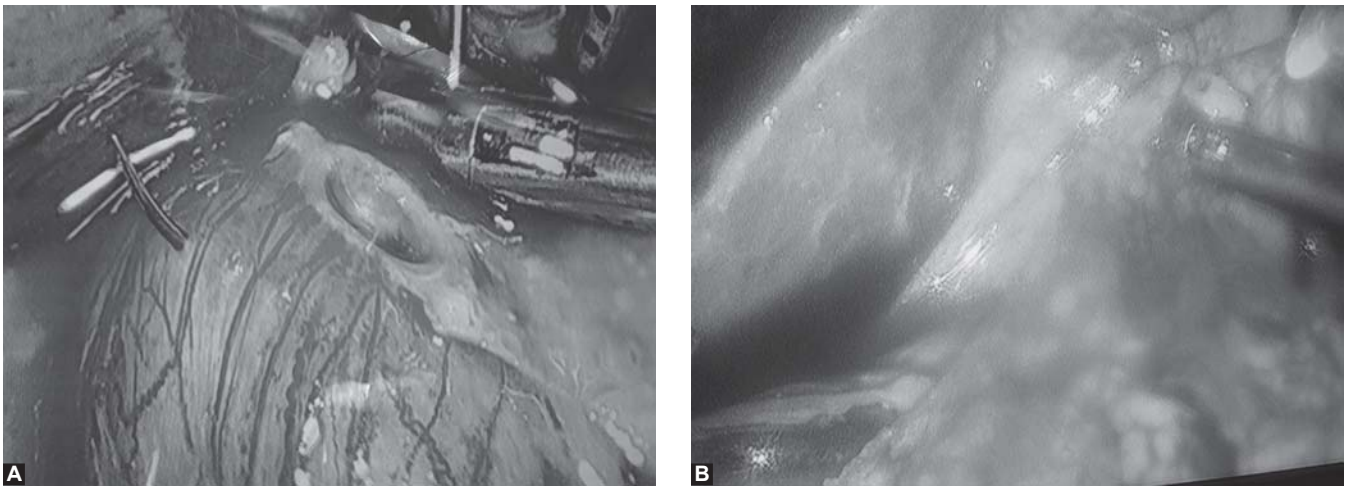
There was no difference in age, weight, duration of symptoms and the time to surgery in both groups. Often it is mentioned that the age of presenting with peptic ulcer in more so in older age group due to excessive use of NSAIDs and aspirin usage. The results in Table 1 show that 57% of the population was among the 40 to 60 age groups, with mean age of 52 years which correlates with literature.[20,22,23]

The mean operating time of the laparoscopic patch repair was significantly longer than the open procedure (52.4:62.1 minutes; $p = 0.001$) which correspond to other studies. A disadvantage of the laparoscopic approach is longer operating time, but this had no impact on the outcome. Three (9.6%) patients were needed conversion to open surgery due large perforation (>1 cm) and other 2 patients had dense adhesions. In analyzing our results with other studies, we observed that clinical parameters that are excluded for safe laparoscopic procedure are shock and symptom duration >24 hours. Patients who presented with shock and delayed presentation have higher conversion rate and worse post-operative course.

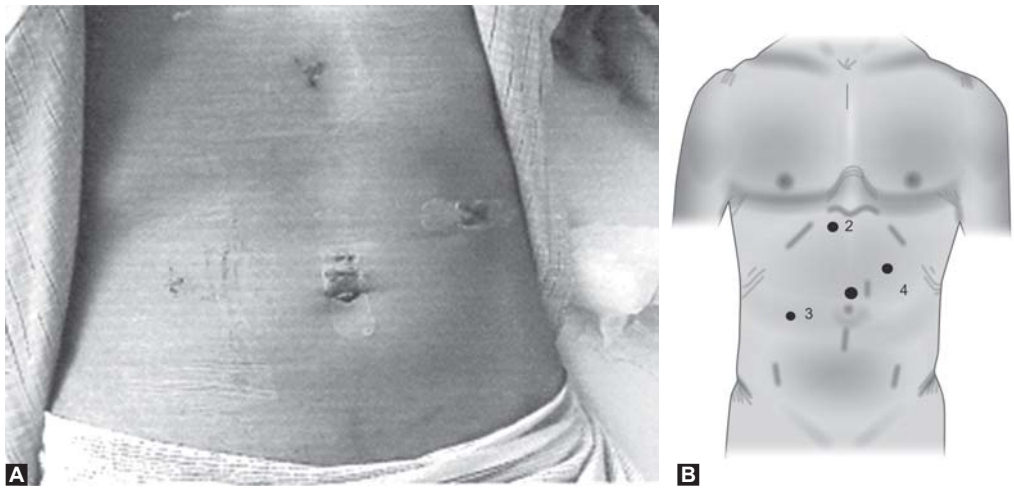
The best parameters to compare the two different surgical techniques are morbidity and mortality. Peptic ulcer perforation has high morbidity with problems of wound infection, sepsis, leakage at repair and pulmonary infections. In our study, high morbidity three (9%) and mortality two (6%) was noticed in open group which is consistent with

Fig. 1: Laparoscopic position of trocars

Fig. 2: Duodenal ulcer perforation (D1)



Figs 3A and B: Perforation closed by placing omentum



Figs 4A and B: Postoperative photo at the time of discharge

other studies.[25,26] The analgesic requirement was significantly less in lap group (p = 0.002); the time to return to normal diet is shorter in lap group (3 days, p = 0.001). This was significantly reflected on the duration of hospital stay which was shorter with lap group (3 days, p = 0.003). A follow-up of upper GI endoscopy was performed on 5 in lap group and 7 in open group after 6 months, rest of patients did not turn up for follow-up. No recurrence of ulcer was noticed in both groups.

Laparoscopic surgery minimizes postoperative wound pain, encourages early mobilization and return to normal.

Daily activities. The benet of early discharge and early return to work may outweigh the consumable cost incurred.

In the execution of the laparoscopic procedures, the role of laparoscopic surgery in emergencies is well-documented.

The change of disease pattern in perforated peptic ulcer favors a simple repair procedure. With the demonstrated benet in our trial, laparoscopic repair of perforated peptic ulcers should be the procedure of choice. Laparoscopy should be incorporated into the general surgeon's armamentarium for the management of patients with peritonitis.

CONCLUSION

Laparoscopic repair of perforated peptic ulcer is a safe and reliable procedure and is proven to be efficient. Even though it was associated with longer operating time, it had no impact

Table 1: Sex distribution

Sex	*Number of cases*	*%*
Male	49	80
Female	12	20
Total	61	100

Table 2: Age distribution

Age	*Number of cases*	*%*
21-40	23	37
41-60	35	57
61-80	3	4
Total	61	100

Table 3: Postoperative complications

Post op. complications	*Open*	*Laparoscopic group*
Wound infection	3 (9%)	1 (3%)
Wound dehiscence	1 (3%)	0
Mortality	2 (6%)	0

on outcome. It had less postoperative pain, reduced chest complications and reduced analgesic usage, shorter postoperative hospital stay, and earlier return to normal daily activities than the conventional open repair. It has lesser morbidity and mortality as compared to open group. Data from the present study indicate that laparoscopic surgical treatment of patients with peptic ulcer perforation can be implemented and completed safely in a large proportion of patients with this life-threatening condition, given that the responsible surgical team has the appropriate technical expertize. We need to do study with more number of cases as to claim advantage of laparoscopic surgery.

REFERENCES

1. Mouret P, François Y, Vignal J, Barth X, Lombard-Platet R. Laparoscopic treatment of perforated peptic ulcer. Br J Surg 1990;77:1006.
2. Nathanson LK, Easter DW, Cuschieri A. Laparoscopic repair/ peritoneal toilet of perforated duodenal ulcer. Surg Endosc 1990;4:232-33.
3. Fletcher DR, Jones RM. Perforated peptic ulcer: A further application of laparoscopic surgery. Aust NZJ Surg 1992;62: 323-24.
4. Tate JJT, Dawson JW, Lau WY, Li AKC. Sutureless laparoscopic treatment of perforated duodenal ulcer. Br J Surg 1993;80:235.
5. Lau WY, Leung KL, Kwong KH, et al. A randomized study comparing laparoscopic versus open repair of perforated peptic ulcer using suture or sutureless technique. Ann Surg 1996;224: 131-38.
6. Matsuda M, Nishiyama M, Hanai T, Saeki S, Watanabe T. Laparoscopic omental patch repair for perforated peptic ulcer. Ann Surg 1995;221:236-40.
7. Sø JBY, Kum CK, Fernandes ML, Goh P. Comparison between laparoscopic and conventional omental patch repair for perforated duodenal ulcer. Surg Endosc 1996;10:1060-63.
8. Johansson B, Hallerbäck B, Glise H, Johnsson E. Laparoscopic suture closure of perforated peptic ulcer. Surg Endosc 1996;10: 656-58.
9. Miserez M, Eypasch E, Spangenberger W, Lefering R, Troidl H. Laparoscopic and conventional closure of perforated peptic ulcer. Surg Endosc 1996;10:831-36.
10. Druart ML, Van Hee R, Etienne J, et al. Laparoscopic repair of perforated duodenal ulcer. Surg Endosc 1997;11:1017-20.
11. Siu WT, Leong HT, Li MKW. Single stitch laparoscopic omental patch repair of perforated peptic ulcer. JR Coll Surg Edinb 1997; 42:92-94.
12. Donovan AJ, Berne TV, Donovan JA. Perforated duodenal ulcer: An alternative therapeutic plan. Arch Surg 1998;133:1166-71.
13. Sebastian M, Prem Chandran VP, Elashaal YIM, Sim AJW. Helicobacter pylori infection in perforated peptic ulcer disease. Br J Surg 1995;82:360-62.
14. Tokunaga Y, Hata K, Ryo J, Kitaoka A, Tokuka A, Ohsumi K. Density of helicobacter pylori infection in patients with peptic ulcer perforation. J Am Coll Surg 1998;186:659-63.
15. Jordan PH Jr, Thornby J. Perforated pyloroduodenal ulcers: Long-term results with omental patch closure and parietal cell vagotomy. Ann Surg 1995;221:479-88.
16. Wissing J, van Vroonhoven TJMV, Schattenkerk ME, Veen HF, Ponsen RJG, Jeekel J. Fascia closure after midline laparotomy: Results of a randomized trial. Br J Surg 1987;74:738-41.
17. Lau JYW, Lo S, Ng EKW, Lee DWH, Lam Y, Chung SCS. A randomized comparison of acute phase response and endotoxemia in patients with perforated peptic ulcers receiving laparoscopic or open patch repair. Am J Surg 1998;175:325-27.
18. Boey J, Wong J, Ong GB. A prospective study of operative risk factors in perforated duodenal ulcers. Ann Surg 1982;195: 265-69.
19. Blomberg LGM. Perforated peptic ulcer long-term results of simple closure in early world: Surg 1997;21:412-15.
20. Schein M. Laparoscopic repair of perforated peptic ulcer. Br J Surg 1993;80:127.
21. Kum CK, Isaac JR, Tekant Y, et al. Laparoscopic repair of perforated peptic ulcer. Br J Surg 1993;80:523.
22. Lau WY. Perforated peptic ulcer open versus laparoscopic repair. Asian J Surg 2002;25:267-69.
23. Siu WT, Leong KL, Lai BP, et al. Laparoscopic repair for perforated peptic ulcer. A randomized control trial. Ann Surg 2002;235:313-19.
24. Bergamaschi R, Marivik R, John Son G, Thoresen JE. Y ST Guard B, MYrvold HE. Open versus laparoscopic repair of perforated peptic ulcer. Surg Endosc 1999;13:679-82.
25. Siu WT, Chau CH, Law BK, Tang CN, Hapy LI MK. Routine use of laparoscopic repair for perforated peptic ulcer. Brt J Surg 2004;91:481-84.
26. Siu WT, Leong HT, Law BK, et al. Laparoscopic repair for perforated peptic ulcer: A randomized control trail. Ann Surg 2002;235:313-19.
27. Lau H. Laparoscopic repair of perforated peptic ulcer: A meta-analysis. Surge Endoos 2004;18:1013-21.

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ORIGINAL ARTICLE

Dilip-Sarbani Knot (New Extracorporeal Knot)

Bijan Kumar Mukhopadhyay

ABSTRACT

Knots are very important in the general and laparoscopic surgery. Knots are of two types, extracorporeal and intracorporeal. Intracorporeal knots are difficult while extracorporeal knots are comparatively easy to make, as we make it outside. This new knot (Dilip-Sarbani knot) is an extracorporeal knot. We shall take 20 cm length suture material of prolene, vicryl or catgut. Then we shall take three simple rounds in left index finger. Then we shall mark it as no 1, 2 and 3. Then we shall take no 1 over no 2 and again no 2 over no 3 and lastly no 3 over no 1. Then we shall pull it tightly. The knot is prepared. Finally push the above portion of knot to the target organ for making it tight. If we want to be more secure then we can give one more simple knot. This knot can be used in tubal ligation, in appendectomy or where tubular structure and stump ligation.

Keywords: Extracorporeal, New knot, Dilip-Sarbani.

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INTRODUCTION

A knot is a method of fastening or securing linear material like rope by tying or interweaving. It may consist of a length of one or several segments of rope, string, chain strap interwoven such that the line can bind to itself or to some other object—the 'load'. Knots have been the subject of interest for their ancient origins, common uses and the area of mathematics known as knot theory.[1]

Knots are very important in the surgery. The history of knots is as old as and belongs to the era of when human beings first began making weapons for hunting.[2] Archaeological studies indicate that the art of tying knots, which has been most simply defined by the Chinese dictionary Shuo-Wen Chieh-Tzu as 'the joining of two cords', by the Chinese people has a legacy that extends back nearly 70,000 to 100,000 years. The knot was the basis for written and symbolic communication, a method of record keeping and a symbolic representation of meaningful historical events that occurred over time. For instance, events of importance were symbolized by tying of knots; the size or girth of the knot itself was reliant upon the importance of significance of the event being archived. Through the ages, the tying of knots has played an important role in the life of man.

Chinese knots are deeply entwined in folkloric tradition. It is evident that decorative knot work is ripe with symbolic meaning. There are currently 18 basic types of Chinese knots: Including the 'cross knot', 'ring hitch' and the 'Chinese lanyard knot' to name a few. Certain knots, such as the 'mystic knot' pattern with its seemingly endless and repetitive pattern evokes one of the fundamental truths of Buddhism and the cyclical nature of all existence. In essence, knot work serves to create an atmosphere of well-being, good luck and health, longevity and harmony. As gifts, they are emotional, sentimental, and are often keepsakes between lovers and friends.

It was the custom of Roman brides to wear a girdle tied with a square (reef) knot, which their husbands untied on their marriage night, as an omen of prolific offspring. Moreover, it was believed that wounds healed more rapidly when the bandages which bound them were tied with a square (reef) knot.

Most of the ancient civilized nations, as well as savage tribes, were accomplished rope makers. Because rope could have served few useful purposes unless it could be attached to objects by knots, man's conception of the rope and the knot must have occurred concomitantly. Knotted ropes played many important roles in the ancient world, being used in building bridges and in rigging ships. Because rope and knots have been two of man's most useful tools since the dawn of history.

In the first century of our common era, the Greek physician Heraklas wrote a brief essay on how to tie 16 knots and nooses for surgical and orthopedic purposes. It was found that seven of Heraklas' 16 knots and nooses were still applied surgically of late, and that four of these have even been recently rediscovered for such applications. The use of knots for basic purposes such as fastening, recording information and tying objects together is known for thousands of years. As the time progressed, people got to know the use of different knots for different tasks like climbing or sailing. Knots were also considered to have spiritual and religious symbolism in addition to their esthetic qualitie—the endless knot appears in Tibetan Buddhism. The rope manufacturing today is same as rope manufactured 2000 to 9000 years ago–with a twist to the left or right.[3] Catgut is made from the gut of animals and has been in use for many hundreds of years for tying knots. There are some examples of knots preserved that are up to 10,000 years old.

This mythology of knots may have contributed to some surgeon's perception of surgical knots more as an art form, than as a science. For those artisans, the use of methods and materials for suturing is usually a matter of habit,

guesswork or tradition. This approach to suturing has contributed to a growing concern that the knot construction employed by many surgeons is not optimal and that they use faulty technique in tying knots, which is the weakest link in a tied surgical suture. Important considerations in wound closure are the type of suture, the tying technique, and the configuration of the suture loops. When a knotted suture fails to perform its functions, the consequences may be disastrous. Massive bleeding may occur when the suture loop surrounding a vessel becomes untied or breaks. Wound dehiscence or incisional hernia may follow knot disruption. As with any master surgeon, he/she must understand the tools of his/her profession. The linkage between a surgeon and surgical equipment is a closed kinematic chain in which the surgeon's power is converted into finely coordinated movements that result in wound closure with the least possible scar and without infection. The ultimate goal of this linkage is the perfection of the surgical discipline.[4]

In general and laparoscopic surgery extracorporeal and intracorporeal knots has a very important role. Intracorporeal knots are difficult while extracorporeal knots are comparatively easy, as we make it outside. Most of the time we use extracorporeal knot as it is best for the operating surgeon and for the benefit of the procedure also. There are so many extracorporeal and intracorporeal knots. Despite recent advances in both suture welding and knotless anchor technology, knot tying will remain a necessary skill which the surgeon must master when performing suture anchor in laparoscopic surgery. There are an endless number of combinations of knots (sliding versus static, simple versus complex, etc.) and suture types (monofilament versus braided) to accomplish this task.

Common extracorporeal knots in general surgery are Reef knot, Granny knot, Square knot, Surgeons knot and in laparoscopic surgery Roeder's knot (Fig. 1), Meltzer knot (Fig. 2), Weston knot (see Fig. 1), Tumble square knot. Intracorporeal laparoscopic knots are Dundee-Jermin, Aberdin, Tumble square.

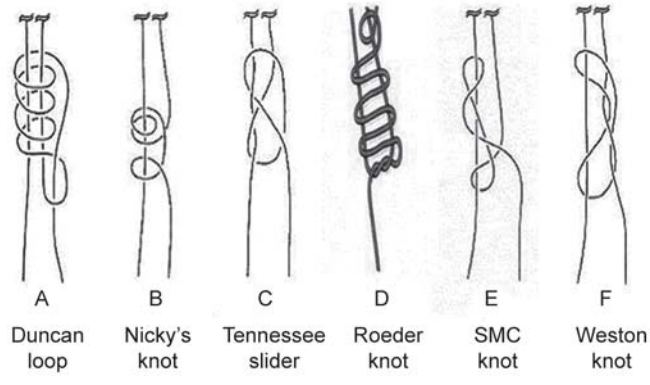

Fig. 1: Commonly used extracorporeal knot (Roeders knot, Weston knot)

Fig. 2: Meltzer knot

Keeping in mind about the knots and their importance in surgeries I am proposing the new knot with many advantages. The new knot is Dilip-Sarbani knot.

It is very simple and gentle knot. It takes very minimal time prepare. No multiple turn and round over suture to make it like in Roeder's, Meltzer's knot and Weston knot even Mishra's knot.

HOW TO MAKE?

We shall take at least 25 cm length suture material of vicryl or chromic catgut or prolene (Fig. 3). Then we should take three simple rounds in index finger of that suture material (Fig. 4). Then we should mark the three rounds as numbers 1, 2 and 3 imaginarily (Fig. 5). Then take no. 1 over no. 2 (Fig. 6) and then again no. 2 over no. 3 (Fig. 7) then again no. 3 over no. 1 (Fig. 8). Then we shall pull it tightly (Fig. 9). The knot is prepared (Fig. 10). Then we shall push the above portion of knot to make it tight. If we need a more secured knot then we can give one more simple knot.

USES OF DILIP-SARBANI KNOT

- It can be used in appendectomy, in tube ligation or anywhere, we want to ligate the stump.
- It is very simple, easy and more secure knot in appendectomy than Roeder's knot and Meltzer knot even Mishra's knot.
- In laparoscopy, we can take the knot through 5 mm port in to the abdominal cavity and with the use of Bhandarkar or Clark knot pusher we can tightly put the knot over the appendix.
- Instead of modified Pomeroy's technique for tube ligation, we can take a bite in mesosalpinx and can put the knot over the loop of the fallopian tube and tightly ligated and cut the loop of tube. In general and laparoscopic surgery, we can use this method.
- For the correction of retroverted uterus, we can tie the round ligament with this method which is more secured.
- During operation to secure the stump, we can use this knot, just after fixing it with some tissue.

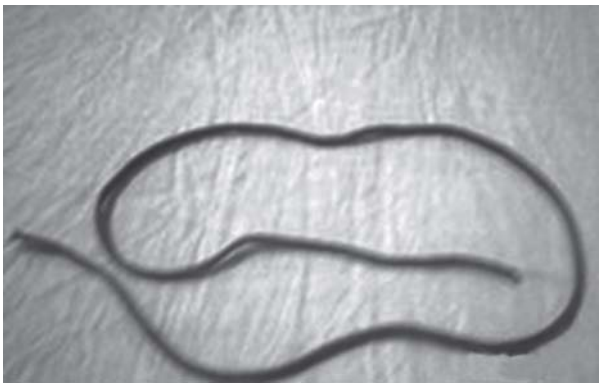

Fig. 3: Suture material

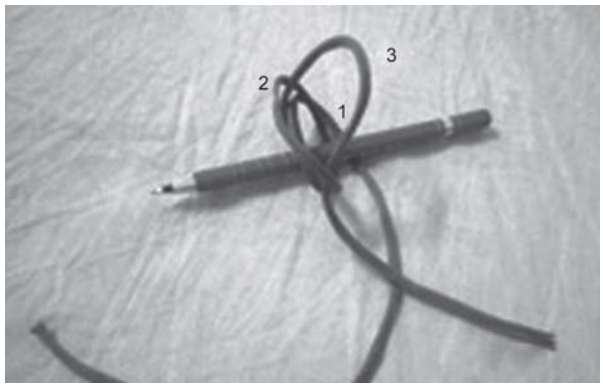

Fig. 7: Take no. 2 over no. 3

Fig. 4: Three simple round over index finger

Fig. 8: Take no. 3 over no. 1

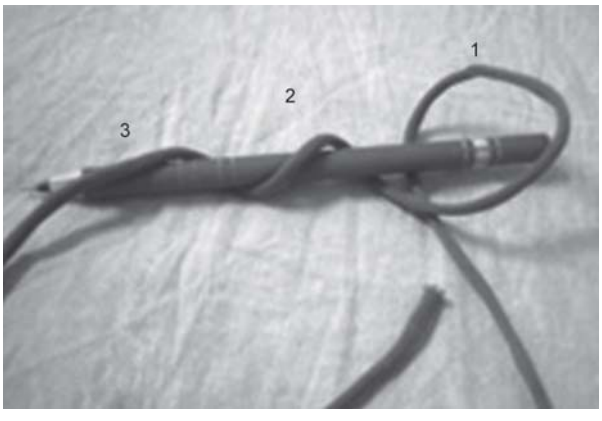

Fig. 5: Make imaginary no. 1, 2 and 3

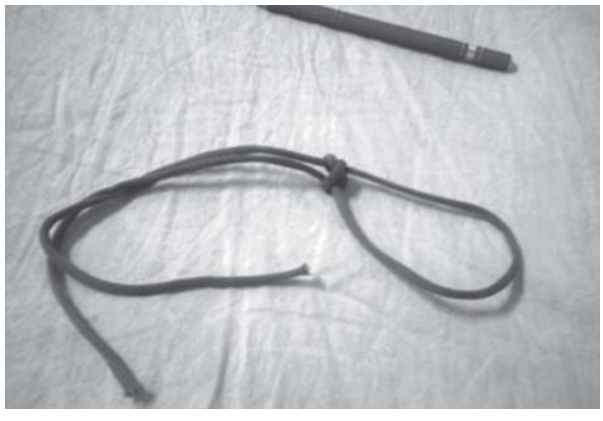

Fig. 9: Pull the knot tightly

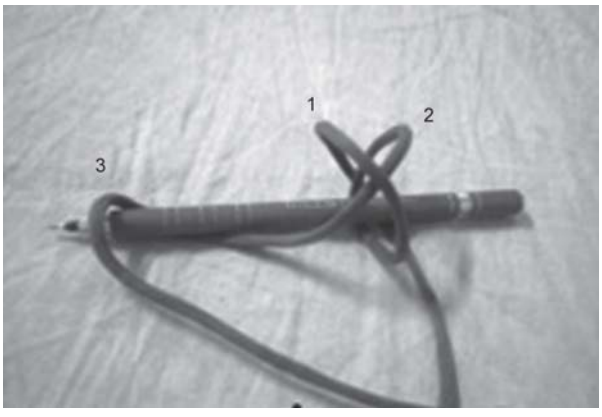

Fig. 6: Take no. 1 over no. 2

Fig. 10: Dilip-Sarbani knot

ADVANTAGES OF DILIP-SARBANI KNOT

- It is probably the simplest knot
- It takes the least possible time to make it
- It can be used in general and laparoscopic surgery
- It is a good hemostatic knot
- It is less complicated so that even a fresher can make it.

CONCLUSION

With above facts in mind it is concluded that Dilip- Sarabani knot will be a highly innovative, easy knot that can be used in general and laparoscopic surgeries. It will be of immense help to surgeons more so to the new people who are starting their profession. It is also my interest to evaluate the efficacy of this new extracorporeal knot which shall form future study aspect.

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REFERENCES

1. Knot. Wikipedia, free encyclopedia. Available from: http://en.wikipedia.org/wiki/Knot.
2. Available from: http://www.theropepeople.com/Indexn.htm.
3. Hage JJ. Heraklas on knots: Sixteen surgical nooses and knots from the first century AD. World J Surg 2008 Apr;32(4): 648-55.
4. Edlich RF, Long WB III. Surgical knot tying manual (3rd ed). Covidien 2008;2-3.

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REVIEW ARTICLE

Is there a Future for Robot-assisted Laparoscopic Nissen Fundoplication (RALF)...?

Kamal H Pushdary

ABSTRACT

Introduction: Gastroesophageal reflux disease (GERD) has been the main health concern in the last few years, both in term of quality of life and symptomatology and also causing long-term health concern like cancer. In our current practice laparoscopic Nissen fundoplication is the most commonly performed operative procedure for reflux disease.

Aim and methodology: We performed our review to predict the future of robot-assisted laparoscopic fundoplication (RALF) by looking at this new technology from different angles namely, comparison with conventional laparoscopic Nissen fundoplication (CLF), in term of operative complications and postoperative outcome, training aspect of RALF, application in complicated cases and difficult tasks, and also in pediatric population.

Conclusion: We are in the opinion that there is a promising future for RALF, despite the increased cost and longer operation time. It has been found that RALF can function better in smaller spaces and more capable in finer dissection and it has shorter and steeper learning curve. The time and the cost issue is expected to reduce with further development and upgrades of the robotic surgery, and increase in surgeons experience in RALF. Therefore, we think the trend should be more toward RALF as a future of antireflux surgery.

Keywords: Robotic surgery, Gastroesophageal reflux disease, Nissen fundoplication.

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INTRODUCTION

Gastroesophageal reflux disease (GERD) has long been recognized as a significant public health concern. It develops when the reflux of stomach contents causes troublesome symptoms and/or complications that affect individual's quality of life and well being.[18]

There is evidence that the prevalence of GERD has increased during the past 2 decades. If this trend continues, it could contribute to the rapidly increasing incidence of more serious complications associated with GERD, such as esophageal adenocarcinoma, as well as costs to health care systems and employers.[17]

From a surgical perspective, GERD is the failure of the antireflux barrier, allowing abnormal reflux of gastric contents into the esophagus. It is a mechanical disorder, which is caused by a defective lower esophageal sphincter (LES), a gastric emptying disorder, or failed esophageal peristalsis. These abnormalities result in a spectrum of disease ranging from symptoms only, such as 'heartburn', to esophageal tissue damage with or without subsequent complications including malignancy or airway disease. While the exact nature of the antireflux barrier is incompletely understood, the current view is that the LES, the diaphragmatic crura, and the phrenoesophageal ligament are key components.[18]

Management of the condition in term of diagnosis and treatment of the GERD has been the matter of debate. The extent of the investigation for the condition preoperatively vary depends on individual surgeons practice. For example, requirement for esophageal physiology and 24 hours pH check, are not routinely performed preoperatively by all surgeons. Patient's selection is also another example which has been the matter of expert's debate. Change of lifestyle and medical treatment, of course, is the initial step in the management. However, if the medical treatment is not feasible option any more, for variety of reasons for example, patients intolerance or partial response to PPI, in this case depend on the surgeons approach when to make the decision about operative option. Even after the operation been decided by the surgeon there are still controversy about different kind of techniques and the type of fundoplication needs to be performed depends on individual patients and the result of their preoperative investigation. It should also be noted that there are regional differences in expert opinion and practice in the choice of fundoplication type for GERD with most North American experts choosing a total fundoplication due to concerns for the long-term effectiveness of the procedure.[18]

AIM AND METHODOLOGY

Our aim is to predict the future of RALF, not only by comparing adult cases of RALF with conventional laparoscopic Nissen fundoplication (CLF); but we also reviewed pediatric papers. Other fields of gastrointestinal surgery like colorectal surgery, as well as learning curve of robotic surgery are also explored.

Literature search from variety of sources including PubMed, Google search engine, Medscape and SAGES

website were used for our review, majority of the studies were comparative studies.

The parameters taken in to account in the review were intraoperative outcome measures were: Operative time, blood loss and complications. Length of hospital stay, functional results and patient satisfaction were all used to compare postoperative outcome.[5,9,10,12,15]

We also reviewed few papers who reviewed robotic application in variety of gastrointestinal surgery, including colorectal and pediatric gastrointestinal surgery.[3,4,8,13,14] The other part was the training aspect of robotic surgery;[1,8,16] to predict the future of robot in gastrointestinal surgery especially in Nissen fundoplication. Our strategy is not just a confined review by only comparing adult cases of RALF with CLF but considering other aspects involved in the review like learning curve of robotic surgery, robot in difficult and complicated cases as well as pediatric fundoplication. I am in the opinion that this approach gives better understanding about the future of RALF.

RESULTS AND DISCUSSION

The articles reviewed were nine comparative papers with total adult 432 patients comparing RALF and CLF.

During our review we can state that majority of the articles agree in their result were comparable between RALF and CLF. The parameters reviewed were operative time, intraoperative difficulty, complication, length of the hospital stay, postoperative outcome, cost and last but not least is patient's satisfaction and quality of life.[2]

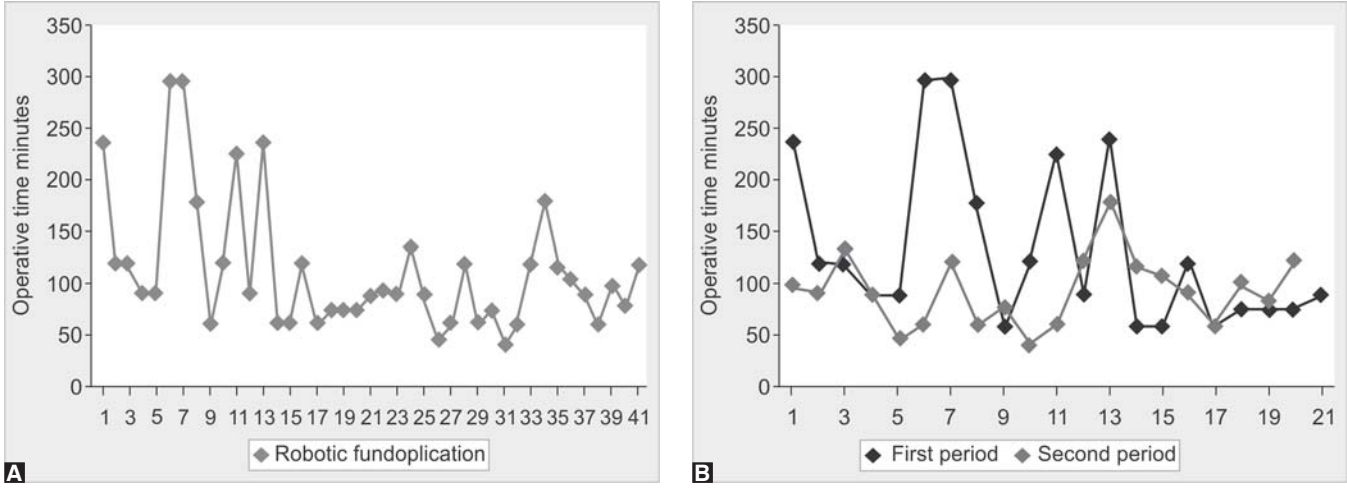
All the results agreed that all the operative and postoperative outcomes are comparable between two modalities however, the cost for RALF was higher ranging between 600 to 1800 Euros, depending on the center where the study was performed. The other disadvantage of robot was the operative time which was longer for robotic surgery.[2,4-7,9-11] On the other hand, a few studies agreed on the safety, increased precision and dexterity and the feel of haptic feed back with RALF.[4,7,9,11,13]

In one of the studies Nissen fundoplication was done in 49 cases (there were also two other types of fundoplication in this group). The mean operative time was 110 minutes (range: 40-300 minutes) for robotic fundoplication and 120 minutes (range: 60-280 minutes) for laparoscopic fundoplication. In the first period (n = 21 cases), the mean operative time was 132.8 minutes (median: 90 minutes) *vs* 92 minutes (median: 90 minutes) for the second period (n = 20 cases).[19] This indicates short learning curve and reduction in operative time when the surgeons become more familiar with robot (Graphs 1A and B).[19]

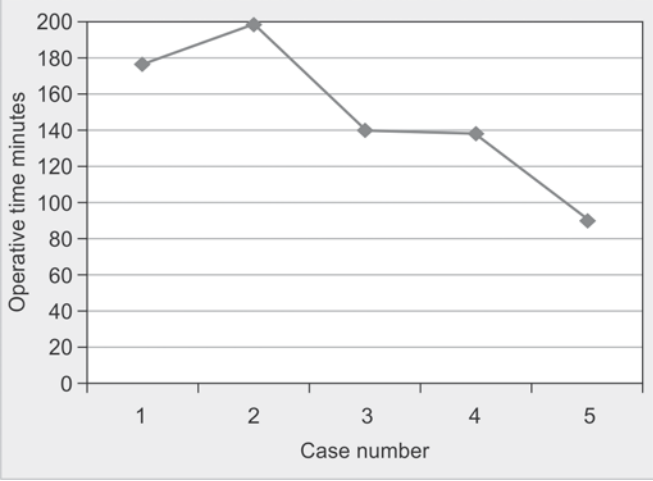
Four papers studied, where the robot applied for training purpose in fundoplication procedure. The outcome from their study reviewed and they all agreed in shorter and steeper learning curve with RALF (Graph 2) and decreasing operator workload.[1,8,16]

Three papers used and compared robot in performing robot in pediatric population. One of the papers quoted comparable operative time between RALF and CLF. However, the cost remained the main disadvantage of RALF. Again in pediatric population as in adult age group additional dexterity was quoted for robotic fundoplication and the advantage of the RALF in training in this age group and its application complicated cases.[3,8,14]

Finally, one paper studied in using robot in gastrointestinal surgery. They recruited 129 patients with abdominal procedures (six cases were Nissen fundoplication), they looked at indications, technique and results of the modern technology. Even though, the papers were



Graphs 1A and B: Robotic fundoplication. (A) Overall operative time. The line indicates the boundary between the first and second periods of experience. (B) Comparison of the operative times between the first period and the second period[19]



Graph 2: The rapid drop of the operative time after five cases of RALF performed by staff surgeons[6,8]

not specialized in investigating and comparing RALF with CLF, the conclusion was that robot had ability to operate in smaller operative, fine and precise dissection, like lymphadenectomy and nerve sparing procedures, and also intracorporeal suturing.[4]

CONCLUSION

From our broad spectrum review we came to the conclusion that the future for robot is bright and promising. The papers performed not specifically mentioned the difficult or complicated cases like Re-do Nissen fundoplication, in which more precise and meticulous dissection is required.

We also think that the centers with better experience and more wider performance of RALF procedure quoted shorter operative time. With regard to the cost there were some differences in the cost depending on when the study was performed, as this was possibly due to drop of the cost as the time progress. In addition, it is a well-known fact that further technological upgrades and development is inevitable in every discovery, which in turn lead to more affordable robotic machines and more practical and quicker setup time. The other argument in favor of cost cutting with RALF is the shorter learning curve.

From our conclusion we recommend that the disadvantage of higher cost and longer operative time at this stage should not function as an obstacle in front of RALF. For junior surgeons and residences RALF has a big place in their future. Furthermore, for senior surgeons we think that the Re-do Nissen fundoplication should be done routinely using RALF. Almost all the comparative studies stated the advantage of RALF in complicated cases; however, we do not have enough data to confirm this fact. Further, randomized clinical trials are required to compare RALF with CLF in Re-do Nissen fundoplication cases.

REFERENCES

1. Stefanidis D, Wang F, Korndorffer JR Jr, Dunne JB, Scott DJ. Robotic assistance intracorporeal suturing performance and safety in the operating room while decreasing operator workload. Surg Endosc 2010 Feb;24(2):377-82.
2. Ceccarelli G, Patriti A, Biancafarina A, Spaziani A, Bartoli A, Bellochi R, et al. Intraoperative and postoperative outcome of robot-assisted and traditional laparoscopic Nissen fundoplication. Eur Surg Res 2009;43(2):198-203.
3. Albassam AA, et al. Nissen fundoplication, robotic-assisted versus laparoscopic procedure: A comparative study in children. Eur J Pediatr Surg 2009 Oct;19(5):316-19.
4. Tomulescu V, Stãnciulea O, Bãlescu I, Vasile S, Tudor S, Gheorghe C, et al. First year experience of robotic-assisted laparoscopic surgery with 153 cases in a general surgery department: Indications, technique and results. Chirurgia (Bucur) 2009 Mar-Apr;104(2):141-50.
5. Müller-Stich BP, Reiter MA, Wente MN, Bintintan VV, Köninger J, Büchler MW, et al. Robot assisted versus Conventional laparoscopic fundoplication: Short-term outcome of a pilot randomized controlled trial. Surg Endosc 2007 Oct; 21(10):1800-05.
6. Müller-Stich BP, Reiter MA, Mehrabi A, Wente MN, Fischer L, Köninger J, et al. No relevant difference in quality of life and functional outcome at 12 months' follow-up-a randomised controlled trial comparing robot-assisted versus conventional laparoscopic Nissen fundoplication. Langenbecks Arch Surg 2009 May;394(3):441-46.
7. Hartmann J, Menenakos C, Ordemann J, Nocon M, Raue W, Braumann C. Long-term results of quality of life after standard laparoscopic vs robot-assisted laparoscopic fundoplications for gastro-oesophageal reflux disease. A comparative clinical trial. Int J Med Robot 2009 Mar;5(1):32-37.
8. Meehan JJ, Meehan TD, Sandler A. Robotic fundoplication in children: Resident teaching and a single institutional review of our first 50 patients. J Pediatr Surg 2007 Dec;42(12): 2022-25.
9. Heemskerk J, van Gemert WG, Greve JW, Bouvy ND. Robot assisted versus conventional laparoscopic Nissen fundoplication: A comparative retrospective study on costs and time consumption. Surg Laparosc Endosc Percutan Tech 2007 Feb; 17(1):1-4.
10. Draaisma WA, Ruurda JP, Scheffer RC, Simmermacher RK, Gooszen HG, Rijnhart-de Jong HG, et al. Randomized clinical trial of standard laparoscopic versus robot-assisted laparoscopic Nissen fundoplication for gastro-oesophageal reflux disease. Br J Surg 2006 Nov;93(11):1351-59.
11. Nakadi IE, Mélot C, Closset J, DeMoor V, Bétroune K, Feron P, et al. Evaluation of da Vinci Nissen fundoplication clinical results and cost minimization. World J Surg 2006 Jun;30(6): 1050-54.
12. Morino M, Pellegrino L, Giaccone C, Garrone C, Rebecchi F. Randomized clinical trial of robot-assisted versus laparoscopic Nissen fundoplication. Br J Surg 2006 May;93(5):553-58.
13. Stefanidis D, Korndorffer JR, Scott DJ. Robotic laparoscopic fundoplication. Curr Treat Options Gastroenterol 2005 Feb;8(1): 71-83.
14. Knight CG, Lorincz A, Gidell KM, Lelli J, Klein MD, Langenburg SE. Computer-assisted robot-enhanced laparoscopic fundoplication in children. J Pediatr Surg 2004 Jun;39(6):864-66.

15. Wright AS, Gould JC, Melvin WS. Computer-assisted robotic antireflux surgery. Minerva Gastroenterol Dietol 2004 Sep; 50(3):253-60.
16. Chitwood WR Jr, Nifong LW, Chapman WH, Felger JE, Bailey BM, Ballint T, et al. Robotic surgical training in an academic institution. Ann Surg 2001 Oct;234(4):475-84.
17. El-Serag HB. Time trends of gastroesophageal reflux disease: A systematic review. Clin Gastroenterol Hepatol 2007 Jan; 5(1):17-26.
18. Stefanidis D, Hope WW, Kohn GP, et al. SAGES: Guidelines for surgical treatment of gastroesophageal reflux disease. Surg Endosc 2010 Nov;24(11):2647-69.
19. Giulianotti PC, Coratti A, Angelini M, Sbrana F, Cecconi S, Balestracci T, et al. Robotics in general surgery: Personal experience in a large community hospital. Arch Surg 2003; 138(7):777-84.

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REVIEW ARTICLE

What Should be the Approach in the Long-term Management of Patients with Gastroesophageal Reflux Disease?

Mohamed Solih

ABSTRACT

Objective: The aim of this study is to review available treatment options and to review current opinions in the management of patients with chronic gastroesophageal reflux disease (GERD).

Materials and methods: This is a review article. Articles for the literature review were collected by using Google Search Scholar Engine. Literature search included relevant original and review articles addressing issues like medical treatment for GERD, surgical treatment for GERD, studies comparing surgical and medical treatment for GERD.

GERD is a common and chronic syndrome. Patients affected with syndrome experience symptoms which affect their quality of life.

The goals of treatment in this condition is to control symptoms, heal injured esophageal mucosa and to prevent complications. Both proton pump inhibitor (PPI) therapy and antireflux surgery are equally effective in controlling symptoms and in healing esophageal mucosal injury. In the recent years, laparoscopic surgery is increasingly been offered to patients with GERD. However, there is still controversy over best approach to management of GERD. This study attempted to review current opinions of this issue.

Conclusion: PPIs is an option for initial management of GERD. However, this condition been a chronic condition, relapse is common while on therapy with medications or following discontinuation of therapy. Hence, a treatment option which provides effective control of symptoms and prevents or minimizes complications has to be offered to patients. Medical therapy with PPI and laparoscopic antireflux surgery, both can achieve these therapeutic goals. Hence, in the light of this literature review it is recommended to individualize the treatment offered to the patient with GERD, in consultation with the patient himself or herself.

Keywords: Acid suppression therapy, Long-term safety of PPIs, Side-effects of PPIs, Surgical management of GERD, Clinical outcomes, PPIs *vs* laparoscopic fundoplication.

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INTRODUCTION

Montreal consensus defines gatroesophageal reflux disease (GERD) as 'a condition which develops when the reflux of stomach contents causes troublesome symptoms and/or complications'. Symptoms are considered to be 'troublesome' if they affect the individual's well being.[1] GERD is one of the most common upper gastrointestinal diseases in the Western countries and is reported to have a prevalence of 10 to 20%. GERD has been recognized as a clinical entity since 1930s.[2-5] From a surgical perspective GERD is viewed as a mechanical disorder resulting from failure of antireflux barrier between the esophagus and the stomach. However, the exact nature of the antireflux barrier is not well-established but the lower esophageal sphincter, the diaphragmatic crura and phrenoesophageal ligament are considered as crucial elements of the antireflux barrier. Failure of this barrier results in reflux of gastric contents into the esophagus. Mechanical causes of failure causing GERD include: Defective lower esophageal sphincter, gastric emptying disorder or failure of esophageal peristalsis. The result of failure of antireflux barrier ranges from symptoms like 'heartburn' to structural damage to esophagus with or without further complications.[6,7] GERD manifestations can be grouped into esophageal and extraesophageal syndromes. The esophageal syndromes include the typical reflux syndrome, the reflux chest pain syndrome and the syndromes with esophageal injury. The esophageal injury may range from reflux esophagitis; reflux esophageal stricture, Barrett's esophagus to esophageal adenocarcinoma, and the extraesophageal syndrome include chronic cough, asthma, otitis media and laryngitis. The extraesophageal manifestations are thought to be due to reflux of gastric contents into the respiratory tract.[8]

GERD is a chronic disease and, hence, the approach to its management aims at controlling the symptoms and to prevent relapse. Symptomatic relief and relapse control can be reasonably achieved with proton pump inhibitors (PPIs) and has been the main stay of treatment for GERD but this approach fails to correct the motor abnormalities of the upper gastrointestinal tract that are associated with GERD.[9] Alternative to PPI drug therapy is surgery. It was Nissen in 1951, who had first performed fundoplication and first laparoscopic fundoplication was reported in 1991 and the latter has rapidly replaced conventional Nissen fundoplication as the surgical therapy for GERD.[10] It is also been reported that laparoscopic fundoplication is increasingly been offered for GERD patients as an alternative to long-term medical management. This is

because various studies has shown that laparoscopic fundoplication is safe in experienced hands, is effective for symptomatic relief and controlling recurrence, improves quality life, reduce hospital stay and also, following laparoscopic fundoplication patients can return to work earlier as compared to conventional Nissen fundoplication.[11,12] In this review, an attempt will be made to compare the pros and cons of medical and surgical management of GERD based on the available literature and recommend a management approach for patient with GERD.

AVAILABLE TREATMENT OPTIONS FOR GERD

Nonsurgical Treatment Approaches

First-line treatment for GERD has been lifestyle modifications, supplemented by different medical formulations ranging from antacids to PPIs. Lifestyle and dietary modifications that appear to decrease gastric acid exposure of lower end of esophagus include; reducing dietary fat intake, reducing weight, cessation of smoking, elevation of the head end of the bed and avoiding recumbency for 3 hours postprandial.[13]

ACID SUPPRESSION THERAPY FOR GERD

Histamine 2 receptor antagonists (H2RAs) have been in use since 1970s, for symptomatic relief in the patients with GERD symptoms. H2RAs are effective in decreasing gastric acid secretion and have a longer duration of action compared to antacids. Drawbacks of H2RAs included relapse while on standard dose and also fails to heal severe esophagitis.[14,15]

Another group of drugs that emerged into the market for the management of GERD were the PPIs. This is regarded as the most effective drugs for gastric acid secretion suppression and they act by irreversibly binding to H^+K^+-ATPase, which is the final step in the gastric acid secretion.[15] Though PPIs are effective in healing duodenal ulcers, gastric ulcers and ulcerative and erosive GERD, there are differences in the effectiveness within the drugs in this class. Rabeprazole, which is a PPI, acts more rapidly on H^+K^+-ATPase to inhibit it compared to other PPIs. Another significant difference between rabeprazole and omeprazole is that, the former has a greater effect on intragastric pH after the first dose.[16] Several trials have compared H2RA and PPIs for their respective efficacy in gastroduodenal ulcer healing and also healing of ulcerative and erosive GERD. These studies have demonstrated the superiority of PPIs over H2RAs.[16] PPIs are more effective in controlling GERD symptoms in patients who have positive endoscopic finding like erosive or ulcerative esophagitis as compared to patients with nonerosive reflux disorder (NERD), but they are still superior compared to H2RAs. In patients with heartburn (NERD), PPI administration resolved symptoms only in 61% of the patients, which is approximately 20 to 30% lower effectiveness than that of patients with erosive esophagitis.[17,18]

Fourty percent of the patients diagnosed with GERD fail to respond to once daily PPI regimen and majority of these patients belong to the NERD group and functional heartburn. In this situation, experts generally recommend to switch over to twice daily dosing regimen, however, before escalating the dose of PPI, it is important to analysis and consider other potential causes for nonresponsiveness like, poor compliance, improper dosing schedules, residual reflux reduced bioavailability. Unless these factors are considered and addressed, simply increasing the dose of PPIs might not be effective.[19]

Treatment failures for PPIs occur both in GERD with positive and negative endoscopic findings. Failure rate is high in the subgroup; NERD. To address this issue researched was focused on novel approaches like 'reflux inhibition' rather than acid secretion suppression. One such approach is inhibition of transient lower esophageal sphincter relaxations (TLESRs). GABA type B receptor blockage is one of the mechanisms through which TLSERs could be modulated. Baclofen is a $GABA_B$ agonist and it may be considered in patients with positive esophageal impedance test for weakly acid reflux, as it reduces the rate of TLESRs. Baclofen is known to have frequent side effects and hence, it is recommended to start with a low dose and gradually increase as tolerated. Visceral pain modulators like trazodone (tricyclic antidepressant) and selective serotonin reuptake inhibitors when used in nonmood altering doses are useful in GERD patients who are found to have negative esophageal impedance monitoring. These drugs act in the central nervous system to produce visceral analgesia.[19,20]

Another group of drugs that has been used in conjunction with PPIs were prokinetic drugs. One representative drug from this group is cisapride, but it was withdrawn from the market because it is associated with fatal arrhythmias. Cispride is a selective agonist of 5-HT4 receptor and it could significantly reduce TLSERs during sleep and hence, used to be combined with PPIs for the treatment of nocturnal reflux. Newer 5-HT4 partial agonists are promising and in a recent study it was shown that tegaserod (selective 5-HT4 receptor partial agonist) reduced postprandial esophageal acid reflux episodes without an apparent effect on lower esophageal pressure.[19]

MAINTENANCE THERAPY

As noted earlier GERD is a chronic disorder and large proportion of GERD sufferers would require prolonged

maintenance therapy, in order to maintain a reasonable quality of life. Both endoscopy-positive and-negative GERD patients experience relapse. Studies have shown that PPIs are the most effective pharmaceutical agents in the management of GERD for maintenance therapy and they are effective in reverting esophageal inflammation and providing symptomatic relief.[21,22]

CONCERNS IN THE LONG-TERM USE OF PPIs

PPIs are not free from potential side effects, especially in prolonged use. Though risk of developing carcinoid tumors due to atrophic gastritis and or hypergastrinemia is remote but is a significant concern. Other problems associated with prolonged use of PPIs are the potential for development of clostridium difficile colitis and bacterial gastroenteritis.[23,24]

Other concerns that have been raised against long-term use of PPIs include; concerns regarding vitamin B_{12} absortion, interference with iron absorption and interference in calcium absorption. Increased risk of gastric and colon cancer is also another concern that has been raised against prolonged use of PPIs.[23]

Several studies have studied the association between vitamin B_{12} absorption and prolonged PPI use but they have failed to substantiate the claim that prolonged PPI use interferes with vitamin B_{12} absorption. On theoretical grounds it is assumed that prolonged use of PPIs can interfere with iron absorption and again the available data is not sufficient to conclude that prolonged PPI use could cause iron deficiency.[23]

Several studies have linked potential for development of osteoporosis and consequent increased risk for fractures in patients on long-term PPI. However, there are no sufficient grounds to recommend discontinuation of PPI therapy for patients on PPI with recommended dose for proper indications.[23]

Though, theoretically there is increased risk of developing gastric and colonic cancers in patients on long-term PPIs, this has not been validated in prospective randomized trials.[23]

SURGICAL TREATMENT FOR GERD

Open Antireflux Surgery

Open antireflux surgery was initiated in 1950s as a treatment for patients with hiatal hernia and was aimed at keeping the lower esophageal sphincter within the peritoneal cavity.[25] Subsequently with the recognition of low esophageal sphincter pressure as the cause of GERD, antireflux surgery was offered to patients with GERD to increase lower esophageal sphincter pressure. It was Nissen in 1956 who had introduced antireflux surgery following an incidental finding that a fundal patch performed to reinforce the esophageal suture line could also correct gastroesophageal reflux.[23] Later Belsyey and Toupet applied a modified fundal wrap where a partial wrap was performed for GERD. Over time the procedures has been refined and outcomes following the procedures in the immediate postoperative period and in the long-term has improved. With better understanding and insight into the pathogenesis of GERD, antireflux surgery aims at lengthening the intra-abdominal portion of lower esophageal sphincter and to prevent effacing of the lower esophageal sphincter that occurs as a consequence of postprandial stomach distension.[23]

The long-term clinical outcome of antireflux surgery is now well established and several studies have shown that there is over 90% reflux control in the long-term following Nissen fundoplication.[26] Following first documentation of successful laparoscopic cholecystectomy, minimally invasive surgery has revolutionized the way various surgical procedures are performed and laparoscopic fundoplication became a reality.

Laparoscopic Antireflux Surgery

It is Geagea from Canada and Dallenmagne from Belgium in 1991 who had first reported series of fundoplication for GERD.[23] Since, then laparoscopic fundoplication has become the procedure of choice for patients with GERD. It is also interesting to note that the threshold in offering surgery for patients with GERD has been lowered following the introduction of laparoscopic fundoplication. This is because of the advantages of minimally invasive surgery. Laparoscopic fundoplication is well-accepted both by the patients and the practitioners alike as it is a straightforward procedure and has an acceptable complication rate in the hands of surgeons experienced in the procedure. Though, laparoscopic fundoplication has been well-established as the procedure of choice for patients with GERD requiring surgical intervention,[27] new approaches are been explored for the management of the same. One such approach is endo-luminal surgery.

ENDOLUMINAL ANTIREFLUX PROCEDURES

Endoscopic approached like endoluminal gastroplication and another technique using a plicator device had been introduced in the recent past. Endoluminal gastroplication was the first endoscopic procedure to be proposed for the management of GERD.[28] A commercially available suturing system called EndoCinch was used for endoluminal gastroplication. This procedure was reported to be safe and found to be effective in 60% of patients with GERD. Though the procedure was reported to be safe and relatively effective

it failed to normalize the acid reflux and had some serious complications.

Plicator device mimics the effects of conventional antireflux surgery by recreating the antireflux barrier, restoring the angle of his and by forming a one-way gastroesopheageal valve.[29] This procedure is free from serious complications and is reasonably tolerated.

Another novel endoluminal technique is the endoluminal fundoplication technique. This is an improvement over plicator technique and in this technique the gastroesophageal valve is recreated from within the stomach through oral route. It is claimed that this technique creates a robust and durable gastroesophageal valve that helps in reconstructing the altered antireflux barrier in patients with GERD. There is an ongoing multicenter study in Europe to assess the long-term efficacy of the endoluminal fundoplication technique.[19]

ADVANTAGES AND DISADVANTAGES OF ANTIREFLUX SURGERY

Conventional Nissen fundoplication involves a complete fundal wrap and is associated with acceptable morbidity and mortality and has a success rate of 90% in the control of reflux in GERD patients who had undergone this surgery.[26] However, it is associated persistent dysphagia, inability to belch and vomit. Other problems like epigastric fullness, postprandial pain and bloating, temporary swallowing discomfort and intense flatus also has been reported. On the other hand Toupet fundoplication is a partial wrap and, hence, basal lower esophageal sphincter tone is significantly lower than in Nissen fundoplication following this procedure. This procedure is reported to normalize lower esophageal sphincter tone, without impairing the ability of the lower esophageal sphincter to relax on proper stimulation.[30] Toupet procedure used to be recommended for the patients with poor esophageal motility but randomized clinical trials fail to support this recommendation and certain modifications on Nissen procedure has minimized the side effects which used to follow Nissen fundoplication. Floppy Nissen with a short wrap is the preferred modification and it is reported to have a success rate of 90% with minimal morbidity and mortality.[31]

Patients with Barrets esophagus usually have severe reflux and antireflux surgery, have the potential to restore lower esophageal sphincter pressure and prevent gastroesophageal reflux. However, complete regression of intestinal metaplasia does not occur but some regression of Barret's epithelium is observed following antireflux surgery. It is also observed that progression to severe dysplasia or adenocarcinoma is also less compared to medical therapy in patients who had undergone antireflux surgery.[32]

Clinical outcome of laparoscopic fundoplication is excellent, but still need for redosurgery is relatively high and ranges from 4 to 13%. Some long-term follow-up of laparoscopic fundoplication patients has shown 90% symptom control 10 years after the surgery while only 10% had to resume medications. Patients with dysphagia after Nissen fundoplication sometimes require revision of surgery and convert to a Toupet procedure or dilatation. Persistant dysphagia, wrap disruption, incorrect wrap placement and slippage are other causes which require revision of surgery. Revision of surgery after initial fundoplication is technically demanding but experienced surgeons are able to reproduce results comparable to initial correct surgery.[33,34]

Studies comparing laparoscopic fundoplication with open surgery have demonstrated that laparoscopic fundoplication is as effective as open surgery in controlling symptoms of GERD. With the advantages of minimally invasive surgery and the procedures ability to effectively control GERD symptoms and improve quality of life even in patients with intractable GERD, laparoscopic fundoplication has replaced the open surgery in most of the centers world over.[19]

DISCUSSION

Open antireflux surgery is effective management option for patients with GERD affecting quality of life, but this option used to be offered to patients with chronic complicated reflux who fail to respond to medication and lifestyle modification. This is because open reflux surgery is a major invasive procedure and is associated with peroperative and postoperative major complications. However, with the introduction of laparoscopic fundoplication there is a tendency to offer surgery for less complicated GERD. There are several reasons for this trend. One of the main reasons for this is that now the surgeons performing this surgery are more experienced in this procedure and techniques of the procedure are more refined and they are able to reproduce constant and reliable results. Since, laparoscopic fundoplication is less invasive and postoperative morbidity is much less, it has become more acceptable to patients as well.

On the other hand, modern medical treatments like PPIs are equally effective in the long-term management of GERD, but there are concerns over their safety in prolonged use. Some of these concerns include; interference with vitamin B_{12} absorption, iron absorption and calcium. However, these concerns have not been proved in large scale randomized control trials. More serious issues raised against prolonged use of PPIs include the theoretical risk of developing gastric carcinoid and colonic malignancies.

Again these theoretical possibilities has not established in the clinical settings.

GERD is a chronic condition and just like any other chronic syndrome patients with GERD also require prolonged medication. The consensus on pathophysiology of GERD is breakdown of antireflux barrier in patients with GERD, and PPIs or other medications effective in controlling GERD symptoms fail to address this primary cause of the disease. This is a major criticism leveled against prolonged use of PPIs by proponents of surgery for GERD. In addition there are several large studies which has shown that the clinical outcome of laparoscopic antireflux surgery is more favorable than that of long-term PPI therapy. Other studies also have demonstrated that laparoscopic Nissen fundoplication provides better physiological control of reflux and improved quality of life.

As noted earlier, GERD is syndrome which represents nonerosive reflux disease and erosive and ulcerative gastroesophageal disease. Hence, there are studies which have challenged the superiority of antireflux surgery in the treatment of esophagitis. These studies have demonstrated that recurrence rate of esophagitis between antireflux surgery and PPI are equal and healing of esophagitis is also similar. Similarly, controversy exists in the management of Barretts esophagus. In this regard, earlier studies have shown laparoscopic antireflux surgery to be the choice for patients with Barrets esophagus, as it reconstructs the antireflux barrier, and following surgery regression of intestinal metaplasia has been observed and it also appeared to reduce the risk of adenocarcinoma. But a recent meta-analysis has failed substantiate such a protective effect against development of esophageal cancer in patients with Barretts esophagus following antireflux surgery.

Endoluminal procedures have been recently evolving in an interesting and promising less invasive procedures than laparoscopic antireflux surgery. However, significant data is lacking about these procedures and there are no studies that have compared the efficacy of these procedures with either antireflux surgery or with medical treatments.

CONCLUSION

GERD is a syndrome resulting from breakdown of antireflux barrier at the lower end of esophagus. This breakdown of antireflux barrier results in reflux of gastric contents into the esophagus. Mechanisms for the antireflux barrier breakdown are thought to be due to TLESRs and hiatus hernia.

PPIs is an option for initial management of GERD. However, this condition been a chronic condition, relapse is common while on therapy with medications or following discontinuation of therapy. Hence, a treatment option which provides effective control of symptoms and prevents or minimizes complications has to be offered to patients. Medical therapy with PPI and laparoscopic antireflux surgery, both can achieve these therapeutic goals. Hence, in the light of this literature review it is recommended to individualize the treatment offered to the patient with GERD, in consultation with the patient himself or herself.

REFERENCES

1. Kahrilas PJ, Shaheen NJ, Vaezi MF, Hiltz SW, Black E, Modlin IM, et al. American gastroenterological association medical position statement on the management of gastro-esophageal reflux disease. Gastroenterology 2008;135:1383-91.
2. Nebel OT, Fornes ME, Castell DO. Symptomatic gastro-esophageal reflux: Incidence and precipitating factors. Am J Dig Dis 1976;21(11):953-56.
3. DeMeester TR, Johnson LF, Joseph GJ, Toscano MS, A Hall AW, Skinner DB. Patterns of gastroesophageal reflux in health and disease. Annals Surg 1976;184(4):459-70.
4. Nandurkar S, Talley NJ. Epidemiology and natural history of reflux disease. Baillieres Best Pract Res Clin Gastroenterol 2000;14(5):743-57.
5. Hunt RH, Tytgat GH, Malfertheiner P, et al. Whistle summary: The slow rate of rapid progress. J Clin Gastroenterol 2007;41(6): 539-45.
6. Little AG. Mechanisms of action of antireflux surgery: Theory and fact. World J Surg 1992;16:320-25.
7. Ireland AC, Holloway RH, Toouli J, Dent J. Mechanisms underlying the antireflux action of fundoplication. Gut 1993;34: 303-08.
8. Vakil N. The frontiers of reflux disease. Dig Dis Sci 2006;51(11): 1887-95.
9. Lundell L. Acid suppression in the long-term treatment of peptic strictures in Barrett's oesophagus. Digestion 1992;51(suppl 1): 49-58.
10. Dallemagne B, Weerts JM, Jehaes C, Markiewicz S, Lombard R. Laparoscopic Nissen fundoplication: Preliminary report. Surg Laparosc Endosc 1991;1(3):138-43.
11. Watson DI, Jamieson GG. Antireflux surgery in the laparoscopic era. Br J Surg 1998;85:1173-84.
12. Carlson MA, Frantzides CT. Complications and results of primary minimally invasive antireflux procedures: A review of 10, 735 reported cases. J Am Coll Surg 2001;193:428-39.
13. Harvey RF, Hadley N, Gill TR, et al. Effects of sleeping with the bed-head raised and of ranitidine in patients with severe peptic oesophagitis. The Lancet 1987;2(8569):1200-03.
14. Harris RA, Kuppermann M, Richter JE. Proton pump inhibitors or histmine 2 receptor antagonists for the prevention of recurrences of erosive esophagitis: A cost effectiveness analysis. Am J Gastroenterol 92(12):2179-87.
15. Sachs G. Proton pump inhibitors and acid-related diseases. Pharmacotherapy 17(1):22-37.
16. Horn J. The proton-pump inhibitors: Similarities and differences. Clin Ther 22(2):266-80.
17. Venables TL, Newland RD, Patel AC, et al. Omeprazole 10 mg once daily, omeprazole 20 mg once daily or ranitidine 150 mg twice daily, evaluated as initial therapy for the relief of symptoms of gastroesophageal reflux disease in general practice. Scand J Gastroenterol 1997;32:965-73.

18. van Pinxteren B, Numans ME, Bonis PA, et al. Short-term treatment with proton pump inhibitors, H2- receptor antagonists and prokinetics for gastroesophageal reflux disease-like symptoms and endoscopy negative reflux disease. Cochrane Database Syst Rev 2006;3:CD002095.
19. Liakakos T, Karamanolis G, Patapis P, Misiakos E. Gatroeshophageal reflux disease: Medical or surgical treatment? Gastroenterol Res Prac 2009;10;1-15.
20. Fass F. Proton pump inhibitor failure—what are the therapeutic options? Am J Gastroenterol 2009;104: S33-38.
21. Lee ES, Lee S, et al. Comparison of risk factors and clinical responses to proton pump inhibitors in patients with erosive oesophagitis and nonerosive reflux disease. Aliment Pharmacol Ther 30(2):154-64.
22. Donnellan C, Sharma N, Preston C, Moayyedi P. Medical treatments for the maintenance therapy of reflux esophagitis and endoscopic negative reflux disease. Cochrane Database Sys Rev 2010;2:CD003245.
23. Ali T, Roberts DN, et al. Long-term safety concerns with proton pump inhibitors. Am J of Med 2009;122:896-903.
24. Targownik LE, Lix LM, et al. Use of proton pump inhibitors and risk of osteoporosis-related fratures. CMAJ 179(4):306-07.
25. Catarci M, Gentileschi P, et al. Evidence based appraisal of antireflux fundoplication. Annals Surg 239(3):325-37.
26. Lundell L, Attwood Ell C, et al. Comparing laparoscopic antireflux surgery with esomeprazole in the management of patients with chronic gastroesophageal reflux disease: A 3 years interim analysis of the LOTUS trial. GUT 2008;57:1207-13.
27. Dallemagne B. Laparoscopic fundoplication. Gastroesophageal Reflux Disease 2006;173-82.
28. Chadalavada R, Lin E, Sedghi S Smith. Comparative results of endoluminal gastroplasty and laparoscopic antireflux surgery for the treatment of GERD. Surg Endosc 18(2):261-65.
29. Chuttani R, Sud R, Sachdev G, et al. A novel endoscopic full-thickness plicator for the treatment of GERD: A pilot study. Gastrointest Endosc 58(5):452-512.
30. Hagedorn C, Lonroth H, Ruth M, Lundell L. Long-term efficacy of total (Nissen Rossetti) and posterior partial (Toupet) fundoplication: Results of a randomized clinical trial. J Gastrointest Surg 6(4):540-45.
31. Hunter JG, Swanstrom L, Waring JP. Dysphagia after laparoscopic antireflux surgery: The impact of operative technique. Annals Surg 1996;224(1):51-57.
32. Lundell L, Miettinen P, Myrvold HE, et al. Seven years follow-up of a randomized clinical trial comparing proton-pump inhibition with surgical therapy for reflux oesophagitis. Br J Surg 2007;94(2):198-203.
33. Dallemagne B, Weerts J, Markiewicz S, et al. Clinical results of laparoscopic fundoplication at 10 years after surgery. Surg Endosc 2006;20(1):159-65.
34. Zornig C, Strate U, Fibbe C, Emmermann A, Layer P. Nissen vs Toupet laparoscopic fundoplication: A prospective randomized study of 200 patients with and without preoperative esophageal motility disorders. Surg Endosc 2002;16(5):758-66.

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REVIEW ARTICLE

Comparing Laparoscopic and Laparotomy for the Surgical Management of Ectopic Pregnancy

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ABSTRACT

Ectopic pregnancy is the most common life-threatening emergency in early pregnancy. This complication results in not only fetal loss, but also causes significant maternal morbidity and mortality. A literature search was carried out using various search engines and the selected articles were analyzed on the outcomes, such as success of the surgery, operating time, intraoperative and postoperative complications, hospital stay, future fertility, convalescence and cost effectiveness. After having analyzed the same it can be concluded that laparoscopic surgery is safe, effective and economical when compared to open laparotomy as the surgical treatment for ectopic pregnancy, and that it should be considered as the gold standard method in managing ectopic pregnancies.

Keywords: Ectopic pregnancy, Laparoscopy, Laparotomy.

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INTRODUCTION

An ectopic pregnancy is a complication of pregnancy wherein the fertilized embryo gets implanted outside the uterine cavity.[1] A majority of ectopic pregnancies are found to be within the fallopian tube. The ampullary part of the fallopian tube has the highest incidence of ectopic pregnancies (80%), followed by the isthmus (12%), fimbrial (5%) and the cornual and interstitial part of the tube (2%).[2] An ectopic pregnancy is a medical emergency which is the currently the leading cause of maternal mortality in the first trimester of pregnancy.[3-5] During the 19th century surviving an ectopic pregnancy was bleak, but toward the turn of the 20th century, with advances in anesthesia, antibiotics, and blood transfusions mortality has reduced significantly.[1]

There are several treatment modalities for treating ectopic pregnancies, however if hemorrhage has already occurred, surgical intervention may be necessary. The preferred method of surgical management is to perform a salpingostomy or a salpingectomy. Dr John Bard, from New York, reported the first successful open surgical intervention to treat an ectopic pregnancy in 1759. Bruhart et al reported the first laparoscopic surgery for ectopic pregnancy in 1980.[6]

Innovations in the surgical field have now lead to the debate of which would be the preferred route for performing the surgery–laparoscopy *vs* laparotomy. Seeber stated that laparoscopic approach has become the preferred surgical method, and that a laparotomy should be reserved for patients that are hemodynamically unstable. Laparotomy may be preferable in the likely event of extensive pelvic adhesions where it is impossible to view the ectopic or in cases of nontubal, intra-abdominal ectopic gestation, where other pelvic structures could be involved.[7]

As a result of the continual debate, this topic was chosen to review the two methods and to analyze the preferred choice surgery.

OBJECTIVE

To compare the surgical outcomes of laparoscopic and laparotomy for the management of ectopic pregnancy.

MATERIALS AND METHODS

A literature search was performed using search engines such as Google, HighWire press and PubMed. The selected papers were analyzed on the basis of the outcomes of both laparoscopy and laparotomy in the management of ectopic pregnancy.

RESULTS

One of the earliest reported comparisons between laparoscopy and laparotomy for the surgical management of ectopic pregnancies was by Brumsted et al, at the University of Vermont. The study was a retrospective case control that involved 101 cases of ectopic pregnancy, conducted between 1982 and 1987. The study compared the difference in outcomes in patients managed by both methods. Twenty-five patients were treated by laparoscopy and 76 by laparotomy. There were no guidelines used while choosing a method of surgery but only the patients who were hemodynamically unstable were treated by laparotomy. The author concluded the study with the results that patients treated by laparoscopic surgery required less operating time, decreased requirement for analgesics, shorter hospitalization and early convalescence (Table 1).[8]

Vermesh et al conceived a prospective study where the factors considered were morbidity, cost of the surgery, postoperative hospital stay and outcome of fertility following linear salpingostomy by laparoscopy *vs* laparotomy. The inclusion criteria included stable vital signs, hematocrit more than 30%, age over 18 years, and those

that wished salvage their fertility. All patients underwent a diagnostic laparoscopy first. Sixty patients with unruptured ectopic pregnancies of 5 cm or less were randomized equally to both laparoscopy and laparotomy. The beta-hCG levels in both groups were comparable. It was seen that there was lesser blood loss in those who had undergone laparoscopic salpingostomy, though unfortunately two patients in the laparoscopy group required laparotomy postoperatively. A hysterosalpingogram confirmed tubal patency (84% of the laparoscopy and 89% of the laparotomy). Six months following surgery, 56% of the patients that had undergone laparoscopy and 58% of those that had undergone laparotomy conceived spontaneously (Table 2).[9]

A trial conducted in Kuwait, by El-Tabbakh, from March 1999 to October 2001, involving 207 patients to compare the surgical outcome of laparoscopy *vs* laparotomy for surgical treatment of ectopic pregnancy. A total of 184 patients were treated by laparoscopy and 23 by laparotomy of the 207 patients that had been diagnosed with ectopic pregnancy based on clinical symptoms, history, physical examination, positive serum beta-hCG, transvaginal ultrasonography and ectopic pregnancy conformed at laparoscopy. Postoperatively, the patients were followed up with serial serum beta-hCG on days 4 and 7, there after weekly until levels less than 20 IU/l were obtained. Those patients treated with laparoscopy had an overall success rate of 98.9% with a significant lesser blood loss. Though, 23% of the patients that had undergone open surgery required blood transfusion, only 13% required it in the laparoscopically treated group. In this study all the patients had the ectopic pregnancy confirmed by laparoscopy and then the decision to proceed with operative laparoscopy or laparotomy depended on the minimally invasive surgery experience of the on call surgeon. No intraoperative complications were reported and the duration of surgery ranged from 1 hour to 72 minutes for both groups. The author thus concluded that laparoscopic surgery offered benefits superior to laparotomy with lesser blood loss. The patients experienced minimal pain and therefore decreased need for analgesia, short duration of hospital stay and early recovery (Table 3).[10]

Another study, conducted by Xiang in China, that consisted of 142 patients compared the resulted of laparoscopic surgery and laparotomy in the management of ectopic pregnancy. Seventy patients were treated by the conventional laparotomy and the remaining 72 by laparoscopy. It was found that of the patients who were treated laparoscopically the operating time and the postoperative hospital stay was significantly reduced. This method of treatment was also found to be more convenient to both the surgeons as well as the patients.[11]

The results of a clinical trial, conducted between 1987 and 1989 at Sahlgrenska University Hospital in Goteborg, Sweden, were evaluated by the Mayo Clinic. The results deduced by Mayo stated that the results of both surgeries were the same but at a much lower cost.[12]

Clasen et al, conducted a Belgian study, involving 293 cases, where they adhered to only laparoscopic management and the results favored a laparoscopic approach. Unfortunately, eight laparotomies had to be performed due to intense hemorrhage and advanced gestation. Of the eight laparotomies performed, three were primary and five were converted from laparoscopy. A total of 14 cases, remained with residual disease and were treated either by methotrexate or a second surgical procedure. This study evaluated that the overall rate of spontaneous conception was 77.3% and there was a 10.6% recurrence rate of ectopic pregnancy. The author concluded that laparoscopy approach should remain the gold standard in treating ectopic pregnancy.[13]

A similar study was conducted by Murphy et al at the San Diego School of Medicine. Here the author ran a prospective study, wherein they compared laparoscopy and laparotomy in the management of hemodynamically stable patients. A total of 63 patients were included in the study of which 26 underwent laparoscopy and 37 underwent laparotomy. The results reported have been summarized in the Table 4.[14]

The study also stated that there was no statistical difference in the rate of subsequent intrauterine pregnancies or ectopic pregnancies. The author has concluded that in a university-based residency program, operative laparoscopy

Table 1: Summarizing the results of the Brumsted et al study

	Laparoscopy (n = 25)	*Laparotomy (n = 76)*
Operating time	Reduced	Relatively longer
Analgesics	Decreased requirement	More requirement
Hospital stay	Short duration	Longer duration

Table 2: Summarizing the results of the Vermesh et al study

	Laparoscopy	*Laparotomy*
Blood loss	Reduced	Relatively more
Positive tubal patency	84%	89%
Pregnancy	56%	58%

Table 3: Summarizing the results of the El-Tabbhak study

	Laparoscopy (n = 184)	*Laparotomy (n = 23)*
Operating time	66-72 mins	66-72 mins
Blood loss	13%	23%
Hospital stay	Short duration	Longer duration

Table 4: Summarizing the results of the Murphy et al study

	Laparoscopy (n = 26)	*Laparotomy (n = 37)*
Operating time	Comparable	Comparable
Blood loss	Significantly reduced	Significantly more
Hospital stay	Short duration	Longer duration
Analgesic requirement	Less	More
Total hospital cost	Less	More
Return to normal activity	Early recovery	Late recovery

is a safe alternative for the management of appropriately selected patients with suspected ectopic pregnancy.[14]

The Department of Gynaecology and Obstetrics, E. Wolfson Medical Center, Israel, designed a parallel study but on hemodynamically unstable patients. One hundred and one women with ectopic pregnancy underwent laparoscopic surgery. Of which 18 had substantial intra-abdominal bleeding and clinical signs and symptoms of hemodynamic instability. These patients underwent laparoscopic salpingectomy and only one required conversion to laparotomy. There were no major intraoperative or postoperative complications, and all the women made a full and uneventful recovery. The study was concluded with the statement that improved anesthesia and cardiovascular monitoring, combined with advanced laparoscopic surgical skills and experience, justifies operative laparoscopy for the surgical treatment of ectopic pregnancy even in women that are hemodynamically unstable.[15]

A French institute conducted a study where 100 ectopic pregnancies were operated on by laparoscopy. The different techniques used included salpingostomy, salpingectomy and tubal expression. There were no intraoperative complications. Though on the fourth postoperative day, one patient underwent a laparotomy due to an occlusive syndrome. Six failures, in cases of conservative treatment were observed including three after tubal expression. The length of operation and hospitalization is similar with regard to the different endoscopic procedures, and shorter than those observed after treatment by laparotomy. These results confirm that laparoscopic treatment of ectopic pregnancies is not only reliable but also significantly less expensive than treatment by means of classical surgery.[16]

A study by Zouves et al analyzed the intraoperative morbidity, postoperative course, postoperative hospital stay and fertility outcome in 216 consecutive tubal pregnancies treated with either laparoscopy or laparotomy. Among the 98 cases treated with laparoscopy, the procedure was successfully completed in 95 (97%). In three cases laparotomy had to be performed to conclude the procedure. The study concludes that laparoscopic treatment of tubal pregnancy was seen to be a safe and effective alternative to laparotomy, yielding similar fertility outcomes and requiring significantly less postoperative analgesia and a significantly shorter hospital stay.[17]

With the introduction of laparoscopic services to the Obstetrics and Gynecology Department at South Cleveland Hospital, the department decided to review their management of ectopic pregnancies. A retrospective analysis of 210 cases of ectopic pregnancy managed over a period of 5 years, including the operative findings and surgical data were analyzed. All the patients with an ectopic pregnancy were treated surgically. One hundred and seventy-seven patients were managed successfully by laparoscopy, with no major intraoperative or postoperative complications. Thirty-three women were managed by laparotomy for various reasons. Of these 22.9% achieved a successful pregnancy and delivery. The estimated blood loss, the need for blood transfusion and the length of hospital stay following laparoscopic treatment were significantly less than those in laparotomy group. This study demonstrated that laparoscopic management of ectopic pregnancy is the most beneficial procedure with maximum safety.[18]

DISCUSSION

A large number of studies have been published on the management of ectopic pregnancy. They range from case reports to randomized trials, from conservative management to radical surgery. Though now it is accepted that laparoscopy should be the gold standard for the surgical treatment of ectopic pregnancies unless absolutely contraindicated.

- *Success of the surgery:* Clasen et al performed only laparoscopic approach to 194 cases of ectopic pregnancy resulting in a 97.4% success rate.[13] Other series of studies also confirm the success rate of operative laparoscopic surgery in ectopic pregnancy between 87 to 97%.[16-18] Some authors had performed operative laparoscopic even in hemodynamically unstable patients with good success rate.[14]
- *Operative time:* Gray et al conducted a randomized, prospective clinical trial to compare the efficacy of laparoscopic surgery over conventional surgical methods. Laparoscopic surgery took less time while compared to those that underwent laparotomy.[12] In fact, it actually saves time, as during a laparotomy, opening the abdomen to gain access to correct site of the affected tube takes up operating time. Other studies have supported this fact.[16,17,19]
- *Intraoperative and postoperative complications:* The study conducted by Chatwani et al stated a statically

significant decrease in the operative blood transfusion rate in those who underwent laparoscopy. Similar were the results in several other studies.[9,10,14,18] These articles have also showed that postoperatively the requirement for analgesics was significantly less.[8,14]

- *Hospital stay:* All the studies here have reported a much shorter hospital stay following laparoscopic surgery and there for proves to be cost effective.[8-11,14,17,18]
- *Fertility outcome:* The concern for future fertility poses a debate as there is a certain amount of damage to the lumen. But both methods of surgery have had comparable pregnancy outcomes.[9,13,14,18]
- *Convalescence:* Minimal access surgery has lead to a better quality of life in term of shorter hospital stay, faster recovery, decreased need for analgesics and cosmetically better scar.[10,14,15]

CONCLUSION

After critiquing several articles published over the past few years, the overview of literature confirms that minimally access surgery is safe, effective and economical when compared to open laparotomy as the surgical treatment for ectopic pregnancy. It should be considered as the gold standard method in managing ectopic pregnancies.

REFERENCES

1. Page EW, Villee CA, Villee DB. Human reproduction (2nd ed). Philadelphia: WB Saunders 1976;211.
2. Speroff L, Glass RH, Kase NG. Clinical gynecological endocrinology and infertility (6th ed). Lippincott Williams Wilkins 1999;1149ff.
3. Centres for diseases control (CDC). Ectopic pregnancy-United States, 1988-1989. MMWR 1992;41:591-94.
4. Centres for disease control (CDC). Ectopic pregnancy-United States, 1990-1992. MMWR 1995;44:46-48.
5. Why women die: Report on confidential enquiries into maternal deaths in the United Kingdom 1994-1996. Norwich: Stationery Office, 1998.
6. Burhart MA, Mahens H, Magee E, Poultry JL. Treatment of ectopic pregnancy by means of laparoscopy. Fertil Strile 1980; 33:411-14.
7. Seeber BE, Barmhart KT. Suspected Ectopic Pregnancy. Obstet Gynecol 2006;107:399-413.
8. Brumsted J, Kessler E, Gibon E, et al. A comparison of laparoscopy and laparotomy for the treatment of ectopic pregnancy. Obstet Gynecol 1988;71:889-902.
9. Vermesh M, Silva PD, Rosen GF, et al. Management of unruptured ectopic gestation by linear salpingectomy a prospective randomized clinical trial of laparoscopy versus laparotomy. Obstet Gynecol 1989:73:400-04.
10. El-Tabbakh MN, Elsays MS. Tubal ectopic pregnancy: Laparoscopy vs Laparotomy. Available from: www.Obgyn.Net/Pregnancy-Birth/Page/Pb/Articles/El-Tabbakh-Tubel-Ectopic.
11. Xiang XD, Tane YQ, Mao JFA. Comparison of laparoscopic surgery and laparotomy in the treatment of ectopic pregnancy. Singapore Med J 1999 Feb;40(2):88-90.
12. Gray DT, Thorburn J, Lundorf P, et al. A cost effective study of a randomized trial of laparoscopy versus laparotomy. Lancet 1995 May 6;345(8958):1139-43.
13. Clasen K, Camus M, Tournaye H, et al. Ectopic pregnancy: Let's cut ! Strict laparoscopic approach to 194 consecutive cases and review of literature and alternatives. Human Reproduction 1997;12(3);596-601.
14. Murphy AA, Nager CW, Wujek JJ, Kettel LM, Torp VA, Chin HG. Operative laparoscopy versus laparotomy for the management of ectopic pregnancy: A prospective trial. Fertil Steril 1992 Jun;57(6):1180-85.
15. Sagiv R, Debby A, Sadan O, Malinger G, Glezerman M, Golan A. Laparoscopic surgery for extrauterine pregnancy in hemodynamically unstable patients. J Am Assoc Gynecol Laparosc 2001 Nov;8(4):529-32.
16. Chapron C, Querleu D, Crepin G. Laparoscopic treatment of ectopic pregnancies: A one hundred cases study. Eur J Obstet Gynecol Reprod Biol 1991 Oct 8;41(3):187-90.
17. Zouves C, Urman B, Gomel V. Laparoscopic surgical treatment of tubal pregnancy. A sage, effective alternative to laparotomy. J Reprod Med 1992 Mar;37(3):205-09.
18. Mohamed H, Maiti S, Phillips G. Laparoscopic management of ectopic pregnancy: A 5-year experience. J Obstet Gynaecol 2002 Jul;22(4):411-14.
19. Chatwani A, Yazigi R, Amin-Hanjani S. Operative laparoscopy in the management of tubal ectopic pregnancy. J Laparoendosc Surg 1992 Dec;2(6):319-24.

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REVIEW ARTICLE

A Review of Medical Education in Minimally Invasive Surgery

Shamanique Shamona Bodie

ABSTRACT

The benefits of minimally invasive surgery have been well documented. The use of minimally invasive surgery has also been increasing in many specialties including gynecology. Medical education has a traditional motto which has been; see one, do one, teach one. However, with laparoscopy and robotics this paradigm may not be the best case for the practitioner or the patient especially with the increasing attempt to minimize the footprint of surgical education. With this in mind, we have to learn how to best educate future minimally invasive surgeons, particularly laparoscopic and robotic surgeons. The present study provides a review of similarities and differences in the medical education of laparoscopy and robotic surgery. This article also highlights the deficiencies and future work required to advance laparoscopic and robotic surgical training.

Keywords: Laparoscopic training, Robotic training, Robotic surgery, Laparoscopic surgery, Robotic surgical education, Laparoscopic surgical education, Robotic learning curve, Laparoscopy learning curve.

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INTRODUCTION

Based on World Health Organization (WHO) data from 29% of participating countries it is estimated that 234.2 million major surgical procedures are undertaken every year worldwide.[1] The hysterectomy is the most commonly performed gynecologic surgery, with an estimated 600,000 performed each year.[2] Minimally invasive surgical techniques currently make up a minority of the procedure; however, they are becoming increasingly common in many surgical specialties' including gynecologic surgery. Each minimal invasive system (robotics and laparoscopy) have documented benefits over traditional open surgery including less postoperative pain, shorter hospital stays, faster return to normal activities, and decreased blood loss and adhesion formation which make them attractive modalities for surgeons to incorporate in their repertoire.[3,4] However, laparoscopy and robotic surgery can be challenging to learn, to train surgeons in and to validate the educational process. The learning curve for many procedures has been documented and studied including the curve for robotic and laparoscopic surgery.[5-8]

Moreover, as the transition is made from conventional open to laparoscopy and robotic surgery, areas including learning these skills, assessment of proficiency in these areas and structured training for surgeons in practice and training is important.[9] Understanding how these surgical techniques are learned and how such learning can be best assessed will enable us to develop protocols for training and set standards for competence and proficiency. As laparoscopic has in use longer than robotic surgery, information on how to proceed with robotic training may be gained from reviewing the strides in laparoscopic education.

AIM

The aim of this article is to review the medical education involved in developing minimal access surgeons specifically laparoscopists and robotic surgeons. This review looks at some similarities and current differences in medical education.

MATERIALS AND METHODS

An electronic literature search was performed, restricted to the English language, of PubMed®, MEDLINE® and search engines, such as Google. Studies that were eligible for review included surgical skills training in postgraduate surgical trainees to capture studies reviewing the educational requirements of laparoscopic and robotic surgery education and training. The Google search engine, MEDLINE® and PubMed® databases were systematically searched until November 2012. References from retrieved articles were reviewed to broaden the search.

RESULTS

Laparoscopy

Laparoscopy was introduced into gynecology in the United States in the late 1960s and slowly advanced from a diagnostic procedure. In the early 1970s, Professor Kurt Semm of Germany expanded the therapeutic applications of laparoscopy by performing oophorectomies, appendectomies, myomectomies, and extensive adhesiolysis. However, other gynecologists did not immediately see the utility until the mid to late 70s. The early efforts were the ground work for later advanced laparoscopic operations.[10,11] Besides the lack of a larger incision as in conventional

surgery, there are other benefits. Standard endoscopic instruments offer a magnified view, haptic feedback. However, there is monocular vision with some depth clues, only 4º of freedom, and reduced operative dexterity and tremor amplification.[12]

Robotics

The da Vinci (Intuitive Surgical, Inc., Sunnyvale, CA) surgical system is being used by surgeons across several surgical specialties. The da Vinci Robotic System is FDA-approved for surgical robotics, consists of three components: A surgeon console, the InSite vision system (which provides three-dimensional (3D) stereoscopic imaging), a patient-side cart with EndoWrist instruments, and either 3 or 4 robotic arms.

The console includes a stereoscopic viewer with an infrared sensor and hand and foot controls that allow the surgeon to control positioning and focus of the camera and activation of monopolar or bipolar energy sources. The vision system creates a 3D image, as the endoscope is composed of two parallel 5 mm telescopes with 0° or 30° lenses. The image is magnified 10 to 15 times. The laparoscopic surgical instruments articulate in 7° of freedom and 90° of articulation, allowing movements that imitate the surgeon's hand. They also decrease tremors and motion artifact. Laparoscopic instruments include energy sources such as monopolar and bipolar cautery, the Harmonic ACE, the PK dissecting forceps, and laser. Graspers, needle drivers, retractors and specialized instruments are also designed for the robotic arms.

The robotic interface is different not only to open surgery, but also to laparoscopy because it involves remote surgical control, stereoscopic vision and lack of haptic feedback. However, in summary, advanced surgical robotic systems offer precise instrument articulation, a magnified 3D visualization, camera stabilization and direct control, tremor filtration, motion scaling and improved ergonomics.[13,14]

EDUCATION IN LAPAROSCOPY AND ROBOTICS

Medical Education

Nine fundamental manipulations of tissues by surgical instruments that surgeons must learn are [both visual and haptic (touch)], aspiration/injection, incision, excision, extraction, evacuation, purposeful injury, closure and implantation/transplantation.[15,16] Learning curve and surgical dexterity are two measurement tools that are used to compare surgical learning and training. Medical education usually uses skill training and various exercises to decrease the learning curve and improve surgical dexterity. Comparing surgical skill acquisition and proficiency using conventional laparoscopy and robotic interfaces may help improve the education in these areas.

Laparoscopic education has been an important part of surgical education for the last two decades. So much so, starting in 2008 United States, The Accreditation Council for Graduate Medical Education (ACGME) changed the requirements for laparoscopic cases for surgical graduates. Moreover, the Fundamentals of Laparoscopic Surgery program that was introduced over a decade ago as a method of measuring competency with laparoscopic techniques is a mandatory component of laparoscopic education.[17]

Computer technology including virtual reality simulators offers an adjunct for surgical training. Having the ability to teach psychomotor skills, they help the progression along the learning curve for this rapidly developing surgical technique within a safe training environment. Hence, basic- and intermediate-level minimally invasive surgical maneuvers can be learned and practiced by trainees and instructors using computer-based virtual environments, and performances can be assessed objectively before trainees proceed to patients in the OR.[18-20]

Training centers and training programs are readily available in the area of laparoscopy, making the training of future surgeons possible. Education costs are manageable. Although not necessary it is also possible to the theater staff trained in laparoscopy.[21-23]

Education in Robotic Surgery

A fast learning curve to a competent level using the da Vinci system is possible helped by the system's intuitive motion. Motion analysis is a useful tool to measure performance in the da Vinci system compared to OSATS and time alone.[24]

Currently, on the market, five different robotic surgery simulation platforms are available. One meta-analysis looked at 11 studies that sought opinion and compared performance between two different groups; 'expert' and 'novice'. Experts ranged in experience from 21-2, 200 robotic cases. The novice groups consisted of participants with no prior experience on a robotic platform and were often medical students or junior doctors.

The Mimic dV-Trainer®, ProMIS®, SimSurgery Educational Platform® (SEP) and Intuitive systems have shown face, content and construct validity. The Robotic Surgical Simulator™ system has only been face and content validated. All of the simulators except SEP have shown educational impact. Feasibility and cost-effectiveness of simulation systems was not evaluated in any trial. Virtual reality simulators were shown to be effective training tools for junior trainees.[25]

DISCUSSION

Although these systems (laparoscopy and robotics) may seem to be inherently different they share some similarities. They are both newer areas of surgery than conventional surgery. Moreover, they are growing areas of surgery with more and more surgeons desiring to be educated in these modalities. Medical education in laparoscopy and robotics are both areas of current interest.

Several studies agree that simulation training used as an adjunct to traditional training methods to equip the next generation of laparoscopic and robotic surgeons with the skills required to operate proficiently and safely. Several valid and reliable monitoring tools for laparoscopic surgical training have been implemented successfully into various surgical training programs.

The development of laparoscopy has been driven by the surgeons; whereas robotic education is currently industry driven. Curriculum for laparoscopy has been developed and is being implemented in many surgical training programs. However, current simulation models have only been validated in small studies. There is no evidence to suggest one type of simulator provides more effective training than any other.

In robotics, simulation has been validated for certain aspects of education. However, more research is needed to validate simulated environments further and investigate the effectiveness of animal and cadaveric training in robotic surgery. However, the effectiveness of animal and cadaveric workshops has been validated in laparoscopy. Some of the current limitations in robotic surgical education include the cost, the availability of training centers, and the need to educate the operating room nursing staff.

CONCLUSION

There are many similarities between the education in laparoscopy and robotic surgery including the need for medical education, the need for continued development of curriculum and the need for continued advancement in technologies. Given the known benefits of these surgical modalities, there is continued need for research and advancing training programs in laparoscopy and training in robotic surgery and programs for safe and effective integration of these modalities into the surgical subspecialties.

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REFERENCES

1. Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, et al. An estimation of the global volume of surgery: A modeling strategy based on available data. The Lancet 2008 Jul;372(9633):139-44.
2. Keshavarz H, Hillis SD, Kieke BA, Marchbanks PA. Hysterectomy Surveillance—United States, 1994-1999. MMWR 2002 Jul;51(SS05):1-8. Available from: http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5105a1.htm.
3. Catenacci M, Flyckt RL, Falcone T. Robotics in reproductive surgery: Strengths and limitations. Placenta 2011 Sep;32(3): S232-37.
4. Chapron C, Fauconnier A, Goffinet F, Bréart G, Dubuisson JB. Laparoscopic surgery is not inherently dangerous for patients presenting with benign gynaecologic pathology. Results of a meta-analysis. Hum Reprod 2002;17(5):1334-42.
5. Kaul S, Shah NL, Menon M. Learning curve using robotic surgery. Current Urol Rep 2006 Mar;7(2):125-29.
6. Zerey M, Adrales GL, Kercher KW. Learning curve in laparoscopic surgery. Minimally invasive surgery training: Theories, models, outcomes. A National Institute of Health and National Library of Medicine.
7. Raja R, Mishra RK. The impact of the learning curve in laparoscopic surgery. Available from: http://www.laparoscopyhospital.com.
8. Lenihan J Jr, Kovanda C, Seshadri-Kreaden U. What is the learning curve for robotic assisted gynecologic surgery? J Minim Invasive Gynecol 2008;15(5):589-94.
9. Roberts KE, Bell RL, Duffy AJ. Evolution of surgical skills training. World J Gastroenterol 2006 May 28;12(20):3219-24.
10. Semm DK. Operative manual for endoscopic abdominal surgery. Operative Pelviscopy. Chicago, London: Year Book Medical Publishers Inc 1987:5-15.
11. Reichert JA, Valle RF. Fitz-Hugh-Curtis syndrome. A laparoscopic approach. JAMA 1976;236:266-68.
12. Westebring-van der Putten EP, Goossens RHM, Jakimowicz JJ, Dankelman J. Haptics in minimally invasive surgery-A review. Minimally Invasive Ther Allied Technol 2008;17(1):3-16.
13. Chen CC, Falcone T. Robotic gynecologic surgery: Past, present and future. Clin Obstet Gynecol 2009 Sep;52(3):335-43.
14. Surgical. Available from: http://www.intuitivesurgical.com. Accessed 10/24/2012.
15. Heinrichs WL, Srivastava S, Pugh C, et al. Visual language to interface users of educational surgical simulators for fundamental surgical manipulations. In: Proceedings of 14th Annual International Meeting of Computer-assisted Radiology and Surgery (CARS). Lemke HJ, (Ed). San Francisco, Amsterdam: Elsevier Publishers; 2000;29-34.
16. Satava RM, Cuschieri A, Hamdorf J. Metrics for objective assessment of surgical skills workshop. Surg Endosc 2003;17(2): 220-26.
17. Fried GM, DeRossis AM, Bothwell J, Sigman HH. Comparison of laparoscopic performance in vivo with performance in a laparoscopic simulator. Surg Endosc 1999;13:1077-81.
18. Grantcharov TP, Rosenberg J, Pahle P, Funch-Jensen P. Virtual reality computer simulation. Surg Endosc 2001;15(3):242-44.
19. Seymour NE, Gallagher AG, Roman SA, et al. Virtual reality performance improves operating room performance: Results of a randomized, double-blinded trial. Ann Surg 2002;236: 458-64.

20. Aggarwal R, Moorthy K, Darzi A. Laparoscopic skills training and assessment. Br J Surg 2004 Dec;91(12):1549-58.
21. Aggarwal R, Grantcharov TP, Eriksen JR, Blirup D, Kristiansen VB, Funch-Jensen P, et al. An evidence-based virtual reality training program for novice laparoscopic surgeons. Ann Surg 2006 Aug;244(2):310-14.
22. Adrales GL, Chu UB, Hoskins JD, Witzke DB, Park AE. Development of a valid, cost-effective laparoscopic training program. Am J Surg 2004 Feb;187(2):157-63.
23. Powers KA, Rehrig ST, Irias N, Albano HA, Malinow A, Jones SB, et al. Simulated laparoscopic operating room crisis: An approach to enhance the surgical team performance. Surg Endosc 2008 Apr;22(4):885-900.
24. Hernandez JD, Bann SD, Munz Y, et al. Qualitative and quantitative analysis of the learning curve of a simulated surgical task on the da Vinci system. Surg Endosc 2004 Mar;18(3):372-78.
25. Abboudi H, Khan MS, Aboumarzouk O, Guru KA, Challacombe B, Dasgupta P, et al. Current status of validation for robotic surgery simulators-a systematic review. BJU Int 2012 Jun 6 [Epub ahead of print].

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REVIEW ARTICLE

Is Minimal Access Surgery of Esophageal Atresia with Distal Esophageal Atresia by Thoracoscopy is better than Conventional Thoracotomy? A Multi-institutional Review of Literature to get the Answer

Usman Javaid

ABSTRACT

Topic: Is minimal access surgery of esophageal atresia with tracheoesophageal fistula by thoracotomy better than conventional thoracotomy? A multi-institutional review of literature.

Objective: Minimal access surgical technique has been one of the most important surgical advances in the last few decades; we have reached now in such era that complex neonate surgical issue can be addressed safely by minimal access surgery without significant morbidity. Esophageal atresia (EA) with distal tracheoesophageal fistula (TEF) has been successfully treated by traditional thoracotomy, but now the trend has been shifted toward minimal access surgery via thoracoscopic repair of EA with distal EA. The quest of this multi-institutional review is to get the answer that is minimal access surgery is better than the traditional open approach.

Materials and methods: A literature view was performed from 2005 to 2012 using the PubMed, science direct, OVID search EBSCOhost and search engines Google and Yahoo. The following search terms were used, thoracoscopic repair or thoracoscopic surgery, thoracotomy and EA.

Inclusion criterion is EA with distal esophageal fistula with comparative study by open thoracotomy or by historical data. Exclusion criteria were other esophageal anomalies.

Results: In 182 patients operated by minimal access surgery by thoracoscopy, the mean gestational age, weight, associated congenital anomalies, mechanical ventilation, perioperative pCO_2, postoperative early and late complication are comparable with historical open thoracotomy. However MAS has a superadded advantage in markedly reduction in scar tissue, postoperative pain and no chest wall deformity.

Conclusion: This multi-institutional review provides a recent comparison of the approached to EA with TEF without any worse effect of thoracoscopy and competes well with traditional open thoracotomy approach. There is dramatic advancement of pediatric MAS over the last decade and the result are comparable with open thoracotomy in perioperative, postoperative and long-term outcome with potential advantages of less scar tissue, less postoperative pain, less disruption of anatomy and function and better cosmoses with markedly reduced musculoskeletal complication. Thoracoscopic repair is a promising adjunct, but there are difficulties for setting it as the open thoracotomy and it still needs more subjective studies with the consideration of learning curve and long surgical time. However, thoracoscopic repair of EA with TEF is a favorable and effective procedure with good prognosis.

Keywords: Thoracoscopy, Minimal access surgery, Esophageal atresia, Tracheoesophageal fistula.

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Source of support: Most of the center have changed the surgical approach for esophageal atresia with distal esophageal atresia from open traditional thoractomy to minimal access surgery by thoracoscopic repair (references: 2, 12, 13, 14, 16).

Conflict of interest: There is also debate that traditional approach of tracheoesophageal atesia with distal esophageal fistula by thoracotomy as described by Burford M concluded as complication rates similar to thoracoscopic repair but increased rate of anastomotic leaks and greater need of anti reflux surgery. However no musculoskeletal sequelae were directly attribute to thoracotomy.

INTRODUCTION

Esophageal atresia (EA), with or without tracheoesophageal fistula (TEF), occurs in three out of 1,000 live births.[1] The most common anatomic variant of EA is the presence of a tracheal fistula to the distant remnant of the esophagus. This type of TEF occurs in 85% of all infants born with EA. The common anomaly has been traditionally operated by classical right poster lateral thoracotomy. The first entirely thoracoscopic repair was reported by Lobe et al[2] in 1999 and described repair of EA in an 8-month-old patient. Rothenberg[3] has subsequently reported on a series of eight neonates with EA and distal fistula operated thoracoscopically. With the advancement of minimal access surgery in technology, engineering, fine instrument, optical magnification and surgical skill it provokes the pediatric surgeons to use the minimal access surgery in pediatric patient. To date, there have been few literature published of thoracoscopic repair of EA with TEF. Still it is unclear how much beneficial is thoracoscopic approach. This study describes the comparative results of 260 (Fig. 1) newborn babies from eight different institutes who underwent thoracoscopic repair of EA with TEF (Table 1) and compared it with the open classical method of thoracotomy from recent and historical group (Table 2).[4-8]

RESULTS

The literature review from 2005 to 2012 were collected and 61 articles were selected but only eight papers were selected

due to number of patients and have control study either with open thoracotomy or historical review. There were some individual papers which mentioned only the outcome of minimal access surgery by thoracoscopy without control study.[9,10] Similarly, some studies have small number of patient also which were not included.[11] These data were collected from the literature and compared with the open thoracotomy approach based on text book and some recent literature (Table 1).

The review of literature showed no difference of minimal access (MAS) surgery between thoracoscopy (TR group) and open thoracotomy (OR group) in EA with TEF in regard of gestational age of patient, with average age of 2.7 to 3.5 days. Similarly, associated anomalies were almost same in both groups. Both groups operated premature babies successfully.

Ma Li[12] and Sazavay[13] revealed a significant difference in operation time between TR and OR groups (185 *vs* 148 and open 106 *vs* 141 minutes), but Tariq[14] et al and Brian Lugo[15] did not find significant difference in operation time between thoracoscopic and open thoracotomy group (179 and 123 minutes and 149 and 156 minutes respectively). Patkowski[16] reported higher time initially but significant improvement after gaining experience (mean 171 minutes for first 10 cases reduce to mean 98 minutes for last 13 cases).

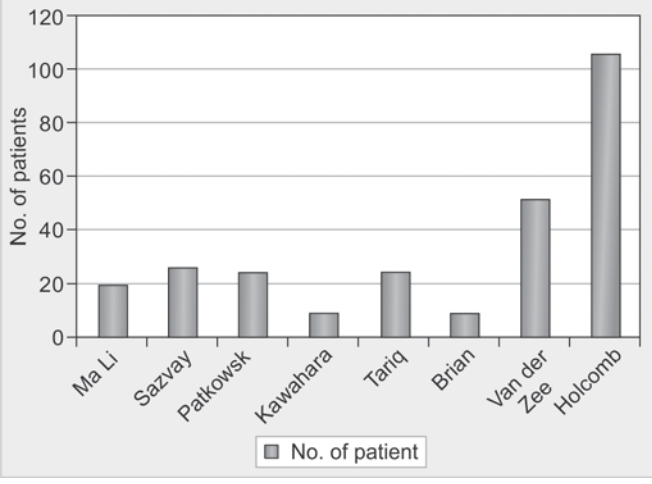

Fig. 1: The number of patient including in this series from different authors. The largest series is by Holcomb

Neonatal tolerance to pneumothorax with CO_2 showed hypercarbia 1 hour after the surgery in both groups, although ET CO_2 was higher in TR group but not reached to significant difference (Table 3).[12]

In other study the impact of CO_2 also showed almost same result by Mark Bishay[17] however in their study although the pH became normal at the end of surgery but the cerebral oxygen saturation decreased.

Szavay[13] in their studies found a significant difference of pCO_2 max in both groups with higher level in TR group (62 *vs* 48 respectively; p = 0.014) (Table 3).

Perioperative surgical complications were also mentioned in the literature including two tracheal injuries in TR group. No other perioperative complication is mentioned in the literature other than that in both groups.[16]

Postoperative ventilation and pain has been studied also but most of literature did not reach to significant difference. However Brian Lugo[15] found significant difference in TR and OR group in regard of postoperative ventilation (4.6 *vs* 19 days) and need of narcotics analgesia (5 *vs* 23.1 days).

Tariq et al[14] reported early postoperative complication which significantly happened in OR group with lung collapse, pneumonia, chylothorax, recurrent laryngeal nerve injury and wound infection.

Holocomb et al[18] and Burfurd et al[4] found longer hospital stay in OR group as compared to TR group (29 *vs* 18.1 days and 66 *vs* 21 days respectively). Tariq et al[14] found no difference in hospital stay.

The rate of anastomotic leak in either group in all literature did not reach to significant level and none of leak needed redo surgery and managed conservatively.

Table 1: Studies included for critical review of the thoracoscopic repair of EA with TEF 2005 to 2012, including mean age and weight, operation time and different complication related to thoracoscopic repair of EA with TEF

	Ma Li	*Sazvay*	*Patkowsk*	*Kawahara*	*Tariq*	*Brian*	*Van der Zee*	*Holcomb*
Year	2012	2011	2009	2009	2008	2008	2007	2005
No. of patients	20	25	23	7	23	8	50	104
Mean gestational age (week)	39.0	35	NR	NR	36.3	39.9	37.2	2.6
Mean weight (kg)	2.6	2.09	2.298	2.814	2.735	2.7	2.620	1.2
Mean operative time	185	141	131	NR	149.4	157	178	129.9
Conversion	NR	NR	NR	NR	NR	1 (12.5%)	2 (4%)	0
Anastomosis leak	NA	—	3 (13%)	3 (30%)	4 (17%)	(1)(12.5)	9 (18%)	8 (7.6%)
Recurrent fistula	NA	—	0	0	2 (8.6%)	—	2 (4%)	2 (1.9%)
Stenosis	NA	—	4 (17%)	—	—	(1) 14%	2 (4%)	4 (3.8%)
Dilatation required	NA	—	4 (17%)	—	—	—	22 (45%)	12 (31.7%)
Antireflux surgery	NA	—	—	2 (28.5%)	—	—	11	26 (24%)
Death	NA	—	3 not related		1	—	1 (sepsis)	2 (0.9%)

Table 2: Comparison with open thoracotomy with recent studies done by Burford and historical study as control

	Burford serried[4]	*Historic control*[5-8]
No. of patient	72	340
Anastomotic leak	2.7%	17.9%
Stricture	5.50%	16.7%
Recurrent fistula	2.70%	7.9%
Fundoplication	12.50%	21%

Postoperative stricture formation is another squella of ES/TEF surgery. Holocomb et al[4] found a significant difference with lower rate in TR *vs* OR group (7.6% *vs* 17.9% respectively) (Fig. 2).

Gastroesophageal reflux is common after EA with TEF repair and needs to address. Nowadays all cases are treated medically however, a number of patients need antireflux surgery.[19,20] Holocomb et al[4] showed that 24% of thoracoscopy patient need fundoplication. The historical data showed fundoplication rate from 15 to 45%.[5-8] Burford et al[4] in his study of open thoracotomy mentioned 12.5% patient need fundoplication.

There is no difference in the incidence of recurrent fistula in either group and incidence is between 0 and 5%.

Few literature mentioned death but it is difficult to ascertain that whether it is pure surgical related or medical related. The mortality by Tariq et al[14] was 3, Pakowaski et al[16] was 3, Van der Zee et al[21] was 2 but none of them is found due to surgical related.

Holocomb et al[18] and Burford et al[4] mentioned scoliosis and higher right shoulder deformity in OR group. None of the literature mentioned such complication in TR group.

DISCUSSION

Advancement in the minimal access surgery have been used in adult for long time but later on it has been used increasingly in pediatric surgery.[22] This evolution lead the surgeon to address the most of the congenital anomalies by minimal access surgery and several report have revealed the safety in pediatric patients.[23] Initially it was hypothesized that neonate may not be able to tolerate the burden of CO_2 but comparative studies done by Ma Li et al[12] showed same ET CO_2 in TR and OR groups without any significant difference (Fig. 3). Although pCO_2 increased intra-operatively but reduced at the end of surgery. Similar studies were done by Matsunari[24] with the finding that thoracoscopy group had a higher incidence of intraoperative hypercapnia and acidosis and required higher inspired oxygen fraction but on admission to ICU Pa(CO_2) was in the normal range

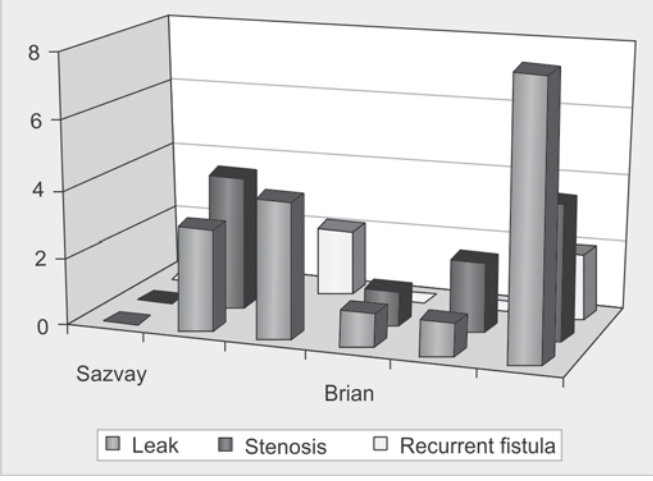

Fig. 2: Number of anastomotic leakage, postoperative anastomotic stricture and recurrent fistula in different studies in current study

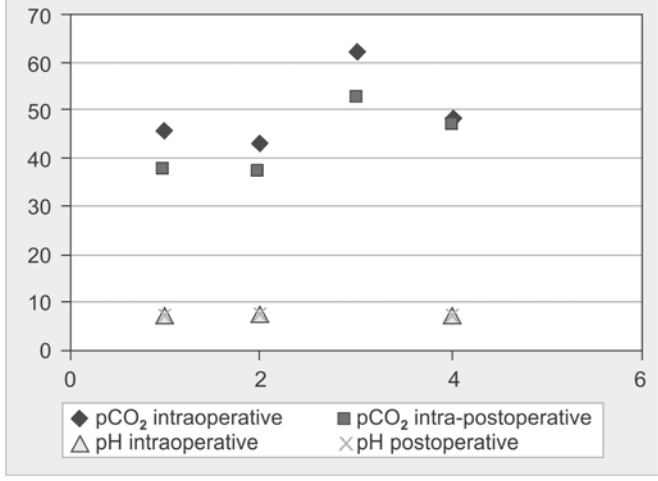

Fig. 3: Study done by Ma Li and Sazvay on intraoperative and postoperative pCO_2 and pH of thoracoscopic repair of EA with TEF showing that intraoperative and postoperative pH and pCO_2 had no significantly differences

Table 3: Comparison of pCO_2 and pH monitoring during open and thoracoscopic repair of EA with TEA. Clearly there is no significant difference between two groups

	Ma Li		*Sazvay*	
	**TR*	***OR*	**TR*	***OR*
pCO_2 (mm Hg) intraoperative	46 ± 8	43 ± 10	62	48
pCO_2 (mm Hg) at end of procedure	38 ± 5	37 ± 6	53	47
pH intraoperative	7.28 ± 0.06	7.30 ± 0.05	—	7.16
pH postoperative	7.32 ± 0.06	7.34 ± 0.07	—	7.20

*TR: Thoracoscopic group; **OR: Thoracotomy group

in both groups and there was no difference in the duration of mechanical ventilation and ICU stay. Preliminary studies by Mark Bishay et al[17] showed no difference in pCO_2 but mentioned that thoracoscopy may be associated with acidosis and decreased cerebral hemoglobin oxygenation saturation measured by near infra-red spectroscopy but still it is not clear and need more data.

The operative time is always long in MAS due to two factors, firstly the MAS is by default a slow surgery and secondly due to the learning curve. A detailed study done by David et al[25] of thoracoscopic repair of EA with TEF over 10 years, in which they have divided the thoracoscopy repair of EA with TEF in two periods of 5-year each. In all 10 years the duration of operative time remained unchanged. Initially due to learning curve and in second half the other members and fellows principally performed surgery under the supervision of the senior surgeon which again leads to same operative time.

Almost all literature mentioned postoperative anastomotic leak, which related to many factors from preoperative to postoperative patient course, but majority of these patient need conservative management. The anastomotic leak was almost same in both groups with average of 10 to 27%.[4-8,13-16] All the leak was mentioned minor leak and healed by conservative management.

Another strong association EA with TEF is with gastroesophageal reflux and is common problem after repair. This incidence of reflux is related to esophagus dysmotility, delayed gastric emptying,[26] there was controversy about the optimal treatment between nonoperative management to surgical intervention with fundoplication. Noteworthy now there is drop in fundoplication rate[26] which can be attributed to the increased use of H2-blockers and proton pump inhibitors. It was postulated that thoracoscopic repair of ET/TEF may lead to improved esophageal motility but Hisyoshi et al[27] did study between TR and OR group of EA with TEF showed that there were no significant differences in esophageal acid exposure [5.5% (0.7-24.6%) *vs* 3.7% (0.3-56.8%); p = 0.71] or mean esophageal acid reflux time [0.5 minutes (0.1-1.4 minutes) *vs* 0.5 minutes (0.1-1.3 minutes); p = 0.87] between the two groups. Fundoplication was conducted in two patients in each group (p = 0.60). There are unlikely to be benefits from thoracoscopic repair of EA in terms of postoperative esophageal motor function. A big advantage of MAS repair of EA with TEF is reduced musculoskeletal complication as compared to open thoracotomy[28-31] as 23% of patient developed winged scapula and 20% asymmetry of thoracic wall and 16% scoliosis was mentioned (but a recent study done by Burford et al[4] mentioned that in OR, two patient developed scoliosis and two patient developed high right shoulder deformity; however no literature showed any of this complication in thoracoscopic patients operated for EA with TEF.

There are two main factors of survival/prognosis for neonates with EA with TEF, birth weight and presence of major cardiac anomalies. Infants with birth weight less than 1,500 gm had 20% less chance of survival compared with those weighting more than 1,500 gm at birth. Similarly, infants with a major cardiac anomaly had 20% higher mortality this is independent to surgical approach.[32]

CONCLUSION

This multi-institutional review provide a recent comparison of approach to EA with TEF without any worse effect of thoracoscopy and compete well with traditional open thoracotomy approach. There is dramatic advancement of pediatric MAS over the last decade and the results are comparable with open thoracotomy in perioperative, postoperative and long-term outcome with potential advantages of less scar tissue, less postoperative pain, less disruption of anatomy and function and better cosmesis with markedly reduced musculoskeletal complication. Thoracoscopic repair is a promising adjunct, but the difficulties for setting it as the open thoracotomy still need more subjective studies with the consideration of learning curve and long surgical time. However, thoracoscopic repair of EA with TEF is a favorable and effective procedure with good prognosis.

REFERENCES

1. Robert E, Mutchinick O, Mastroiacovo, et al. An international collaborative study of esophageal atresia or stenosis. Reprod Toxicol 1993;7:405-21.
2. Lobe TE, Rothenberg SS, Waldschmidt J. Thoracoscopic repair of esophageal atresia in an infant: A surgical first. Pediatr Endosurg Innov Tech 1999;3:141-48.
3. Rothenberg SS, Colorado D. Thoracoscopic repair of tracheo-esophageal fistula in new born. J Pediatr Surg 2002 Jun;37(6): 869-72.
4. Burford JM, Malvin S, et al. Repair of esophageal atresia with tracheoesophageal fistula via thoracotomy. Am J Surg 2011;202: 203-20.
5. Spitz L, Kiely E, Brereton RJ. Esophageal atresia: Five-year experience with 148 cases. J Pediatr Surg 1987;22(2): 103-08.
6. Yanchar NL, Gordon R, Cooper M, et al. Significance course and early upper gastrointestinal studies in predicting complications associated with repair of esophageal atresia. J Pediatr Surg 2001;36:815-22.
7. Randolph JG, Newman KD, Anderson KD. Current results in repair of esophageal atresia with tracheoesophageal fistula using physiologic status as a guide to therapy. Ann Surg 1989; 209:526-30.

8. Manning PB, Morgan RA, Coran AG, et al. Fifty years' experience with esophageal atresia and tracheoesophageal fistula. Ann Surg 1986;204:446-51.
9. Mackinlay GA. Esophageal atresia surgery in 21st century. Semin Pediatr Surg 2009;18(1):20-22.
10. Lima M, De Biangi L, Gafgano T, et al. Thoracoscopic treatment of esophageal atresia. Pediatr Med Chir 2007;29(5):262-66.
11. Zainabadi K, Bui T, Emil S, Gelfand D, Nguyen N. Thoracoscopic repair of esophageal atresia and tracheoesophageal fistula: Lessons learned. J Laparoendosc Adv Surg Tech A 2006; 16(2):174-78.
12. Ma L, Liu YZ, Ma YQ, Zhang SS, Pan NL. Comparison of neonatal tolerance to thoracoscopic and open repair of esophageal atresia with tracheoesophageal fistula. Chin Med J 2012;125(19)3492-95.
13. Sazvay PO, Zundel S, Bkynebsticj G, et al. Perioperative outcome of patient with esophageal atresia and tracheoesophageal fistula under going open versus thoracoscopic surgery. J Laparoendosc Adv Surg Tech A 2011;21(5);439-43.
14. Tariq AT, Zamakhshary M, Salah A, et al. Thoracoscopic repair of tracheoesophageal fistula: A case control matched study. JPS 200;43:805-09.
15. Lugo B, Malhotra A, Guner Y, Nguyen T, Ford H, Nguyen NX. Thoracoscopic versus open repair of tracheoesophageal fistula and esophageal atresia. J Laparoendosc Adv Surg Tech A 2008;18(5):753-56.
16. Patkowsk D, Rysiakiewicz K, Jaworski W, Zielinska M, Siejka G, Konsur K, et al. Thoracoscopic repair of tracheoesophageal fistula and esophageal atresia. J Laparoendosc Adv Surg Tech A 2009 Apr;19 Suppl 1:S19-22.
17. Bishay M, Giacomello L, Retrosi G, Thyoka M, Nah SA, McHoney M, et al. Decreased cerebral oxygen saturation during thoracoscopic repair of congenital diaphragmatic hernia and esophageal atresia in infants. J Pediatr Surg 2011;46(1): 47-51.
18. Holcomb GW III, Rothenberg SS, Bax KM, Martinez-Ferro M, Albanese CT, Ostlie DJ, et al. Thoracoscopic repair of esophageal atresia and tracheoesophageal fistula: A multiinstitutional analysis. Ann Surg 2005;242(3):422-28.
19. Castilloux J, Noble AJ, Faure C. Risk factors for short- and long-term morbidity in children with esophageal atresia. J Pediatr 2010;156(5):755-60.
20. Foker JE, linden BC, Boyle EM, et al. Development of a true primary repair for the full spectrum of esophageal atresia. Am Surg 1997;226:533-47.
21. Van der Zee DC, Bax KN. Thoracoscopic treatment of esophageal atresia with distal fistula and of tracheomalacia. Semin Pediatr Surg 2007;16(4):224-30.
22. Gupta AR, Gupta R, Jadhav V, Sanghvi B, Shah HS, Parelkar SV. Minimal access surgery in children: An initial experience of 28 months. Afr J Paediatr Surg 2009 Jul-Dec;6(2):93-97.
23. Kalfa N, Allal H, Raux O, Lopez M, Forgues D, Guibal MP, et al. Tolerance of laparoscopy and thoracoscopy in neonates. Pediatrics 2005;116(6):e785-91.
24. Matsunari Y, Kinouchi K, Ono R, Haruna J. Comparison of thoracoscopic and open repair of esophageal atresia with tracheoesophageal fistula. Masui 2010 Oct;59(10):1234-40.
25. Van der Zee DC, Tytgat SH, Zwaveling S, van Herwaarden MY, Vieira-Travassos D. Learning curve of thoracoscopic repair of esophageal atresia. World J Surg 2012;36:2093-97.
26. Konkinm DE, Hali W, Webber EM, Blair GK. Outcome in esophageal atresia and tracheoesophageal fistula. JPS 2003; 38(12):1726-29.
27. Kawahara H, Okuyama H, Mitani Y, et al. Influence of thoracoscopic repair of esophageal atresia on esophageal motor function and gastroesophageal reflux. JPS 2009 Dec;44(12): 2282-86.
28. Jaureguizar E, Vazquez J, Murcia J, et al. Morbid musculoskeletal sequelae of thoracotomy for tracheoesophageal fistula. J Pediatr Surg 1985;20:511-14.
29. Khan IH, McManus KG, McCraith A, McGuigan JA. Muscle sparing thoracotomy: A analysis confirms preservation of muscle strength but no improvement in wound discomfort. Eur J Cardiothorac Surg 2000;18(6):656-61.
30. Freeman NV, Walkden J. Previously unreported shoulder deformity following right lateral thoracotomy for esophageal atresia. J Pediatr Surg 1969;4:627-36.
31. Durning RP, Scoles PV, Fox OD. Scoliosis after thoracotomy in tracheoesophageal fistula patients. J Bone Joint Surg Am 1980;62:1156-58.
32. Lopez PJ, Keys C, Pierro A, Drake DP, Kiely EM, Curry JI, et al. Esophageal atresia: Improved outcome in high risk groups. J Pediatr Surg 2006 Feb;41(2):331-34.

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REVIEW ARTICLE

Laparoscopic *vs* Robotic-assisted Sacrocolpopexy

B Lavanya

ABSTRACT

Background: Laparoscopic sacrocolpopexy has been in vogue since 1993. Robotic technique has started only since 2004.[1] In this article both the techniques are reviewed and an attempt is made to discuss the advantages of each.

Objective: Initially, a description of the procedure is given. Then, the article will review the recent published studies on the procedure, patient selection, intraoperative complications, postoperative complications, recovery, postoperative pain, quality of life and economic aspect of sacrocolpopexy performed laparoscopically and robotic assisted and discuss the merits of each.

Materials and methods: Literature review conducted from Google, PubMed, Springer Link, Highwire Press, da Vinci surgery community.

Conclusion: The minimal access approach offers reduced morbidity, shorter hospitalization, and decreased postoperative pain. The disadvantages of the laparoscopic approach compared to open include longer operating time and need for advanced laparoscopic surgical skills including suturing. Robot-assisted laparoscopic procedure allows the performance of complex laparoscopic maneuvers with less ergonomic difficulty, and thereby simplifies the complex procedure but is currently expensive.

Keywords: Sacrocolpopexy, Laparoscopic sacrocolpopexy, Robotic-assisted sacrocolpopexy.

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INTRODUCTION

Increasing life span of the world population in general is supposed to increase the incidence of pelvic organ prolapse. Currently the incidence of uterocervical prolapse is 11 to 14%[2] and the incidence of vault prolapse is estimated to be 1.3 for every 1,000 women.

Symptoms

1. Seeing or feeling bulge or protrusion
2. Pressure, heaviness
3. Urinary incontinence, frequency and urgency: Manual reduction of prolapsed required to start or complete voiding.
4. Bowel symptoms: Incontinence, feeling of incomplete emptying, straining, digital evacuation, splinting.
5. Sexual symptoms: Dyspareunia, lack of sensation.[3]

Aim of the sacrocolpopexy procedure is to restore the vagina to the normal anatomical location where it lies over the levator plate with the apex above the ischial promontory and axis pointing toward the sacrum. Apex of the vagina or cervix is attached to the anterior longitudinal ligament of the sacral promontory with a prolene mesh.

Preoperative considerations include demonstration of the prolapse with magnetic resonance imaging (MRI) colpocytogram in resting as well as straining position, urodynamic studies where indicated, general evaluation of morbidity factors considering the advanced age group of the patients, cardiovascular stability as long operative time and steep Trendelenburg position is required.

X-ray of the sacral promontory is indicated by some surgeons.

Laparoscopic Technique

Patient is placed in Trendelenburg position. Four ports are taken. The general abdominal cavity is explored. Adhesiolysis is performed as required. If uterus is to be removed, it is done first by total or subtotal as decided. Advantage of subtotal hysterectomy[4] is that the cervix acts as an anchor for the mesh but of course the woman is instructed on the need to go for regular pap screening.

If the procedure is done laparoscopically, in a patient with intact uterus, it is pushed up with an elevator and the peritoneal fold of the bladder is dissected from the anterior wall of the uterus. This causes the ureters to go below and thereby avoids injury. Then a paracervical buttonhole window is made by opening the anterior layer of the broad ligament and following it the posterior. This completes the anterior dissection.

Posteriorly, the peritoneum between the uterosacrals is held and cut. The incision is extended over the peritoneum of the uterosacrals to join the window made in the broad ligament. The peritoneum of the sacral promontory is cut on the right side to the rectum and the anterior longitudinal ligament is exposed.

A Y-shaped prolene mesh is taken.[5] Preformed mesh is not necessary. A 20 by 3 cm mesh is taken and cut in Y-shape such that the long limb is 10 cm and both curved limbs 10 cm. The cervix is encircled with the curve of the Y and sutures are placed attaching it to the anterior vagina. Anterior peritoneum is closed.

Posteriorly, the end of the vertical limb is sutured to the uterosacrals and posterior layer of the cervix. The first suture is taken through the uterosacrals and mesh to lift the enterocele and attached to the vagina. The vertical limb is

folded into the shape of a U and sutured to posterior cervix. Now, the suture is passed through the loop of the U or bite is taken and attached to the anterior longitudinal ligament. The uterus is kept elevated during this step. It is checked that the round ligaments are horizontal. This ensures the uterus is pulled up just adequate. Peritoneum is closed. No. 1 Dacron or PTFE has high strength and is used for the procedure. Drain is placed.

Vault Prolapse

When the procedure is done for vault prolapse, Y-shaped mesh is not required. Instead, 2 long strips are taken. Here, dissection is begun by incising the peritoneum over the sacral promontory. Then anterior dissection is started. A ribbon retractor placed in the vagina and pushed up facilitates the separation of bladder.

Posterior cul-de-sac is separated on either side of the rectum. Pararectal dissection is carried out till the ischiorectal pad of fat is crossed and the levator ani is reached.

Posteriorly, the mesh is sutured to either side of the levator ani fascia and vaginal fascia. Middle of the mesh is sutured to the uterosacrals. The other end is sutured to the anterior longitudinal ligament. Redundant mesh is cut. Anteriorly, bladder is separated and bites are taken on the vaginal fascia and the mesh. Then both parts are sutured with three knots on either side with Dacron or silk. Partial reperitonization is done.

If the procedure includes a vaginal assisted hysterectomy, a sagittal posterior colpotomy incision is given and the specimen is removed. Culdotomy is closed and further surgery proceeds.

Robotic-assisted Laparoscopic Sacrocolpopexy

Patient is placed in lithotomy position. The shoulders are padded and the patient is secured.

Laparoscopic instrument ports are then placed in the abdomen. Veress needle is placed supraumbilically. A 12 mm camera is placed following intraperitoneal insufflation. Two 8 mm, robotic instrument ports are placed approximately one handbreadth away from the camera port to prevent collision between robotic arms. A third 8 mm robotic instrument port is placed inferiorly and far to the left to be used by the fourth arm for retraction, if needed. A 12 mm port is placed inferiorly and on the far right near the iliac crest to be used by the assistant surgeon.

The robot is docked between the patient's legs or side-docking is done to facilitate vaginal manipulation.[6]

The technique is almost similar to lap surgery. Tacker may or may not be needed.

DISCUSSION

According to the study results tabulated (Table 1) by Jason P Gilleran, the overall rates of success for the lap procedure range from 75 to 98% with follow-up mostly around 1 year. The success rates of RSC are comparable to LSC in short-term follow-up.[25]

The lowest time required to complete the procedure was 97 *vs* 186 minutes in the study. Study by Paraiso et al showed the time taken as 199 *vs* 265 minutes.[26]

Suturing is aided by the robot whereas handling suturing in the region of sacral promontory is difficult ergonomically and a tracker is preferred in LSC.

Olgaraam et al say that quicker recovery time is associated with minimally invasive procedures. Level III data suggest that early outcomes of robotic sacrocolpopexy are similar to those of open sacrocolpopexy. A single randomized trial has provided level I evidence that robotic and laparoscopic approaches to sacrocolpopexy have similar short-term anatomic outcomes, although operating times, postoperative pain and cost are increased with robotics.[6]

Improved visualization and dexterity is afforded by the robot and may decrease learning curves associated with conventional laparoscopy, leading to broader adoption of minimally invasive techniques. Likewise, robotic surgery has several unique limitations not encountered in laparoscopic or open surgery. Surgeons do not get haptic feedback or sensation when operating robotically; therefore, visual changes in tissue blanching and movement must be used to compensate for tactile differences in tissues and structures.

Patient satisfaction and long-term outcomes of both robotic and laparoscopic sacrocolpopexy are insufficiently studied. Existing studies rarely report outcomes beyond 1 year after prolapse surgery and are limited by retrospective study designs, small sample sizes, inconsistent nomenclature, nonstandardized prolapse quantification, lack of masking, and lack of validated symptom and quality-of-life measures. The cost per procedure was $8.508 for robotic, $7.353 for laparoscopic, and $5.792 for open sacrocolpopexy (Table 2).

Patient selection was comparable in both the procedures but RSC included women with more severe condition in few studies.[27,28]

According to the Table 3 data we can say that robotic surgery offers the advantage less blood loss, fewer complications but is more expensive and takes longer.

From Table 3 we can say that disadvantages of the robot include its clinical limitations, not being cost-effective at present, increased operating time and being redundant where precise dissection is not required.

Table 1: Outcomes: laparoscopic and robotic mesh sacrocolpopexy series

Author (year)	*Mean age (years)*	*Mean OT (min)*	*Mean LOS (days)*	*Mean follow-up (months)*	*Success rate*	*Definition of success*	*Complications/notes*
Laparoscopic sacrocolpopexy							
Akladios et al (2010)[7] (n = 48)	56 (36-78)	237	4 (3-15)	16	96%	No recurrent prolapse	33 supracervical hysterectomy, 3 transobturator slings, 4.1% complication rate
Antiphon et al (2004)[8] (n = 108)	59 (36-79)	261 ± 79	7 (2-32)	17	75%	POP ≥ grade 2	2.8% complication rate, comparison of 33 anterior only *vs* 71 ant/post, concomitant SUI surgery 74.1%
Claerhout et al (2009)[9] (n = 132)	65 ± 10	180	5.7	13	78% (2% apical)	POP-Q ≥ – 1 any point	18% posterior failure, 11% complication rate (6 mesh erosions), Q follow-up in multiple domains
Cosson et al (2002)[10] (n = 77)	47 (28-66)	276	3.5 (2-7)	11	94%	No recurrent prolapse	Burch in 74, SCH in 60, 7.2% conversion rate, 5% complication rate
Gadonneix et al (2004)[11] (n = 46)	59 (41-76)	171 ± 37	4.0 ± 2.1	??	83%	No recurrence ≥ grade 2	Bladder injury 7%, mesh erosion 2%, recurrent rectocele in 12%
Granese et al (2009)[12] (n = 165)	67 (58-76)	NR	3 (2-7)	43	95%	No recurrent vaginal vault prolapse	Vyprol (absorbable) mesh used early but abandoned due to early recurrence in 3 patients
Klauschie et al (2009)[13] (n = 43)	60	183	1.5	7	100%	No apical prolapse	Bladder injury 7%, no other difference between open and LSC, 14% of LSC underwent second POP repair
Marcickiewicz et al (2007)[14] (n = 60)	58 (30-83)	129	4 (2-21)	34 (13-60)	78% subjective 75% objective	Reoperation for prolapse	Compared vaginal sacrospinous fixation with LSC, most reoperations for cystocele or SUI
Rivoire et al (2007)[15] (n = 138)	60 ± 9.5	191 ± 50	5	34	88%	No recurrence >grade 2	Vaginal mesh erosion in 5, 46% with postop SUI, 2% required emergent reoperation
Ross and Preston (2005)[16] (n = 43)	67 (41-83)	96 ± 42	NR	NR* (all have 5-year follow-up)	93%	No recurrent prolapse	Complication 8% (mesh erosion), posterior mesh tacked to perineum
Rozet et al (2005)[17] (n = 363)	63 (35-78)	97	4 (2-7)	15	96%	Anatomic cure	Conversion to open in 2%, mesh erosion 0.9%, *de novo* UUI in 19 patients
Sarlos et al (2008)[18] (n = 101)	62 (36-81)	141	4.6 (2-8)	12	92% objective 98% subjective	Stage 0 in all compartments on POP-Q	No mesh erosion, 3 rectal injuries, 2 bladder injuries, 2 converted to open
Sundaram et al (2004)[19] (n = 10)	61 (43-83)	196	2 (1.5-3)	16	90%	Not defined	Gore-Tex patch used and not polypropylene mesh; mostly describe technique
Robotic sacrocolpopexy							
Akl et al (2009)[20] (n = 80)	67 ± 8.3	198	2.6	5	97%	No recurrent prolapse	Mesh erosion in 6%, conversion to open in 5%
Daneshgari et al (2007)[21] (n = 12)	64 (50-79)	317	2.4 (1-7)	3	100%	POP-Q scores	Mean C point + 2.1 (pre-) and – 8.3 (postop); 3/15 open conversion
Elliott et al (2006)[22] (n = 30)	67 (47-83)	186	1 (1-2)	24	95%	Not defined	Open conversion in 1, mesh extrusion in 2, recurrent rectocele in 1, apical prolapse in 1
Geller et al (2008)[23] (n = 73)	60	328 ± 55	1.3	NR	NR	POP-Q scores	Mean C point – 9 for RASC *vs* – 8 for open
Kramer et al (2009)[24] (n = 21)	66 (52-86)	194	1.1	25	95%	No apical prolapse	Apical support only; 12/21 underwent secondary repair of cystocele or rectocele

OT: Operative time; LOS: Length of stay; NR: Not reported; LSC: Laparoscopic sacrocolpopexy; SCH: Supracervical hysterectomy; SUI: Stress urinary incontinence[25]

Table 2: Comparison between laparoscopic and robotic sacrocolpopexy[26]

	Laparoscopic (n = 47)	*Robotic (n = 20)*	*p-value*
Total operating time (min)	199 ± 47	265 ± 50	<0.001
Operative time (min)	231 ± 69	128 ± 48	<0.001
Mean blood loss (ml)	280	55	0.03
Mean duration of catheter (days)	3.1 ± 1.6	2.5 ± 1.8	0.03
Sacrocolpopexy time (min)	162 ± 47	227 ± 47	<0.001
Hospital stay (h)	34 ± 11	43 ± 37	0.17
Mean cost ($)	*$14,342 ± 2,941	$16,278 ± 3,326	0.008
Operating room cost ($)	Mean difference: +$1,667	—	0.008
Postop complications (Clavien classification)			
Grade I	10	4	0.3
Grade II	5	1	0.3
Grade IIIA	—	—	—
Grade IIIB	3	1	0.7

Table 3: Comparing both techniques in terms of general principles

Robotic surgery	*Laparoscopic surgery*
Three-dimensional vision	Two-dimensional vision
Motion scaling	Not possible
Wrist articulation	Limited range of movement
Fluid movement	Rigid movement
Tremor filter	Tremor is magnified
Remote sensing technology	Abdominal wall is the fulcrum
Ergonomically intuitive	Comparatively poor ergonomics
Multiple instrument ejection system	Not possible
Haptic feedback	Limited tactile feedback
Telesurgery and teleproctoring	Not possible
Small learning curve	Long curve
25 times magnification at 10 cm	10 times magnification
Expensive	Comparatively costs less

CONCLUSION

It can be said that laparoscopic as well as robotic-assisted sacrocolpopexy are close to each other in efficacy and robot can offer more comfort with ergonomics. ln the recent years lot of work is going on in the field of robotics. Robotic technique has certain definite advantages and is not just a fancy. Being a new technology and that too heavily machine dependent, the costs are understandable. As with all technical aspects, higher availability and future work may bring down the costs.

REFERENCES

1. DiMarco DS, Chow GK, Gettman MT, Elliott DS. Robotic-assisted laparoscopic sacrocolpopexy for treatment of vaginal vault prolapse. Urology 2004;63:373-76.
2. Doshani A, Teo REC, Christopher JM, Tincello DG. Uterine prolapse. BMJ 2007;335:819.
3. Uzoma A, Farag KA. Vaginal vault prolapse. Obstet Gynecol Int 2009;2009:275621.
4. Benson AD, Kramer BA, Wayment RO, Schwartz BF. Supracervical robotic-assisted laparoscopic sacrocolpopexy for pelvic organ prolapse. JSLS 2010 Oct-Dec;14(4):525-30.
5. Culligan PJ, Murphy M, Blackwell L, Hammons G, Graham C, Heit MH. Long-term success of abdominal sacral colpopexy using synthetic mesh. Am J Obstet Gynecol 2002;187: 1473-80.
6. Ramm O, Kenton K. Robotics for pelvic reconstruction. Curr Bladder Dysfunct Rep 2011 Jun 30;6(3):176-81.
7. Akladios CY, Dautun D, Saussine C, Baldauf JJ, Mathelin C, Wattiez A. Laparoscopic sacrocolpopexy for female genital organ prolapse: Establishment of a learning curve. Eur J Obstet Gynecol Reproductive Biol 2010;149:218-21.
8. Antiphon P, Elard S, Benyoussef A, Fofana M, Yiou R, Gettman M, et al. Laparoscopic promontory sacral colpopexy: Is the posterior, rectovaginal, mesh mandatory? Eur Urol 2004;45:655-61.
9. Claerhout F, De Ridder D, Roovers JP, Rommens H, Spelzini F, Vandenbroucke V, et al. Medium-term anatomic and functional results of laparoscopic sacrocolpopexy beyond the learning curve. Eur Urol 2009;55:1459-68.
10. Cosson M, Rajabally R, Bogaert E, Querleu D, Crepin G. Laparoscopic sacrocolpopexy, hysterectomy and Burch colposuspension: Feasibility and short-term complications of 77 procedures. J Soc Laparoendoscopic Surg 2002;6: 115-19.
11. Gadonneix P, Ercoli A, Salet-Lizee D, Cotelle O, Bolner B, Van Den Akker M, et al. Laparoscopic sacrocolpopexy with two separate meshes along the anterior and posterior vaginal walls for multicompartment pelvic organ prolapse. J Am Assoc Gynecol Laparosc 2004;11:29-35.
12. Granese R, Candiani M, Perino A, Romano F, Cucinella G. Laparoscopic sacrocolpopexyin the treatment of vaginal vault prolapse: Eight years experience. Eur J Obstet Gynecol Reproductive Biol 2009;146:227-31.
13. Klauschie JL, Suozzi BA, O'Brien MM, McBride AA. A comparison of laparoscopic and abdominal sacral colpopexy: Objective outcome and perioperative differences. Int Urogynecol J 2009;20:273-79.
14. Marcickiewicz J, Kjollesdal M, Ellstrom Engh M, Eklind S, Axen C, Brannstrom M, et al. Vaginal sacrospinous colpopexy and laparoscopic sacral colpopexy for vaginal vault prolapse. Acta Obstet Gynecol 2007;86:733-38.
15. Rivoire C, Botchorishvili R, Canis M, Jardon K, Rabischong B, Wattiez A, et al. Complete laparoscopic treatment of genital prolapse with meshes including vaginal promontofixation and anterior repair: A series of 138 patients. J Minimally Invasive Gynecol 2007;14:712-18.

16. Ross JW, Preston M. Laparoscopic sacrocolpopexy for severe vaginal vault prolapse: Five-year outcome. J Minimally Invasive Gynecol 2005;12:221-26.
17. Rozet F, Mandron E, Arroyo C, Andrews H, Cathelineau X, Mombet A, et al. Laparoscopic sacral colpopexy approach for genitourinary prolapse: Experience with 363 cases. Eur Urol 2005;47:230-36.
18. Sarlos D, Brandner S, Kots L, Gygax N, Schaer G. Laparoscopic sacrocolpopexy for uterine and post-hysterectomy prolapse: Anatomical results, quality of life and perioperative outcome—a prospective study with 101 cases. Int Urogynecol J 2009;19: 1415-22.
19. Sundaram CP, Venkatesh R, Landman J, Klutke CG. Techniques in endourology laparoscopic sacrocolpopexy for the correction of vaginal vault prolapse. J Endourol 2004;18:620-24.
20. Akl MN, Long JB, Giles DL, Cornella JL, Pettit PD, Chen AH, et al. Robotic-assisted sacrocolpopexy: Technique and learning curve. Surg Endosc 2009;23:2390-94.
21. Daneshgari F, Kefer JC, Moore C, Kaouk J. Robotic abdominal sacrocolpopexy/sacrouteropexy repair of advanced female pelvic organ prolaspe (POP): Utilizing POP-quantification-based staging and outcomes. BJU Int 2007 Oct;100(4): 875-79.
22. Elliott DS, Krambeck AE, Chow GK. Long-term results of robotic assisted laparoscopic sacrocolpopexy for the treatment of high grade vaginal vault prolapse. J Urol 2006;176: 655-59.
23. Geller EJ, Siddiqui NY, Wu JM, Visco AG. Short-term outcomes of robotic sacrocolpopexy compared with abdominal sacrocolpopexy. Obstet Gynecol 2008;112:1201-06.
24. Kramer BA, Whelan CM, Powell TM, Schwartz BF. Robot-assisted laparoscopic sacrocolpopexy as management for pelvic organ prolapse. J Endo Urol 2009;23:655-58.
25. Gilleran JP, Johnson M, Hundley A. Robotic-assisted laparoscopic mesh sacrocolpopexy. Ther Adv Urol 2010 Oct;2(5-06): 195-208.
26. Paraiso MF, Jelovsek JE, Frick A, Chen CC, Barber MD. Laparoscopic compared with robotic sacrocolpopexy for vaginal prolapse. Obstet Gynecol 2011 Nov;118(5):1005-13.
27. Ramavath KK, Murthy PS. Robotic sacrocolpopexy: An observational experience at Mayo Clinic, USA. J Gynecol Endosc Surg 2011 Jan-Jun; 2(1): 53-57.
28. Seror J, Yates DR, Seringe E, Vaessen C, Bitker MO, Chartier-Kastler E, et al. Prospective comparison of short-term functional outcomes obtained after pure laparoscopic and robot-assisted laparoscopic sacrocolpopexy. World J Urol 2012 Jun;30(3): 393-98.

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SURGICAL TECHNIQUE

Two Trocar Laparoscopic Repair of Morgagni Hernia in Infant and Childhood: Simplified Technique

Medhat M Ibrahim

ABSTRACT

Purpose: Morgagni hernia (MH) is a rare entity that accounts for less than 6% of all surgically treated diaphragmatic hernias in pediatric age group. They are mostly asymptomatic and discovered incidentally. Open surgical repair has been the gold standard in all cases. However, since the introduction of minimal access surgery, different laparoscopic techniques of MH repair have been reported. Most of them are reporting on few cases and the immediate outcomes. I report one of the largest experiences to date assessing the safety and efficacy two trocars laparoscopic repair of MH in children with more emphasis on the short-term outcomes, such as the recurrence, conversion rate, operative, postoperative complications and the fate of the hernia sac.

Patients and methods: Fifteen children with MHs underwent primary laparoscopic repair by placement of U-shaped, nonabsorbable sutures through the full thickness of the anterior abdominal wall incorporating, the posterior rim of the defect, and returning back out through the anterior abdominal wall with the sutures tied in the subcutaneous tissue using the Storz port closure needle and without hernia sac excision, no insertion of chest tube or drain.

Results: A total of 15 patients with MH were operated upon. There were 10 males and 5 females. Left-sided MH was present in five cases (33%), right-sided MH was present in seven cases (47%) and three bilateral MH (20%). Male-female ratio was 2:1. Intraoperative and postoperative analgesia requirement was minimal. All operations were completed laparoscopically. None of the patients developed intraoperative or postoperative complications. The maximum follow-up was 48 months (mean, 20 months). All patients are in good health without recurrence or significant sac residual.

Conclusion: This easy save technique of MH repair is reducing the operative time and postoperative hospital stay. Also it is minims the need of postoperative analgesia. The hernia sac excision or not is not affecting the outcome.

Keywords: Laparoscopic, Morgagni hernia.

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INTRODUCTION

Morgagni-Larrey type hernia occurs through a weakness in the anterior fibers of the diaphragm between its costal and sternal part, in the muscle free triangular space called the Larrey space. It is also called retrosternal, parasternal, substernal and subcostosternal hernia.[1] Although the Morgagni duct is existent congenital diaphragmatic hernias are relatively rare; occurring in 0.02 to 0.05% of live births.[2] Morgagni hernia (MH) is the least common type of congenital diaphragmatic hernia and is often diagnosed incidentally in asymptomatic adults.[3] Since or even before birth, a large number of hernias appear later in infant or childhood age. The condition is often asymptomatic but it is often diagnosed incidentally during the investigation of other conditions.[4] Diagnosis needs a high index of suspicion as misdiagnosis and noncorrection may end in a catastrophe.[5]

Standard surgical procedures for the repair of MH traditionally require a laparotomy or thoracotomy, but with the recent improvement in minimal invasive surgery instrument and vision, repair can safely be performed laparoscopically. The method of laparoscopic closure of the defect and the excision of the sac are debatable.[6] Many technique has been described as primarily closure with a continuous suture by Fernandez et al,[7] interrupted sutures with intracorporeal knot tying, and Ramachandran et al[8] laparoscopic-assisted repair of MH by taking full thickness of anterior abdominal wall in a U-shaped suture under direct vision with extracorporeal knot tying in the subcutaneous tissue is also scribed.[9,10]

I used laparoscopic two ports and Sorze port closure needle to insert U-shape sutures to close the defect in MH of infant and children without excision of the sac or insertion of chest drain. This is simplified technical and can help surgeons to overcome difficulties of the laparoscopic surgery, reduce the number of port and improve the operative outcome. This article describes the operative technique and its short-term outcome.

PATIENT AND METHODS

This study was conducted in Royal Commission Medical Center (RCMC) Yanbu, KSA between March 2008 and April 2012. All patients with Morgagni diaphragmatic hernia MH were subjected to thorough clinical examination and routine laboratory and radiological investigations. The main outcome measurements were feasibility of the technique, conversion rate, operative time, blood loss, postoperative analgesic requirement and hospital stay, fat of the nonexcised hernia sac and recurrence rate. The technique was approved by the ethical committee of the hospital. Written detailed informed consent was obtained from all

the parents. All the patients received one dose of antibiotic prophylaxis in the form of ceftriaxone 50 mg/kg at the time of induction of anesthesia. All patients went preoperative assessment aiming to exclude patients with significant pulmonary hyperplasia and identify other congenital anomalies. Preoxygenation with O_2 100% without positive pressure was done. The routine monitoring as pulse oximetry, capnometry, ECG, precordial stethoscope and noninvasive blood pressure, were applied before the induction of the anesthesia and during the operation. The induction of anesthesia was done mainly by inhalation agent (sevoflurane), intravenous fentanyl (1-2 µg/kg) and atracurium (0.5 mg/kg) then the trachea was intubated. General anesthesia (GA) was maintained with 1.5 MAC sevoflurane in air/O_2 (FiO_2 = 0.5). The lungs were mechanically ventilated using pressure-controlled ventilation aiming $EtCO_2$ between 25 to 30 mm Hg. An additional dose of 0.5 µg/kg of fentanyl was given intraoperatively, if the heart rate increased >20% of the basal record. Just before closure of the skin, anesthesia was discontinued and then tracheal extubation was done once the patient fulfilled the criteria of extubation. Maintenance of fluids was with D_5½ normal saline (4 ml/kg/hour). After induction of GA, the patient was placed in anti-Trendelenburg, position (head up 15-20º). The surgeon position was at the left side of the patient. A 5 mm vise port with 5 mm telescope was inserted supra or infra umbilicus according to the baby abdominal size by close technique under vision. Pneumoperitoneum was adjusted to a pressure of 10 to 12 mm Hg, according to the child condition and the anesthesia monitor of the cardiorespiratory state. Through this port 5 mm, scope 30° was used for initial visualization of the abdominal cavity and the diaphragmatic defect. Second 5 mm accessory port was inserted under direct vision in the left subcostal space below the nipple (Fig. 1).

The patient position and the pneumoperitoneal pressure often aids in the reduction of the hernial content to the abdomen and also increase the abdominal cavity space. Once the intestine was reduced into the abdomen, the falciform ligament of the liver was dissected by the harmonic dissector to free the liver from the diaphragm and also remove all the tissue passing from the abdomen to the chest though the defect. The diaphragmatic defect was examined all around (Fig. 2).

The defect was closed by U shape nonabsorbable 2/0 proline sutures. Knot tying was extracorporeal and subcutaneous. The sutures would be placed between the posterior rim of the diaphragmatic defect and the intercostal muscles with the aid of Storz port closure needle (Fig. 3).

Three to four stitches are usually required to complete the repair (Fig. 4). A snip incision of the skin was done over the intercostal space above the diaphragmatic defect for insertion of the facial needle. A 2/0 proline was mounted into the hollow of the needle. The needle was introduced into the chest cavity and manipulated to pass through the

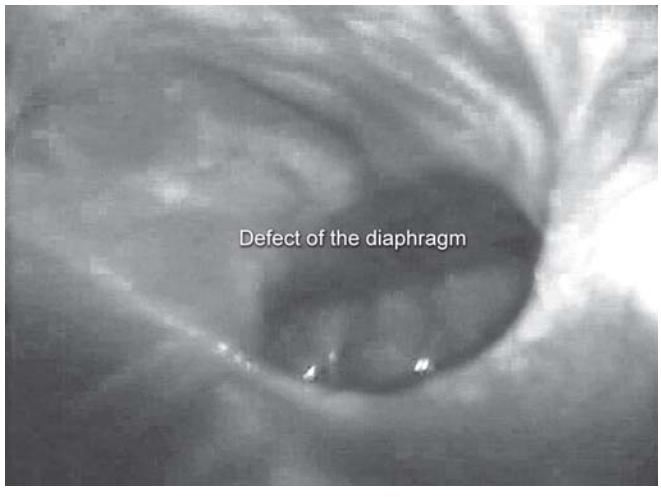

Fig. 2: The diaphragmatic defect

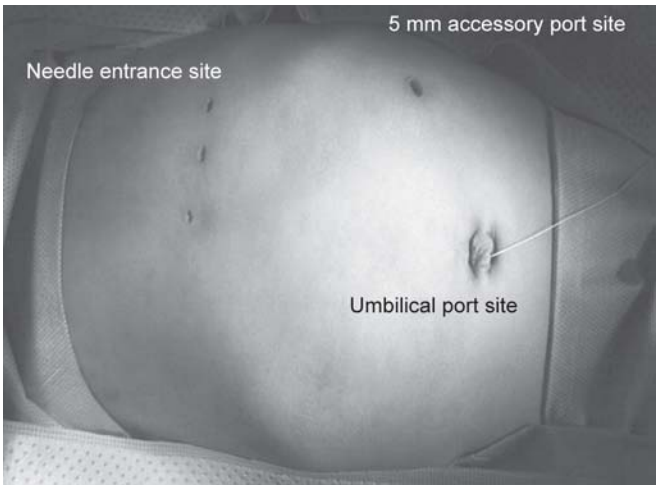

Fig. 1: This is port site

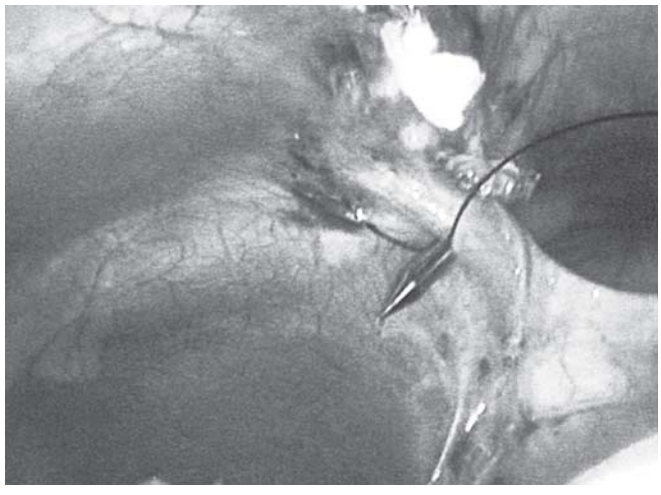

Fig. 3: This is Storz port closure needle U-shape suture

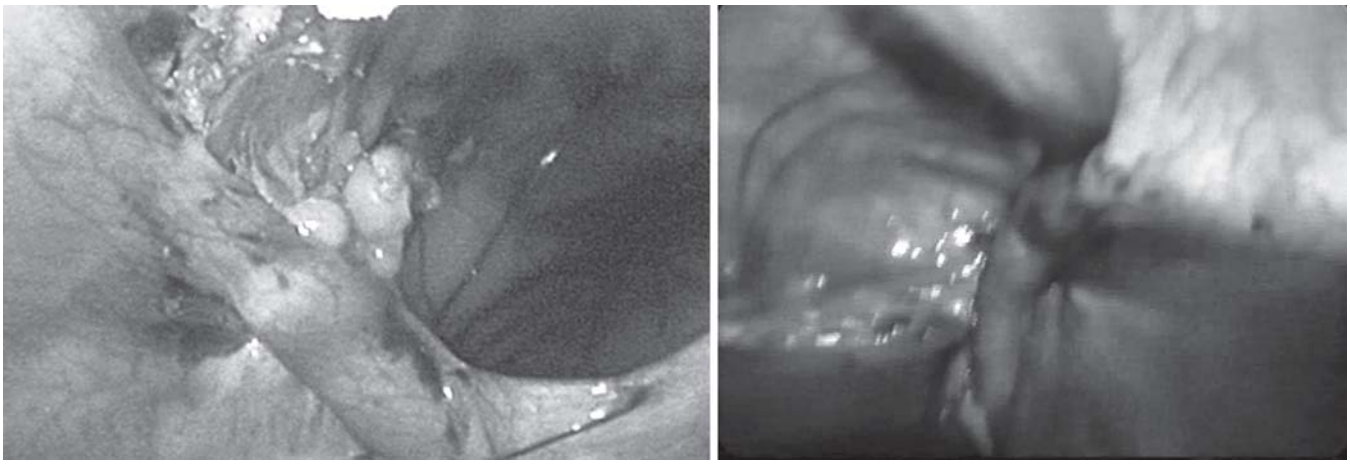

Fig. 4: This is the U sutures between the intercostals and diaphragmatic rim before and after ligation

free posterior rim of diaphragmatic defect. Then the hollow of the needle was opened and the thread was pulled out by the dissector. The needle was withdrawn to come out from the chest. Though the same previous skin incision the nonmounted facial needle was passed transverse 1.5 cm subcutaneously to re-enter the chest and pass through the diaphragmatic defect again. The hollow of the needle was opened and the thread was fixed to the needle by the grasper aid. The needle was withdrawn to come out from the chest but this time with the thread forming U-shape suture puling the diaphragmatic muscle up toward the chest wall closing the defect. The two ends of the thread were tightened extracorporeal forming a mattress suture, closing the anterior diaphragmatic defect. The procedure was repeated again to close the whole defect at the anterior aspect. All of the defects were repaired primarily without tension or need for any mesh. No drain or chest tube was inserted. Full inspection of the diaphragm and the closed defect was done. Laparoscopic abdominal exploration was done in all cases. Postoperatively, all patients started regular feeding after full recovery from anesthesia and audible normal intestinal sound. All patients were discharged with normal plan chest X-ray. Outpatient clinic visit after 7 days, 2 weeks, 6 months and 1 year later was planned for patient follow-up.

RESULTS

A total of 15 patients with MH were operated upon. There were 10 males and five females. Left-sided MH was present in five cases (33%), right-sided MH was present in seven cases (47%) and three bilateral MH (20%) (Table 1).

The statistic evaluation of the operative time and hospital stay were in Table 2.

There was a hernial sac in all patients. The hernia included in its content; transverse colon alone in 11 patients, transverse colon and small intestine in two patients, left lobe of the liver and intestine in two patients. Reduction of

Table 1: Patient's demography

No.	*Age (months)*	*Presenting symptom*	*Defect*	*Associated anomalies*	*Sex*
1	5	Nonspecific symptom cardiac	Left side	Male rotation	Female
2	6	Chest wheeze	Right side	—	Male
3	6	Nonspecific disorder neurologic	Bilateral	—	Male
4	7	Recurrent chest infection	Left side	Male rotation	Male
5	9	Recurrent chest infection	Right side	—	Male
6	11	Recurrent vomiting idiopathic	Right side	—	Male
7	13	Recurrent vomiting idiopathic	Left side	Male rotation, appendix in the falciform ligament of the liver	Male
8	10	Palpitation with dyspnea	Right side	—	Female
9	19	Nonspecific disorder neurologic	Bilateral	—	Male
10	8	Palpitation and dyspnea	Bilateral	—	Male
11	20	Vomiting	Left side	—	Male
12	14	Constipation with abdominal distension	Right side	—	Female
13	12	Recurrent chest infection with gastroesophageal reflux	Left side	—	Male
14	24	Bronchial asthma with vomiting	Right side	—	Female
15	22	Bronchial asthma	Right side	Male rotation	Female

Table 2: The statistic result

Age (months)	19 ± 12.40
Operative time (minutes)	55 ± 34.33
Hospital stay (days)	5 ± 3.47

hernial contents was easy in 13 cases and difficult in two cases. The diaphragmatic defect was closed directly by suturing the posterior diaphragmatic edge of the defect with the intercostal muscles using Storz port closure needle in all patients. The hernial sac was excised in three cases. The procedure was completed easily and successfully in 14 (93.3%) patients. Elective conversion was required only in one (6.7%) patient, because the liver was preventing save needle manipulations to do suture in small abdominal cavity. A prosthetic patch was not required in any patient, as the defects were closed without tension. There was no blood loss. A chest drain was not inserted in all patients and there was not any complication from the nonexcised sac. All patients achieved full recovery without intra- or postoperative complications. After the operation, a conventional ventilator was required for two children. The mean postoperative ventilatory support was 1 day.

All patients started with paracetamol suppository 15 mg/kg/dose, 10 patients needed second dose after 6 hours. Two patients needed fentanyl (0.5 µg/kg) plus midazolam (0.05-0.1 mg/kg).

There was no morbidity, mortality or recurrence all over the follow-up period. Chest X-ray and clinical examination were normal in all patients at the 6th month postoperatively. Practically, no visible scars were reported at the 1 year follow-up.

DISCUSSION

The diagnosis of the MH may be difficult and patients often undergo extensive investigations. However, it may be discovered accidentally during routine investigations for other problems. The diagnosis is usually apparent on chest radiograph and can be confirmed with computed tomography (CT) or magnetic resonance imaging (MRI). Barium enema or meal is rarely required as the sensitivity of CT and MRI approaches 100%.[11] In this study CT was 100% sensitive, while the chest radiography was suspecting a lesion in 11 (73.3%) cases and did not show any significant radiological signs in other four patients (26.6%). One barium enema was done to exclude colonic intestinal obstruction in the hernia.

Because MH is rare, comparing conventional open repairs with laparoscopic repairs have not been performed. Patient demographics, hernia characteristics and perioperative outcomes for the 15 cases of laparoscopic repair of MH are summarized in Tables 1 and 2. Only four patients were discharged after the second postoperative day, and there were no perioperative morbidities or operative mortalities. There have been no recurrences reported in laparoscopic MH repairs, but long-term follow-up has not been provided.

Transabdominal exploration and reduction of the hernial contents followed by suture closure of the hernial defect is commonly performed. However, laparoscopic repair, first carried out by Kustar et al[12] in 1992, since that, much modification has been described to improve, ease the operative technique and the outcome. Improved video technology, laparoscopic instruments, and surgical skills have allowed surgeons to expand the repetition of minimally invasive procedures.

In traditional laparoscopic approaches to a MH, a 3-trocar technique is generally used with the umbilical site used for visualization (usually a 3 or 5 mm telescope) and 2 upper abdominal working ports. Depending upon the patient size, the working instruments may range in size from 2 to 5 mm. Triangulation of the access sites allows intracorporeal sewing and tying with relative ease, in a sense, mimicking the natural ergonomics of open surgery.[11,13]

In this study, the facial needle was useful as it reduced the need for more than one port to perform the dissection of the falciform ligament of the liver, help in the hernial content reduction and aid the facial needle thread holding intracorporal.

In a MH the retrosternal rim of the diaphragm is frequently absent, and a simple suture technique is usually not possible. Suturing of the diaphragmatic hernial margin to the peritoneum or periosteum behind the sternum is difficult and not very solid, particularly with the laparoscopic approach.[13] The defect itself may be closed either by primary suture closure, primary placement of a mesh, or by a combination of both.[9,14] In this work, I performed laparoscopic repair of MH using the full thickness of the anterior-abdominal wall to the posterior diaphragmatic rim, with extracorporeal knot tying in the subcutaneous tissue without the need of a mesh in all cases.

Insertion of the needle from outside the thoracic cavity into the intercostal muscles was not difficult but the negotiation of the needle with the posterior diaphragmatic rim was the challenge and need for some aide by the grasper. The U sutures between the intercostal muscles and the free posterior diaphragmatic edge in the part of the defect were effective. Extracorporeal ligation of the suture was ease. It abolishes the difficulty of intracorporeal suturing and knot tying. It does not need a long learning curve and is an effective rapid technique for closure of MH in children. The repair described in this paper takes advantage of the fact that it incorporates the whole thickness of the intercostal

muscles with the anterior rim of the diaphragmatic defect and provides a tension free strong repair with minimal port site and good cosmetic outcome.

The excision of the hernial sac is controversial. Some advice hernial sac excision while other does not.[15] The cavity obliteration was the same with nonexcised cases.[10] In these study only three cases, hernial sac was excised as it comes to the abdominal cavity during the reduction of the content. There was no bleeding with hernial sac excision by harmonic tissue dissector. It was increasing the operative time. Farther more, I did not insert chest tube or chest drain in all cases. The chest X-ray was normal all over the follow-up period. Traditionally, other studies which use standard surgical procedures for the repair of MH, require a laparotomy which need more anesthetic, analgesic intervention and delayed recovery. The patient not only get benefit from the minimally invasive approach, early recovery from major surgery and minimal scaring, but also, abdominal exploration and detection of associated intra-abdominal anomalies.

CONCLUSION

This easy and save technique of MH repair is reducing the operative time, anesthetic, analgesic requirement and postoperative hospital stay. There is not effect of excision of hernial sac on the outcome of surgery.

REFERENCES

1. Cullen ML, Klain MD, Phillipart Al. Congenital diaphragmatic hernia. Surg Clin North Am 1985;65:1115-38.
2. Akhavan-Heidari M, Edwards D, Besenhaver J, Wolfer R. Incidental finding of congenital thoracic malformations in adult population. South Med J 2006;99:539-43.
3. Rogers FB, Rebuck JA. Case report: Morgagni hernia. Hernia 2006;10:90-92.
4. Contini S, Dalla Valle R, Bonati L, Zinicola R. Laparoscopic repair of a Morgagni hernia: Report of a case and review of the literature. J Laparoendosc Adv Surg Tech 1999;9:93-99.
5. Fell SC. Surgical anatomy of the diaphragm and phrenic nerve. Chest Surg Clin N Am 1998;8:281-94.
6. Lima M, Domini M, Libri M, et al. Laparoscopic repair of Morgagni-Larrey hernia in child. J Pediatr Surg 2000;35: 1266-68.
7. Fernandez Cebrian JM, De Oteyza JP. Laparoscopic repair of hernia of foramen of Morgagni: A new case report. J Laparoendosc Surg 1996;6:61-64.
8. Ramachandran CS, Arora V. Laparoscopic transabdominal repair of hernia of Morgagni-Larrey. Surg Laparosc Endosc Precut Tech 1999;9:358-61.
9. Azzie G, Maoate K, Beasley S, et al. A simple technique of laparoscopic full-thickness anterior abdominal wall repair of retrosternal (Morgagni) hernias. J Pediatr Surg 2003;38:768-70.
10. Mallick MS, Alqahtani A. Laparoscopic-assisted repair of Morgagni hernia in children. J Pediat Surg 2009;44:1621-24.
11. Hussong RL Jr, Landreneau RJ, Colo FH Jr. Diagnosis and repair of Morgagni hernia. Ann Thorac Surg 1997;63:1474-75.
12. Danielson PD, Chandler NM. Single-port laparoscopic repair of a Morgagni diaphragmatichernia in a pediatric patient: Advancement in single-port technology allows effective intracorporeal suturing. J Pediatr Surg 2010;45:E21-E24.
13. Van De Winkel N, De Vogelaere K, De Backer A, Delvaux G. Laparoscopic repair of diaphragmatic Morgagni hernia in children: Review of 3 cases. J Pediatr Surg 2011;46:E23-E26.
14. Korkmaz M, Guvenc BH, Senel U. Minimal access surgical repair of Morgagni hernia: The fate of the unresected hernia sac. J Laparoendosc Adv Surg Tech 2007;17:833-36.
15. Taha A, Radi E, Djamal O. Laparoscopic repair of Morgagni diaphragmatic hernia in infants and children: Do we need to resect the hernia sac? Annals Pediatr Surg 2012 Jan;8(1):1-4.

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