Laparoscope-assisted appendectomy in adults: the two-trocar technique

Fiaz Maqbool Fazili,* Yousef Al Bouq,† Osman.M. El Hassan,* Hossam Fawzi A Gaffar †

BACKGROUND: Open appendectomy is still the most common method of treating appendicitis. Laparoscopic procedures for removal of the appendix by the "in" technique as an alternative to conventional appendectomy have gained wide popularity, but have been criticized for their technical difficulty and high cost. We assessed the safety and efficacy of the laparoscope-assisted appendectomy (the two-trocar technique) in adults.

PATIENTS AND METHODS: We retrospectively studied 129 patients who had appendectomy using the laparoscope-assisted two-trocar technique between July 2002 to December 2003. The procedures were done by consultants and surgeons-in-training with experience in minimally invasive and open techniques. Locally modified endoloop and reusable trocars were used to reduce the cost. Appendectomy was performed extra-abdominally after the appendix was identified by using a laparoscope through one port and then delivered outside through the second port using reusable laparoscopy instruments.

RESULTS: The two-trocar technique was successful in 101 (78.3%) cases; 14 (10.8%) needed a third trocar to complete the operation extra-abdominally, 6 (4.6%) were converted to open surgery, and 5 (3.8%) had an intra-abdominal laparoscopic appendectomy. The mean operation time was 35 minutes (range, 30-90 minutes). Six cases (4.6%) had infection. The mean hospital stay was 2.8 days (range, 2-7 days). No case of port hernia was reported during the follow-up period (range, 14 -30 months).

CONCLUSION: The laparoscope-assisted two-trocar technique for removal of the appendix can be performed as safely and efficiently as the open technique, but at a lower cost than the complete laparoscopic 'in" method and does not need much technical expertise. This method is recommended as an alternative procedure to open appendectomy or the complete laparoscopic "in" technique in adults.

*From the Departments of Surgery, *King Fahad Hospital, Al Medinah Al Munawarah, †Ohud Hospital, Al Medinah Al Munawarah Kingdom of Saudi Arabia*

Correspondence and reprint requests:
Fiaz Maqbool Fazili, MD
P.O. Box 5147Al
Medinah Al Munawarah
Kingdom of Saudi Arabia.
Mobile: +966507545049
Tel/Fax: +966-4-825-5303
fiazmfazili@yahoo.com

Accepted for publication
November 2005

Ann Saudi Med 2006;26(2):100-104

Although laparoscopic treatment for appendicitis has been documented as a feasible and safe alternative to conventional open appendectomy with minimal complications and short hospital stay,[1,2] there remains skepticism in the surgical community with respect to its increased technical difficulty and hospital cost.[3-5] Laparoscopic appendectomy is most frequently performed as "in" appendectomy with three trocars.[6] In an attempt to overcome the criticism, a new technique," laparoscope-assisted"[7,8] and using two trocars has gained acceptance in children.[9] After a careful *Medline* internet search we found no studies of the new two-trocar technique in adults from the Kingdom of Saudi Arabia; only one study in adults in the English literature was found.[10] We report our experience with 129 cases using this technique at Ohud

Hospital Al Medinah Al Munawarah, Saudi Arabia. The aim of this study was to assess the efficacy and safety of this modified technique.

Patients and Methods

During the period starting from July 2002 till December 2003,129 cases of acute appendicitis were done at Ohud Hospital Medinah Al-Munawarah, Saudi Arabia using the 2-trocar technique. Only patients older than 12 years of age were included in this study. Inclusion criteria included—pain in the right iliac fossa with muscle guarding, vomiting, fever, leukocytosis and localized ileus.[9] All the patients had a plain abdominal radiograph and routine blood and urine analysis. Only female patients had a sonographic examination to exclude pregnancy and/or adnexal pathology. Patients diagnosed with diffuse peritonitis were excluded from the study. Informed and written consent for laparoscopic and/or open appendectomy was taken. The procedures were done by consultants and surgeons-in-training who attended an advanced course in laparoscopy and had good experience in the open technique. All the patients were asked to void before going to the operating room. Prophylactic antibiotics in the form of intravenous cefoxitin 1 g (Tabuk Pharmaceutical, Saudi Arabia) plus 500 mg metronidazole were given at the time of induction of anesthesia and were continued for the next 24 hours (3 doses). The same antibiotic regimen was given for 5 days in those cases with localized pus collection. All cases were done using general anesthesia with the patient in the supine position, the operating surgeon standing on the left side and the assistant on the right side and the TV monitor at the foot side. The pneumoperitoneum was established using a Veress needle. A 10-mm trocar was introduced in the supraumblical region and a 10-mm 00 telescope (Stryker 4000 Santa Clara, CA, USA) was introduced to view the intra-abdominal cavity using different table positions. The appendix was identified easily in most of the cases. In case of difficulty a slight lateral tilt to the left with the patient in the Trendelenburg position would solve this problem. The diagnosis of acute appendicitis was confirmed. The tip of the telescope was used to sweep away the omentum and/or intestinal loops obscuring the scene, but sometimes this did not work. In that situation another 10-mm trocar would be introduced in the right iliac fossa under direct vision at the shortest vertical distance between the caecum and the anterior abdominal wall. This access would be used as a working port for further dissection and in case of conversion the same wound would be enlarged to perform open appendectomy. The pull/push and strip and tease technique was used to skeletonize the appendix. Blood vessels up to 1 mm in diameter were controlled by carrying dissection along the mesoappendix border where the vessels are free up to the base. The proposed site of the appendix ligation was marked by briefly touching the appendix by diathermy,[11] with the jaws of the endo-Babcock soaked in India ink and/or methylene blue. The tip of the appendix was grasped gently with the endo-Babcock and pulled out by screwing movements into the sleeve of the right iliac fossa trocar, lifting the wall of the caecum towards the anterior abdominal wall. Once the tenting of the caecal base was seen, the pneumoperitoneum was released to shorten the distance between the caecal wall and anterior abdominal wall, which laxed the opening in the abdominal wall of the 10-mm trocar at the right iliac fossa. With gentle screwing movements and a steady pull on the endo-Babcock, holding the tip of the appendix and simultaneously counter pushing on the skin surrounding the trocar entrance site by gauze, the appendix along with the trocar was pulled out from the peritoneal cavity through this incision. This whole controlled maneuver of traction and push helped to deliver the whole length of the appendix along with the trocar outside the peritoneal cavity. While the endo-Babcock held the appendix in position outside the abdominal cavity, the mesoappendix outside on the abdominal wall was held by an ordinary Babcock allowing the mesoappendix to fan out. The ordinary Babcock replaced the endo-Babcock and the trocar was removed. A conventional appendectomy was then performed extraabdominally. The cut end was painted with Alphadine (povidone iodine 10%W/V Riyadh Pharma, Riyadh, Saudi Arabia) and the pneumoperitoneum was re-established. During this procedure care was taken to avoid any parietal contact during the delivery of the appendix from the peritoneal cavity and when the stump was reinserted in the peritoneal cavity, by surrounding the outside incision with Alphadine-soaked gauze. The cut end of the appendix with the base was returned to the peritoneal cavity as the intraabdominal pressure built up. A final check for hemostasis, and abdominal lavage, if necessary, was carried out afterwards. The linea alba was closed using 2-0 interrupted absorbable sutures and the skin was closed with 4-0 subcuticular absorbable sutures. Before skin closure wound lavage with normal saline was performed. In cases with peritonitis, a peritoneal

Table 1. Characteristics, diagnosis and outcome in 129 patients who underwent the two-trocar technique for appendectomy.

	Numberofpatients (%)
Male	59 (45.7)
Female	70 (54.2)
Age range	13 to 65 years
Diagnosis	
Acute appendicitis	105 (81.4)
Gangrenous appendicitis	6 (4.6)
Perforated appendicitis	11 (8.5)
Normal	6 (4.6)
Outcome	
Technique successful	101 (78.3)
Third trocar needed	14 (10.8)
Appendix difficult to deliver intact	5 (3.8)
Appendicular mass converted to the open technique	6 (4.6)

lavage using 3 to 5 liters of normal saline was performed and a vacuum drain was left in the pelvis and brought through a side port. All the appendix specimens were sent for histopathological examination. In some cases it was difficult to mobilize the appendix because of a short or dense mesentery or adhesions. In those cases another 5-mm port in the left iliac fossa was introduced medial to the anterior iliac spine just above the bikini line and away from the urinary bladder, avoiding the inferior epigastric vessels. This additional port further facilitated the use of instruments for mobilization or skeletonization of the appendix and clipping the appendicular artery with an endodissector, hook scissors, and a knot pusher or endoclip. In cases where the appendix could not be delivered due to friability, the base of the appendix was ligated first by the locally made 2-0 vicryl endoloop and then the base was cut with scissors inside the peritoneal cavity. To avoid contact with the parietal peritoneum the thumb end of a sterile glove and/or a plastic cover of a nasogastric tube was used to deliver the appendix in pus-laden gangrenous cases. The operation time was measured at the time from skin incision to closure. The results were analyzed using Microsoft Access.

Results

In the 18-month period, 129 appendectomies were performed. Fifty-nine patients (45.7%) were females and 70 patients (54.2%) were males. Patient ages ranged from 13 to 65 years (Table 1). All the specimens were sent for histopathological examination. The diagnosis of acute appendicitis was made in 105 (81.4%) cases, gangrenous appendicitis in 6 (4.6%), and perforated appendicitis in 11 (8.5%). Six specimens (4.6%) were reported as normal. There was one case of appendiceal cancer detected during this study and 10 (7.7%) had concomitant adnexal pathology. The two-trocar technique was successful in 101 (78.3%) cases, while 14 (10.8%) needed a 5-mm third trocar in the left iliac fossa, beneath the bikini line to complete the laparoscope-assisted operation. In five cases (3.8%) the appendix was difficult to deliver intact through the right iliac fossa port because of a friable appendix, gangrenous and/or perforated, and autoamputated with localized pus collection. In these cases a laparoscopic "in" operation was performed. In all these cases of peritonitis a Redivac drain through the third 5-mm trocar incision in the left iliac fossa was left in place until it stopped draining. Six cases (4.6%) had appendicular mass, and they were all converted to the open tecnique extending the right iliac fossa port wound. The right iliac fossa trocar incision had to be enlarged in 3 (2.4%) cases to permit easy delivery of a turgid appendix with an edematous and inflamed mesoappendix even after using the third port site to ease out the adhesions. The mean operation time was 35 minutes (range, 30-90 minutes) and the mean hospital stay was 2.8 days (range 2-7 days).

A few postoperative complications were encountered (Table 2). These included one case of a port abscess diagnosed on the sixth postoperative day in a patient with perforated appendicitis, which was drained. Six patients (4.6%) had minor wound infections, including one patient with a caecal perforation complicating electrocautery of the appendicular artery, which was detected on the second postoperative day. This patient had open drainage and primary closure of her caecal perforation. She had an uneventful recovery. One case of appendiceal carcinoma with peritoneal metastases was detected. The operation was completed by converting to the open technique. No case of port site hernia was seen throughout the follow-up period (range14 to 30 months).

Discussion

Conventional open appendectomy is still the most common method of treatment for acute appendicitis and has stood the test of time even when performed by the surgeon-in-training at odd hours when senior surgeons are not available. Two hundred forty-three appendectomies were done in our institution during the study period. Although the technique of laparoscopic appendectomy using three trocars is gaining acceptance and popularity,[2,12-13] there are still reservations on its technical difficulties and cost.[5,14-16] Inspired by these arguments, we thought of using the 2-trocar laparoscope-assisted appendectomy in adults. The procedure is simple, cost effective and has all the advantages of minimally invasive and open surgery.[9,10] Using this technique, we managed to spare the cost of two endoloops and one trocar saving up to US $220 per case compared with the three-trocar technique. In case of conversion to the open procedure the wound for the trocar in the right iliac fossa can be used for a conventional ("McBurney") incision. Like other laparoscopic procedures we noticed that the operative time is related to the learning curve. Identification of the ceco-appendicular junction is very important so as not to leave a big stump of the appendix. This is done by accurate marking of the base, using methylene blue, India ink and/or electric cautery.[11] Diagnostic laparoscopy has been advocated to clarify the diagnosis in equivocal cases and has been shown to reduce the rate of unnecessary appendectomy. Our figure of 4.6% was far less than the reported series (25.4%) using the open technique.[17] It is most effective in female patients of childbearing age since a gynecological cause of pain is easily identified, as visualization of the pelvis is superior.[18] Despite the restricted selection criteria in females, 10% of our patients still had adnexal problems detected intraoperatively. Although having access to the abdomen is an opportunity and advantage in dealing with adnexal problems in the same sitting, we suggest that there is a further scope for improvement in the preoperative screening of females in childbearing age. Six patients (4.6%) had minor wound infection, which is slightly more than the 2.3% reported in the laparoscopic technique and less than the 6.1% reported in the open technique.[19] We had one major complication related to direct injury of the caecum caused by excessive use of electrocautery in the vicinity of the ceco-appendicular junction. Electrocautery should be discouraged. There is no obvious mention of caecal injury in laparoscopic appendectomy apart from the 0.2% rate of bowel injury reported in a study from Switzerland of 2179 cases.[20] The laparoscope-assisted appendectomy using the two-trocar technique combines the advantages of the minimally invasive and open methods besides being economical and technically easy. For these reasons, the two-trocar technique is suggested as an alternative to other appendectomy procedures in adults. One of the restricting factors in doing this technique is that it needs to be done by fairly senior doctors in surgical training and this may exclude junior residents who are doing the majority of these cases by the open technique. For this reason, we encourage basic training in laparoscopy to be an integral part of the surgical training programme.

Table 2. Postoperative complications in 129 patients who underwent appendectomy.

Port abscess	1 (0.7%)
Minor wound infections	6 (4.6%)
Appendiceal carcinoma with peritoneal metastases	1 (0.7%)

We wish to thank Dr. I Valioulis for his kind help.

References

1. Hellberg A, Rudberg C, Kullman E et al. Prospective randomized multicentric study of laparoscopic versus open appendectomy. *Br J Surg* 1999;86:48-53.

2. Ozmen MM, Zulfikaroglu B, Tanik A, Kale T. Laparoscopic versus open appendectomy: Prospective randomized trial .*Surg Laparosc Endosc* 1999;9:187-189.

3. Merhoff AM, Merhoff GC, Flanklin ME. Laparoscopic versus open appendectomy. *Am J Surg* 2000;179:375-378.

4. Martin LC, Puente I, Sosa Bassin A,et al. Open versus laparoscopic appendectomy: a prospective randomized comparison study. *Ann Surg* 1995;22:256-261.

5. McCahill LE, Pellegrini CA, Wiggis T et al. A clinical outcome and cost analysis of laparoscopic versus open appendectomy. *Am J Surg* 1996;171:533-7.

6. Gilchrist BF, Lobe TE, Schropp KP et al.Is there a role for laparoscopic appendectomy in pediatric surgery? *Pediatr Surg* 1992;27:209-214.

7. Valla JS, Ordorica-Flores RM, Steyaert H et al. Umbilical one-puncture laparoscopic assisted appendectomy in children. *Surg Endosc* 1999;13:83-85.

8. Varler F, Tardieu D, Limonne B et al. Laparoscopic versus open appendectomy in children. *Eur J Pediatr Surg* 1994;4:333-337.

9. Valioulis I, Hameury F, Dahmani L, Levard G.Laparoscope -Assisted appendectomy in children :The Two -Trocar technique. *Eur J Pediatr Surg* 2001;11:391-394

10. Nicholson T, Tiruchelvam V. Comparison of laparoscopic-assisted appendectomy with intracorporal laparoscopic appendectomy and open appendectomy. *JSLS* 2001;5:47-51

11. Kelly SB, Li AKC. Laparoscopic appendicectomy. *Post Graduate Surgery.*1994;3:60-64.

12. Moberg AC, Montgomery A. Appendicitis: Laparoscopic versus Conventional Operation. A study and review of the literature. *Surg Laparosc Endosc* 1997;7: 459-463

13. Tarnoff M, Arabeck U, Goodman M et al. A comparison of laparoscopic and open appendectomy. *J Soc Laparoendosc Surg* 1998; 2:153-158.

14. Huang MT, Wei PL, Chao -Chaun Wu, Lai I R et al. Needlescopic, Laparoscopic, and Open appendectomy: A comparative study. *Surg Laparosc Endosc* 2001;11:306-312.

15. McCahill LE,Pellegrini CA, Wiggins T, Helton WS. A clinical outcome and cost analysis of laparoscopic versus open appendectomy. *Am J Surg* 1996;171:533-7

16. Garbutt JM, Nathaniel JS, Shannon WD, Botero A et al. Meta -Analysis of Randomized Controlled trials comparing laparoscopic and open appendectomy. *Surg Laparosc Endosc* 1999; 9:17-26.

17. Barrat C, Catheline JM, Rizk N, Champault G.Does laparoscopy reduce the incidence of unnecessary appendicectomies? *Surg Laparosc Endosc* 1999; 9:27-31.

18. Gandy CP, Kipling RM,Kennedy RH. Laparoscopic colorectal surgery. Recent Advances of Surgery ed Johnson C, Taylor I, published by Royal Society of Medicine press Ltd London. 2004;27:123-136.

19. Hansen JB, Smithers BM, Schache D, Wall DR, Miller BJ, Menzes BL. Laparoscopic versus open appendectomy. *World J Surg* 1996;20:17-21

20. Schafer M, Krahenbuhl L, Frei E. Laparoscopic appendectomy in Switzerland: A prospective audit of 2179 cases. *Dig Surg* 2000;17:497-502