Conventional Laparoscopic Appendicectomy and Laparoscope-Assisted Appendicectomy: a Comparative Study

Mayank Baid · Manoranjan Kar · Utpal De ·
Mrityunjay Mukhopadhyay

Received: 8 June 2012 / Accepted: 15 January 2013 / Published online: 31 January 2013
© Association of Surgeons of India 2013

Abstract Laparoscopic procedures for removal of the appendix by the three-port technique as an alternative to conventional appendicectomy have gained wide popularity, but they have been criticized for technical difficulty, more time consumption, and high cost. We have compared conventional three-port laparoscopic appendicectomy (LA) and laparoscope-assisted appendicectomy (LAA). In period from August 2010 to January 2012, 77 patients underwent appendicectomy by a minimally invasive procedure (39 LA and 38 LAA), at Medical College and Hospital, Kolkata. All the 39 cases of LA were completed successfully, but of the 38 cases, LAA could be completed only in 32 cases. Of the six cases where LAA could not be completed, five were converted to LA [three because of excessive body mass index (BMI) and two because of bleeding]. One case had to be converted to open appendicectomy because of excessive bleeding. In LA, the mean duration of surgery was less than that in LAA (18.18 versus 24.39 min). Wound infections were more common in LAA compared to LA (six

versus two). Severe postoperative pain was present in eight cases in LAA compared to two in LA. On day 2, 79.487 % patients undergoing LA were discharged compared to 28.947 % in LAA. LA is better as a minimally invasive procedure. LAA can only be done in patients with lower BMI, is more time consuming, has more complications, more incidence of postoperative pain, wound infections, and longer hospital stay.

Keywords Laparoscopic appendicectomy (LA) · Laparoscope-assisted appendicectomy (LAA)

Introduction

Open appendicectomy (OA) has been the most common method of treating appendicitis. Laparoscopic procedures for removal of the appendix by the three-port technique as an alternative to conventional appendicectomy have gained wide popularity, but they have been criticized for its technical difficulty, high cost, and more time consumption [1]. We have compared the conventional laparoscopic appendicectomy (LA) and laparoscope-assisted appendicectomy (LAA).

Materials and Method

In period from August 2010 to January 2012, 77 patients underwent appendicectomy by minimally invasive procedure (39 by LA and 38 by LAA) at Medical College and Hospital, Kolkata. For randomization, the two techniques were performed alternatively; that is, first case was put up for LA, second for LAA, third for LA, and so on. Abdominal pressure

M. Baid (✉) · U. De · M. Mukhopadhyay
Department of General Surgery, Medical College,
88 College Street,
Kolkata, 700 073 West Bengal, India
e-mail: drmayankbaid@gmail.com

U. De
e-mail: utpalde@vsnl.net

M. Mukhopadhyay
e-mail: mrit_drm@rediffmail.com

M. Kar
Department of General Surgery, Malda Medical College,
Malda, West Bengal, India
e-mail: drmkar68@yahoo.co.uk

Fig. 1 Conventional laparoscopic appendectomy. **a** Port placement. **b** Base of appendix tied with the Endoloop

was kept below 12 mmHg in all cases. Cases of appendicular lump and appendicular abscess were excluded from the study. All surgeries were performed under general anesthesia and by the same surgical team.

In LA, the first 10-mm port was placed at umbilicus, the second 10-mm port in suprapubic region, and the third 5-mm port in right iliac fossa. In some cases, the position of second and third ports was modified according to the position of the appendix. The scope was first introduced through the umbilical port to locate the appendix, and after placing the suprapubic and right iliac fossa port, the suprapubic port was used for scope and the umbilical and right iliac fossa port became the working ports. The procedure was performed by standard laparoscopic instruments and 30° 10-mm telescope. Mesoappendix was cauterized by bipolar diathermy. The base of the appendix was tied with Endoloop. The appendix was held by a grasper and cut between Endoloop and grasper and brought out through umbilical port. In some cases where the appendix was inflamed, stretching of umbilical port was required to deliver the appendix. Betadine-soaked gauze was applied at the appendix base. After hemostasis with scope was checked, pneumoperitoneum was deflated (Fig. 1).

In LAA, the first port of 10 mm was made at the umbilicus and the appendix was identified with the scope. The second port of 10 mm was then made in the right iliac fossa over the appendix. The appendix was then grasped and

brought out with the 10-mm port. In many cases, stretching of port was required to deliver the appendix outside. Pneumoperitoneum was deflated, mesoappendix and base were ligated, and appendectomy was done extracorporeally, using conventional instruments as used in OA. Betadine-soaked gauze was applied at the appendix base. The base and the mesoappendix were released back into the abdomen. Pneumoperitoneum was reestablished and hemostasis was checked with the scope (Fig. 2). The Statistical Package for Social Sciences (17) program for Windows was used for statistical analysis.

Results

Of the 77 patients who underwent appendectomy by minimal access technique, 39 had LA and 38 had LAA. Both the groups were well matched for age, sex distribution, and also body mass index (BMI) (Table 1).

The most common position of the appendix was pelvic (46.753 %) followed by retrocecal (33.766 %), paracecal (15.584 %), preileal (2.597 %), and postileal (1.299 %). The distribution of the appendix position was also comparable—retrocecal (12 LA versus 14 LAA), pelvic (15 LA versus 21 LAA), paracecal (9 LA versus 3 LAA), and preileal (2 LA) and postileal (1 LA) ($P=.129$).

Fig. 2 Laparoscope-assisted appendectomy. **a** Incision for right iliac fossa port over appendix. **b** Extracorporeal ligation of appendix after deflation of pneumoperitoneum

Time taken by LA was much less, with mean duration of 18.18 min compared to LAA whose mean duration was 24.39 min ($P=.000$), which is highly significant. Standard error of mean (SEM) of duration for LA was .693 and of LAA was .778. Ninety-five percent of the confidence interval (CI) for LA was 16.82172 to 19.53828 and that for LAA was 22.86512 to 25.91488. The mean duration for LA was found to be less than the lower limit of CI for LAA (Table 2).

Thirteen patients had BMI of $>25 \text{ kg/m}^2$, of whom four were in the LA group and nine in the LAA group ($P=.116$). LA was performed without any difficulty in the four patients, but of nine patients of LAA, we faced difficulty in delivering the appendix out in three; therefore, an extra port had to be placed to complete appendicectomy intracorporeally and thus LAA cases were converted to LA ($P=.073$), which may become significant with larger sample size. A significant correlation was found between BMI of $>25 \text{ kg/m}^2$ and conversion to LA in cases put up for LAA (Spearman's $\rho=.447$).

Complications were more common in LAA compared to LA ($P=.006$). Of the 38 cases of LAA group, one patient had injury to mesoappendix and had to be converted to OA because of excessive bleeding. In two cases, an extra port had to be made to control bleeding by bipolar diathermy, and thus, they had to be converted to LA because of bleeding. In LAA, eight (21.053 %) cases had contamination by fecalith in the right iliac fossa port while performing appendicectomy compared to only one (2.564 %) case of contamination in LA at the umbilical port during delivery of appendix.

During operation, only two (5.128 %) cases of LA required stretching of port compared to 22 (57.895 %) cases of LAA ($P=.000$). The 2 cases of LA and 8 out of 22 cases of LAA developed severe postoperative pain (more than 7 on visual analogue scale on day 1) ($P=.038$). A significant

correlation was found between stretching of port and severe postoperative pain (Spearman's $\rho=.407$).

Wound infection occurred in six cases (15.789 %) of LAA in the right iliac fossa port site, compared to only two cases (5.128 %) of LA where wound infection occurred at the umbilical port site ($P=.125$), which may become significant with larger sample size. The cause may be related to more fecal contamination in LAA during extracorporeal appendicectomy. A significant correlation was found between contamination with fecalith and occurrence of wound infection (Spearman's $\rho=.671$).

Cases undergoing LA were discharged much earlier than LAA ($P=.000$), which is highly significant. Of the 39 patients put for LA, 31 were discharged on day 2 and 8 on day 3 (mean hospital stay was 2.20513 days). The SEM for LA was .0655 and CI was 2.07662 to 2.33338. In comparison, of the 38 cases of LAA, 11 were discharged on day 2, 26 on day 3, and 1 on day 4 (mean hospital stay was 2.7368 days). SEM for LAA was .0816 and CI was 2.580464 to 2.896736. Thus, 79.487 % of patients undergoing LA were discharged on day 2 compared to only 28.947 % of patients undergoing LAA. Most of the patients of LAA were discharged on day 3 (68.421 %).

On follow-up, none of the patients complained of chronic pain and there was no significant scar and almost all patients were satisfied with their operation except for one patient who developed a hypertrophic scar after wound infection at the right iliac fossa port after LAA (Table 3).

All the 39 cases put up for LA were completed successfully without any difficulty. Of the 38 cases scheduled for LAA, LAA was completed successfully only in 32 cases. Of the six cases where LAA could not be completed, five cases had to be converted to LA, three for excessive BMI, and two for bleeding from mesoappendix. One case had to be converted to OA because of excessive bleeding.

Table 1 Demographic data of the patients undergoing laparoscopic appendicectomy and laparoscope-assisted appendicectomy

	LA	LAA	<i>P</i> value ^a	Standard error of the mean	95 % confidence interval	
					Upper limit	Lower limit
Age (years)	24.62*	25.68*	.466	.995 (LA) 1.069 (LAA)	26.5702 27.77524	22.6698 (LA) 23.58476 (LAA)
Sex ratio (M/F)	14:25	17:21	.612 ^b	–	–	–
BMI	22.4218*	23.1589*	.222	.38988 (LA) .45545 (LAA)	23.1859648 24.051582	21.6576352 (LA) 22.266218 (LAA)

* Values are mean

LA laparoscopic appendicectomy, LAA laparoscope-assisted appendicectomy

^a *t* test unless indicated otherwise

^b Chi-square test

Table 2 Comparison between laparoscopic appendectomy and laparoscope-assisted appendectomy in the intraoperative period

	LA	LAA	<i>P</i> value ^a	Standard error of the mean	95 % confidence interval	
	Cases (%)	Cases (%)			Upper limit	Lower limit
Conversion for BMI >25	0 (0)	3 (7.895)	.073 ^d	–	–	–
Bleeding ^b	0 (0)	3 (7.895)	.073 ^d	–	–	–
Contamination ^c	1 (2.564)	8 (21.053)	.012	–	–	–
Stretching of port	2 (5.128)	22 (57.895)	.000	–	–	–
Duration (in minutes)	18.18 [*]	24.39 [*]	.000 ^c	.693 (LA) .778 (LAA)	19.53828 25.91488	16.82172 (LA) 22.86512 (LAA)

^{*} Values are mean

LA laparoscopic appendectomy, LAA laparoscope-assisted appendectomy, BMI body mass index

^a Chi square test unless indicated otherwise

^b from mesoappendix

^c by fecalith

^d May become statistically significant with larger sample size

^e *t* test

Discussion

Appendectomy by McBurney's incision remained the procedure of choice for nearly a century until 1983 when Kurt Semm offered an alternative “laparoscopic appendectomy” [2, 3].

The LA technique has evolved over the years. Attempts have been made to reduce the number of ports and improve cosmesis [4]. Surgeons have explored the standard three-port appendectomy and LAA. Recently, a number of techniques such as single-incision laparoscopic surgery and natural orifice transluminal surgery have been introduced to further improve the outcome and cosmesis of minimal invasive surgery [5]. In many parts of the world, LAA and the conventional three-port LA are still very popular, and we have compared these two techniques in our study.

LA has proved to be clearly beneficial in obese and women of reproductive age group and in patients with diagnostic dilemma [6, 7]. It is also gaining popularity because of shorter operative time, less postoperative pain, and lesser incidence of surgical site infection [8–14]. Its only drawback is slightly higher rate of intra-abdominal abscess [15–18].

LAA is similar to LA, except that the appendix is delivered through the right iliac fossa and tied extracorporeally. It has an added advantage of minimal tissue trauma [19]. It is fast, easy to perform, and expected to decrease overall cost of LA. Its only contraindication is excessive body weight [20, 21].

Cochrane Database of Systematic Reviews 2010 included 67 studies, of which 56 compared LA (with or without diagnostic laparoscopy) versus OA in adults. Wound infections were less likely after LA than after OA [odds ratio (OR) 0.43; CI 0.34–0.54], but the incidence of intra-abdominal abscesses was increased (OR 1.87; CI 1.19–

2.93). The duration of surgery was 10 min (CI 6–15) longer for LA. Pain on day 1 after surgery was reduced after LA by 8 mm (CI 5–11 mm) on a 100-mm visual analogue scale. Hospital stay was shortened by 1.1 days (CI 0.7–1.5). Return to normal activity, work, and sport occurred earlier after LA than after OA. Whereas the operation costs of LA were significantly higher, the costs outside hospital were reduced. Seven studies on children were included, but the results do not seem to be much different when compared to adults. Diagnostic laparoscopy reduced the risk of a negative appendectomy, but this effect was stronger in fertile women [relative risk (RR) 0.20; CI 0.11–0.34] as compared to unselected adults (RR 0.37; CI 0.13–1.01) [15].

They concluded that in those clinical settings where surgical expertise and equipment are available and

Table 3 Comparison between laparoscopic appendectomy and laparoscope-assisted appendectomy in the postoperative period

	LA Cases (%)	LAA Cases (%)	<i>P</i> value ^a
Wound infection	2 (5.128)	6 (15.789)	.125 ^d
Severe postop pain ^b	2 (5.128)	8 (21.053)	.038
Dischargeability ^c	31 (79.487)	11 (28.947)	.000
Hypertrophic scar	0 (0)	1 (2.632)	.308
Patient dissatisfaction	0 (0)	1 (2.632)	.308

LA laparoscopic appendectomy, LAA laparoscope-assisted appendectomy

^a Chi-square test unless indicated otherwise

^b More than 7 on visual analogue scale on day 1

^c on day 2

^d May become statistically significant with larger sample size

affordable, diagnostic laparoscopy and LA (either in combination or separately) seem to clearly have various advantages over OA. They also recommended LA in patients with suspected appendicitis unless laparoscopy itself is contraindicated or not feasible. Especially young female, obese, and employed patients seem to benefit from LA [15, 22]. In our study, all the 39 cases scheduled for LA were completed successfully, but of the 38 cases put up for LAA, LAA could be completed in only 32 cases.

Because of randomization, BMI of $>25 \text{ kg/m}^2$ was found only in four cases put up for LA compared to nine cases for LAA, but it was not statistically significant. Three cases of LAA among the nine cases had to be converted to LA because of difficulty in delivering the appendix out due to high BMI. Therefore, a lesson learnt from the study is that one should avoid LAA in patients with BMI of $>25 \text{ kg/m}^2$.

One case of LAA had to be converted to OA and two to LA because of bleeding from mesoappendix. Possible explanation may be that during appendectomy by LAA, the appendix is pulled out and ligatures are tied under tension, which might loosen when we release the base of the appendix and the mesoappendix back into the abdomen.

Stretching of port was required in many cases of LAA, to deliver the appendix out for extracorporeal appendectomy, and thus, they suffered from significantly higher incidence of severe postoperative pain. Wound infections were also more common in LAA probably because of more incidence of fecal contamination in LAA. Both LA and LAA are equally appealing cosmetically, and patient compliance and satisfaction are excellent.

In this study, we conclude that standard LA is better as a minimally invasive procedure. LAA can only be done in patients with lower BMI, is more time consuming, has more complications, has more incidence of postoperative pain and wound infections, has longer hospital stay, and ultimately is not cost-effective. Therefore, when we have laparoscopic facilities, we must opt for conventional laparoscopic technique for appendectomy.

Acknowledgments We are grateful to the patients for their acceptance and cooperation.

Conflict Interest Nil

References

- Fazili FM, Al-Boug Y, El-Hassan OM, Gaffar HF (2006) Laparoscope-assisted appendectomy in adults: the two-trocar technique. *Ann Saudi Med* 26(2):100–104
- Sweeney KJ, Keane FB (2003) Moving from open to laparoscopic appendectomy. *Br J Surg* 20:257–258
- Lin YY, Shabbir A, So JB (2010) Laparoscopic appendectomy by residents: evaluating outcomes and learning curve. *Surg Endosc* 24:125–130
- AtéI O, Hakgöder G, Olguner M, Akgör FM (2007) Single-port laparoscopic appendectomy conducted intracorporeally with the aid of a transabdominal sling suture. *J Pediatr Surg* 42:1071–1074
- Malik AM (2012) The laparoscopic appendectomy—a recent trend. In: Malik AM (ed) *Advances in laparoscopic surgery*. ISBN: 978-953-307-933-2. [Available at: <http://www.intechopen.com/books/advances-in-laparoscopiesurgery/the-laparoscopic-appendectomy-a-recent-trend>. Accessed 5 June 2012] InTech Press; 2012:3–12
- Yagnik VD, Rathod JB, Pathak AG (2010) A retrospective study of two-port appendectomy and its comparison with open appendectomy and three-port appendectomy. *Saudi J Gastroenterol* 16:268–271
- Vetoretto N, Agresta F (2011) A brief review of laparoscopic appendectomy: the issues and the evidence. *Tech Coloproctol* 15(1):1–6
- Park J, Kwak H, Kim SG, Lee S (2012) Single-port laparoscopic appendectomy: comparison with conventional laparoscopic appendectomy. *J Laparoendosc Adv Surg Tech A* 22(2):142–145
- Kim SY, Hong SG, Roh HR, Park SB, Kim YH, Chae GB (2010) Learning curve for a laparoscopic appendectomy by a surgical trainee. *J Korean Soc Coloproctol* 26:324–328
- Wei B, Qi CL, Chen TF, Zheng ZH, Huang JL, Hu BG, Wei HB (2011) Laparoscopic versus open appendectomy for acute appendicitis: a metaanalysis. *Surg Endosc* 25(4):1199–1208
- Baek HN, Jung YH, Hwang YH (2011) Laparoscopic versus open appendectomy for appendicitis in elderly patients. *J Korean Soc Coloproctol* 27(5):241–245
- Ali R, Khan MR, Pishori T, Tayyab M (2010) Laparoscopic appendectomy for acute appendicitis: is this a feasible option for developing countries? *Saudi J Gastroenterol* 16:25–29
- Kaplan M, Salman B, Yilmaz TU, Oguz M (2009) A quality of life comparison of laparoscopic and open approaches in acute appendicitis: a randomised prospective study. *Acta Chir Belg* 109:356–363
- Li X, Zhang J, Sang L, Zhang W, Chu Z, Li X et al (2010) Laparoscopic versus conventional appendectomy—a meta-analysis of randomized controlled trials. *BMC Gastroenterol* 10:129
- Sauerland S, Jaschinski T, Neugebauer EAM (2010) Laparoscopic versus open surgery for suspected appendicitis. *Cochrane Database Syst Rev* 6(10):CD001546. doi:10.1002/14651858.CD001546.pub3
- Towfigh S, Chen F, Mason R, Katkhouda N, Chan L, Berne T (2006) Laparoscopic appendectomy significantly reduces length of stay for perforated appendicitis. *Surg Endosc* 20:495–499
- Bennett J, Boddy A, Rhodes M (2007) Choice of approach for appendectomy: a meta-analysis of open versus laparoscopic appendectomy. *Surg Laparosc Endosc Percutan Tech* 17:245–255
- Tuggle KR, Ortega G, Bolorunduro OB, Oyetunji TA, Alexander R, Turner PL et al (2010) Laparoscopic versus open appendectomy in complicated appendicitis: a review of the NSQIP database. *J Surg Res* 163:225–228
- Milewicz M, Michalik M, Ciesielski M (2003) A prospective, randomized, unicenter study comparing laparoscopic and open treatments of acute appendicitis. *Surg Endosc* 17:1023
- Konstadoulakis MM, Gomatos IP, Antonakis PT, Manouras A, Albanopoulos K, Nikiteas N et al (2006) Two-trocar laparoscopic-assisted appendectomy versus conventional laparoscopic appendectomy in patients with acute appendicitis. *J Laparoendosc Adv Surg Tech A* 16(1):27–32
- Panait L, Bell RL, Duffy AJ, Roberts KE (2009) Two-port laparoscopic appendectomy: minimizing the minimally invasive approach. *J Surg Res* 153(1):167–171
- Al-Mulhim AS, Al-Mulhim FM, Al-Suwaiygh AA, Al-Masaud NA (2002) Laparoscopic versus open appendectomy in females with a clinical diagnosis of appendicitis. *Saudi Med J* 23:1339–1342