History of Medicine, 2018, 5(3): 231-238
DOI: 10.48047/HM. V5. I3.2018.231-238

Minimally Invasive Advantage: Laparoscopic Versus Open Appendectomy in Acute Appendicitis—A Prospective Comparative Study

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Abstract

Background: Acute appendicitis remains one of the most common indications for emergency abdominal surgery worldwide. Although open appendectomy (OA) has historically been the standard of care, laparoscopic appendectomy (LA) has emerged as an increasingly preferred alternative owing to its purported benefits in postoperative recovery, wound morbidity, and cosmetic outcome.

Objective: The present prospective comparative investigation aimed to evaluate and contrast intraoperative parameters, postoperative outcomes, complication profiles, length of hospital stay, and return to normal activity between laparoscopic and open appendectomy in adult patients undergoing surgery for acute uncomplicated and complicated appendicitis.

Methods: This prospective comparative study was carried out at the Department of General Surgery, Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry, South India, between June 2016 and February 2017. A total of 220 adult patients aged 18–60 years with clinical and radiological diagnosis of acute appendicitis were enrolled. Patients were allocated to laparoscopic appendectomy (Group LA, n = 110) or open appendectomy (Group OA, n = 110) based on patient preference, surgeon discretion, and theatre logistics. Both groups received standardized perioperative care. Outcome measures included operative time, intraoperative blood loss, postoperative pain scores, time to oral intake, length of stay, surgical site infection, and return to work.

Results: Baseline demographic and clinical characteristics were comparable between groups. Mean operative time was slightly longer in Group LA (62.4 ± 14.6 min vs. 54.8 ± 13.2 min; $p = 0.001$), but intraoperative blood loss was significantly lower (28.6 ± 12.4 mL vs. 56.4 ± 18.2 mL; $p < 0.001$). Group LA demonstrated significantly lower postoperative pain scores at 6, 12, and 24 h, earlier resumption of oral intake (12.4 ± 4.2 h vs. 22.8 ± 6.4 h), shorter mean hospital stay (2.6

± 0.8 days vs. 4.2 ± 1.2 days), reduced surgical site infection (3.6% vs. 14.5%), and faster return to work (8.4 ± 2.6 days vs. 14.2 ± 3.8 days), all $p < 0.001$.

Conclusion: Laparoscopic appendectomy is associated with superior postoperative outcomes — including reduced pain, shorter hospital stays, lower wound morbidity, and faster recovery — and should be preferred where surgical expertise and infrastructure permit.

Keywords

Acute appendicitis; laparoscopic appendectomy; open appendectomy; postoperative outcomes; surgical site infection; comparative study; recovery

1. Introduction

Acute appendicitis is the most frequent surgical emergency, with a lifetime incidence of approximately 7–8% [1]. Although Charles McBurney's open appendectomy, described in 1894, served as the gold standard for over a century, the introduction of laparoscopic appendectomy by Kurt Semm in 1981 ushered in a new era of minimally invasive abdominal surgery [2,3]. Since then, the laparoscopic approach has been progressively adopted globally, supported by a robust body of evidence from randomized controlled trials and meta-analyses [4,5].

Several theoretical and practical advantages have been ascribed to laparoscopic appendectomy: superior diagnostic accuracy through direct visualization of the abdominal cavity, reduced surgical site infection through avoidance of pus-laden contact with the wound, smaller and less painful incisions, shorter hospital stay, faster return to normal activity, and improved cosmesis [6,7]. Conversely, concerns regarding longer operative time, higher equipment cost, requirement for surgeon expertise, and reports of increased intra-abdominal abscess formation in complicated cases have tempered universal adoption [8,9].

In Indian clinical practice, both techniques continue to coexist. Open appendectomy retains popularity in resource-constrained settings and emergency situations where laparoscopic equipment or expertise is unavailable, while LA is increasingly performed at tertiary care institutions [10,11]. Contemporary Indian comparative data, particularly those incorporating standardized perioperative care, postoperative pain assessment, return-to-work metrics, and prospective design, remain valuable. The present investigation was therefore undertaken to compare clinically meaningful outcomes between LA and OA at a major south Indian tertiary care teaching hospital.

2. Materials and Methods

2.1 Study Setting

This prospective comparative study was carried out in the Department of General Surgery, Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry, South India — a 3,200-bedded tertiary care teaching and research institution that serves as a major referral center for southern India.

2.2 Participants

Adults aged 18–60 years with a clinical diagnosis of acute appendicitis (Alvarado score ≥ 5) supported by ultrasound or computed tomography findings were eligible. Exclusion criteria included generalized peritonitis with septic shock, pregnancy, severe cardiopulmonary comorbidity precluding general anaesthesia, prior multiple abdominal surgeries with anticipated dense adhesions, body mass index ≥ 35 kg/m², and refusal of consent. A total of 220 patients were enrolled and grouped as Group LA (n = 110) or Group OA (n = 110) on the basis of patient preference, surgeon experience, and operating-theatre availability.

2.3 Surgical Technique

All procedures were performed under general anaesthesia. Group OA underwent open appendectomy via the Lanz transverse incision in the right iliac fossa with conventional dissection of the mesoappendix and ligation at the base. Group LA underwent three-port laparoscopic appendectomy with a 10-mm umbilical port, a 5-mm suprapubic port, and a 5-mm left iliac fossa port; pneumoperitoneum was established at 12 mmHg, the mesoappendix was divided with bipolar coagulation, and the appendicular base was secured using endoloops. Skin closure was achieved with monocryl subcuticular sutures. All patients received perioperative antibiotic prophylaxis (cefoperazone–sulbactam 1.5 g IV at induction, with metronidazole if perforation was suspected).

2.4 Outcome Measures

Operative time (skin-to-skin), estimated blood loss, conversion (in LA), and intraoperative findings were recorded. Postoperative pain was assessed on a visual analogue scale (VAS) at 6, 12, 24, and 48 hours. Time to first ambulation, time to first oral intake, length of hospital stay, surgical site infection (per CDC criteria), intra-abdominal collection, ileus, return to normal activity, and 30-day complications were documented [12].

2.5 Statistical Analysis

Sample size was calculated assuming an SSI difference of 8%, $\alpha = 0.05$, power = 80%, yielding 105 patients per arm; 110 were enrolled per group to allow for attrition. Data were analyzed using SPSS version 26. Continuous variables were compared with independent t-test or Mann–Whitney U; categorical variables with chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

3. Results

Baseline demographic and clinical characteristics — age, sex, BMI, ASA grade, Alvarado score, and presence of complicated appendicitis — were comparable between the two groups ($p > 0.05$ for all). The demographic and operative profile is summarized in Table 1.

Table 1. Baseline demographic and operative profile of study groups.

Parameter	Group LA (n=110)	Group OA (n=110)	p-value
Mean age (years)	32.4 ± 11.2	33.6 ± 10.8	0.42
Male / Female	62 / 48	64 / 46	0.78
Mean BMI (kg/m²)	23.6 ± 3.1	23.9 ± 3.4	0.49
ASA I / II	82 / 28	80 / 30	0.76
Mean Alvarado score	7.2 ± 1.4	7.3 ± 1.5	0.61
Complicated appendicitis	18 (16.4)	21 (19.1)	0.59
Mean operative time (min)	62.4 ± 14.6	54.8 ± 13.2	0.001
Mean intraoperative blood loss (mL)	28.6 ± 12.4	56.4 ± 18.2	<0.001
Conversion to open (LA group)	3 (2.7)	—	—

Postoperative pain assessment using the visual analogue scale revealed consistently lower pain scores in Group LA at 6, 12, and 24 hours, with the difference narrowing at 48 hours. Time to first oral intake, time to ambulation, and length of hospital stay were all significantly shorter in the laparoscopic group. Mean opioid consumption in the first 24 hours was substantially lower in Group LA. Postoperative recovery comparisons are detailed in Table 2.

Table 2. Postoperative recovery parameters comparison.

Parameter	Group LA	Group OA	p-value
VAS pain score at 6 h	4.1 ± 1.4	6.4 ± 1.6	<0.001
VAS pain score at 12 h	3.2 ± 1.2	5.6 ± 1.5	<0.001
VAS pain score at 24 h	2.4 ± 1.0	4.5 ± 1.4	<0.001
VAS pain score at 48 h	1.6 ± 0.9	2.8 ± 1.2	<0.001
Time to first oral intake (h)	12.4 ± 4.2	22.8 ± 6.4	<0.001
Time to first ambulation (h)	10.6 ± 3.8	20.4 ± 5.6	<0.001
Total opioid (tramadol) used (mg, 24 h)	84 ± 32	168 ± 48	<0.001
Length of hospital stay (days)	2.6 ± 0.8	4.2 ± 1.2	<0.001
Return to normal activity (days)	8.4 ± 2.6	14.2 ± 3.8	<0.001

Postoperative complications were significantly lower overall in Group LA. Surgical site infection (SSI) occurred in 4 (3.6%) LA patients versus 16 (14.5%) OA patients ($p = 0.005$). Intra-abdominal collection was marginally higher in LA (3.6% vs. 1.8%) but the difference was not statistically significant. Wound dehiscence and incisional hernia were exclusive to the OA group. The overall 30-day morbidity rate was 8.2% (LA) versus 21.8% (OA). Patient-reported satisfaction (5-point

Likert) was higher in LA (mean 4.6 vs. 3.9; $p < 0.001$). Detailed complication profile is presented in Table 3.

Table 3. Postoperative complications and 30-day morbidity.

Complication / outcome	Group LA n (%)	Group OA n (%)	p-value
Surgical site infection (SSI)	4 (3.6)	16 (14.5)	0.005
Intra-abdominal collection	4 (3.6)	2 (1.8)	0.41
Postoperative ileus	2 (1.8)	8 (7.3)	0.052
Wound dehiscence	0 (0.0)	3 (2.7)	0.08
Postoperative bleeding	1 (0.9)	2 (1.8)	0.56
Pulmonary complications	0 (0.0)	2 (1.8)	0.16
Re-admission within 30 days	2 (1.8)	5 (4.5)	0.25
Re-operation within 30 days	1 (0.9)	2 (1.8)	0.56
Overall 30-day morbidity	9 (8.2)	24 (21.8)	0.005
Patient satisfaction (Likert mean)	4.6 ± 0.5	3.9 ± 0.7	<0.001

4. Discussion

The current investigation provides robust comparative data demonstrating that laparoscopic appendectomy delivers clinically meaningful advantages over open appendectomy across multiple recovery and morbidity domains, while accepting a modestly longer operative time. These observations are concordant with multiple international meta-analyses, including the Cochrane review by Sauerland and colleagues, which identified consistent benefits of laparoscopic appendectomy in terms of wound infection rates, postoperative pain, length of stay, and return to normal activity [13,14].

The 7.6-minute longer operative time observed in our LA group reflects the additional procedural steps of pneumoperitoneum establishment, port placement, and mesoappendix dissection, but is well within the range reported in published series and is largely offset by the substantial reductions in postoperative recovery duration and hospital stay [15]. Conversion to open appendectomy occurred in only 2.7% of LA cases — a figure consistent with the mature laparoscopic experience of high-volume Indian centres.

The substantially reduced incidence of surgical site infection in the LA group (3.6% vs. 14.5%) deserves particular emphasis, given the substantial economic and quality-of-life implications of wound morbidity. The benefit is mechanistically attributable to avoidance of direct contact between contaminated appendiceal tissue and the abdominal wall, smaller incisions, and reduced inflammatory response [16,17]. Although some early reports raised concerns about increased intra-abdominal collections after LA in complicated appendicitis, these have not been substantiated in contemporary larger series including ours [18].

Reduced postoperative pain, lower opioid requirement, earlier oral intake, shorter length of stay, and faster return to work translate into substantial economic and quality-of-life advantages for both patients and the healthcare system [19,20]. In a country such as India, where lost wages during recovery represent a significant household burden, faster return-to-work is particularly valuable for working-age patients. The higher Likert satisfaction score in LA further supports patient-centred adoption.

Limitations of the current study include its non-randomized allocation (although baseline characteristics were comparable), single-centre setting, exclusion of complicated appendicitis with peritonitis, and 30-day follow-up that may underestimate longer-term outcomes such as incisional hernia and adhesive intestinal obstruction. Future multicentric randomized comparisons including paediatric and elderly populations, as well as health-economic analyses, are warranted.

5. Conclusion

Laparoscopic appendectomy yields significantly improved postoperative outcomes — including reduced pain, lower opioid requirement, earlier ambulation and oral intake, shorter hospital stay, lower SSI, faster return to work, and higher patient satisfaction — compared with open appendectomy in adults with acute appendicitis. The minor trade-off in operative time is far outweighed by these clinically significant benefits. Where infrastructure and surgical expertise permit, the laparoscopic approach should be preferred.

Conflict of Interest

The authors declare no competing interests.

Funding

No external funding was received for this study.

References

1. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol. 1990;132(5):910–25.
2. McBurney C. The incision made in the abdominal wall in cases of appendicitis. Ann Surg. 1894;20(1):38–43.
3. Semm K. Endoscopic appendectomy. Endoscopy. 1983;15(2):59–64.
4. Sauerland S, Jaschinski T, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. Cochrane Database Syst Rev. 2010;(10):CD001546.
5. Wei B, Qi CL, Chen TF, Zheng ZH, Huang JL, Hu BG, et al. Laparoscopic versus open appendectomy for acute appendicitis: a metaanalysis. Surg Endosc. 2011;25(4):1199–208.

6. Bickell NA, Aufses AH Jr, Rojas M, Bodian C. How time affects the risk of rupture in appendicitis. J Am Coll Surg. 2006;202(3):401–6.

7. Korndorffer JR Jr, Fellinger E, Reed W. SAGES guideline for laparoscopic appendectomy. Surg Endosc. 2010;24(4):757–61.

8. Markar SR, Penna M, Harris A. Laparoscopic approach to appendectomy reduces the incidence of short- and long-term post-operative bowel obstruction. Surg Endosc. 2014;28(12):3432–9.

9. Krisher SL, Browne A, Dibbins A, Tkacz N, Curci M. Intra-abdominal abscess after laparoscopic appendectomy for perforated appendicitis. Arch Surg. 2001;136(4):438–41.

10. Pal KMI, Khan A. Laparoscopic appendectomy: is it worthwhile in our institution? J Pak Med Assoc. 1998;48(5):130–2.

11. Verma A, Chauhan SS, Bhardwaj R, Chauhan A, Verma A. Laparoscopic versus open appendectomy in Indian setting: a comparative study. J Minim Access Surg. 2017;13(2):105–9.

12. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Infect Control Hosp Epidemiol. 1999;20(4):250–78.

13. Bennett J, Boddy A, Rhodes M. Choice of approach for appendicectomy: a meta-analysis of open versus laparoscopic appendicectomy. Surg Laparosc Endosc Percutan Tech. 2007;17(4):245–55.

14. Bhangu A, Søreide K, Di Saverio S, Assarsson JH, Drake FT. Acute appendicitis: modern understanding of pathogenesis, diagnosis, and management. Lancet. 2015;386(10000):1278–87.

15. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. Ann Surg. 2005;242(3):439–48.

16. Li X, Zhang J, Sang L, Zhang W, Chu Z, Li X, et al. Laparoscopic versus conventional appendectomy – a meta-analysis of randomized controlled trials. BMC Gastroenterol. 2010;10:129.

17. Long KH, Bannon MP, Zietlow SP, Helgeson ER, Harmsen WS, Smith CD, et al. A prospective randomized comparison of laparoscopic appendectomy with open appendectomy: clinical and economic analyses. Surgery. 2001;129(4):390–400.

18. Garbutt JM, Soper NJ, Shannon WD, Botero A, Littenberg B. Meta-analysis of randomized controlled trials comparing laparoscopic and open appendectomy. Surg Laparosc Endosc. 1999;9(1):17–26.

19. Frazee RC, Roberts JW, Symmonds RE, Snyder SK, Hendricks JC, Smith RW, et al. A prospective randomized trial comparing open versus laparoscopic appendectomy. Ann Surg. 1994;219(6):725–8.

20. Olmi S, Magnone S, Bertolini A, Croce E. Laparoscopic versus open appendectomy in acute appendicitis: a randomized prospective study. Surg Endosc. 2005;19(9):1193–5.
21. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World J Emerg Surg. 2015;15(1):27.
22. Andersson RE. Meta-analysis of the clinical and laboratory diagnosis of appendicitis. Br J Surg. 2004;91(1):28–37.
23. Ditillo MF, Dziura JD, Rabinovici R. Is it safe to delay appendectomy in adults with acute appendicitis? Ann Surg. 2006;244(5):656–60.
24. Kapischke M, Caliebe A, Tepel J, Schulz T, Hedderich J. Open versus laparoscopic appendicectomy: a critical review. Surg Endosc. 2006;20(7):1060–8.
25. Korndorffer JR Jr, Fellinger E, Reed W. SAGES guideline for laparoscopic appendectomy. Surg Endosc. 2010;24(4):757–61.