

ORIGINAL ARTICLE

Clinical Outcomes of Laparoscopic Appendectomy in Complicated Appendicitis among Young Children

TARIQ HAYAT KHAN¹, SYED AAMER HUSSAIN², ALI GOHAR KHAN³, TARIQ JAMIL⁴, FAZAL HUSSAIN⁵, SUMMAR FATIMA⁶¹Assistant Professor, General and Laparoscopic Surgery, Lady Reading Hospital, Peshawar²Specialist Registrar General Surgery, Ayub Teaching Hospital, Abbottabad³Associate Professor General Surgery, Fauji Foundation Hospital, Peshawar Cantt⁴Associate Professor, General Surgery, Bakhtawar Amin Medical College, Multan⁵Consultant Surgeon Polyclinic Hospital, Peshawar⁶MBBS, DA, MS Anaesthesia, Specialist Anaesthetist, Al Nafees Medical College and Hospital Isra University, Islamabad Campus

Corresponding author: Syed Aamer Hussain, Email: Aamer183@hotmail.com

ABSTRACT

Background and Aim: Despite the good outcomes associated with laparoscopic appendectomy for uncomplicated appendicitis, the benefits of this procedure for complicated appendicitis are less obvious due to increased infection risk. The current study aims to assess the effectiveness of laparoscopic appendectomy in children with complicated appendicitis.**Patients and Methods:** This retrospective study was conducted on 92 complicated appendicitis cases among young children (<8 years) in the department of Surgery, Lady Reading Hospital, Peshawar for the period from January 2022 to June 2022. Prior to study conduction, surgical consent was provided by each individual. Demographic details such as age and gender, operative time, hospital stay, operative finding, postoperative complications, bowel function return, and oral feed resumption were recorded.**Results:** Of the total 92 cases, 52 (56.5%) were male and 40 (43.5%) were females. The overall mean age was 5.9±0.8 years with an age range from 4.2 to 7.8 years. Among the total cases, 88 (95.7%) underwent complete laparoscopic appendectomy whereas 4 (4.3%) patients needed conversion to open appendectomy. The mean length of hospitalization was 4.8±3.3 days. The operation took 72.8±26.4 minutes. In terms of postoperative complications, the incidence of post-operative ileus, superficial wound infections, and intra-abdominal collections developed in 4 (4.3%), 2 (2.2%), and 6 (6.5%) respectively. There was no death recorded.**Conclusion:** The present study concluded that children with complicated appendicitis can benefit from laparoscopic appendectomy. In addition to its feasibility, safety, rapid recovery and good cosmetic results, this procedure is associated with minimal post-operative morbidity.**Keywords:** Complicated appendectomy, Laparoscopic appendectomy, Clinical outcomes

INTRODUCTION

Appendicular infection accounts for 15% to 20% of pediatric abdominal surgery crises [1]. With the development of laparoscopic surgery in past few years, its treatment has improved. Many publications recognize the benefits of this surgical procedure, and many teams throughout the world use it [2, 3]. In pediatric patients, appendicular pathology is the most common reason for laparoscopy [4]. In children, acute appendicitis is a frequent gastrointestinal condition. Appendicitis affects almost one out of every 13 individuals at some time in their lives, with approximately one-third of all persons experiencing it during childhood or adolescence [5]. In past few years, acute appendicitis has been divided into two types: simple appendicitis (or non-perforating/uncomplicated) and complex appendicitis (or necrotizing/perforating) [6]. The prevalence of these two categories varies greatly with age. Simple appendicitis accounts for approximately 65% of occurrences in the pediatric population [7]. There have been a number of changes to the open appendectomy, including laparoscopic appendectomy [8], antibiotic treatment for complicated appendicitis following surgery, and even the dogma that suspected appendicitis should be operated on as soon as possible to prevent perforation is being replaced with the option of delaying surgery for up to 24 hours in selected cases.

Complication rates have been found to vary from 5 to 15% of all pediatric cases, and as high as 29% in the subset of children with severe appendicitis [9, 10]. In recent years, there has been an increase in interest in non-operative treatment of uncomplicated appendicitis using antibiotics as an alternative to appendectomy [10-12], but we can benefit from further information on the dangers of appendectomy as current practice in the meanwhile. For a long period of time, open appendectomy (OA) was the standard technique for appendicitis, but laparoscopic appendectomy (LA) has gained acceptance among pediatric surgeons [13]. Many published studies have found that LA outperforms OA in uncomplicated appendicitis, particularly in terms of, short hospital stay, reduced postoperative pain, better aesthetic outcomes, early resumption to physical activity, and lower incidence of wound

complications [14]. Therefore, the present study intended to evaluate the clinical outcomes of laparoscopic appendectomy in complicated appendicitis among young children.

METHODOLOGY

This retrospective study was conducted on 92 complicated appendicitis cases among young children (<8 years) in the department of Surgery, Lady Reading Hospital, Peshawar for the period from January 2022 to June 2022. Prior to study conduction, surgical consent was provided by each individual. Demographic details such as age and gender, operative time, hospital stay, operative finding, postoperative complications, bowel function return, and oral feed resumption were recorded. An intraabdominal abscess or an acute appendicitis with purulent discharge was classified as complicated appendicitis. The challenging cases were determined based on surgical results. Patients with appendiceal masses verified on imaging and uncomplicated appendicitis were excluded. All patients underwent intravenous antibiotics prior to surgery (cephalosporin). All LAs were performed under general anesthesia with endotracheal intubation. In all children, a nasogastric tube and Foley catheter were routinely utilized. LA was accomplished using two hands and three trocars. The open approach was used to introduce the 5 mm umbilical port. CO₂ insufflation began at a pressure of 8-10 mmHg. Under direct eyesight, two 5-mm trocars were then implanted in the lower-left quadrant and suprapubically. The appendix was removed and the mesoappendix was cauterized with a monopolar diathermy coupled to a hook or gripping forceps. An extracorporeal or polyglactin endoloop was ligated around the base of the appendix with a Vicryl 2/0 suture, and the appendix was then separated and rapidly evacuated. The patient was given metronidazole 30 mg/kg/24 h and intravenous antibiotics (cefotaxime 100 mg/kg/24 h after surgery).

Postoperative complications were recorded. Postoperative ileus was referred to a 48-hour delay in resuming bowel function. Antibiotics or surgical drainage were used to treat erythema, surgical site infection, or localized wound collection. Abdominal

ultrasonography and/or computed tomography were used to identify intraabdominal collections following appendectomy. Patients with less than 3 cm collections were treated conservatively with intravenous antibiotics.

RESULTS

Of the total 92 cases, 52 (56.5%) were male and 40 (43.5%) were female. The overall mean age was 5.9±0.8 years with an age range from 4.2 to 7.8 years. Among the total cases, 88 (95.7%) underwent complete laparoscopic appendectomy whereas 4 (4.3%) patients needed conversion to open appendectomy. The mean length of hospitalization was 4.8±3.3 days. The operation took 72.8±26.4 minutes. In terms of postoperative complications, the incidence of post-operative ileus, superficial wound infections, and intra-abdominal collections developed in 4 (4.3%), 2 (2.2%), and 6 (6.5%) respectively. There was no death recorded. Figure-1 illustrate the gender's distribution. The demographic details and clinical findings are shown in Table-I. Post-operative complications are depicted in Figure-2.

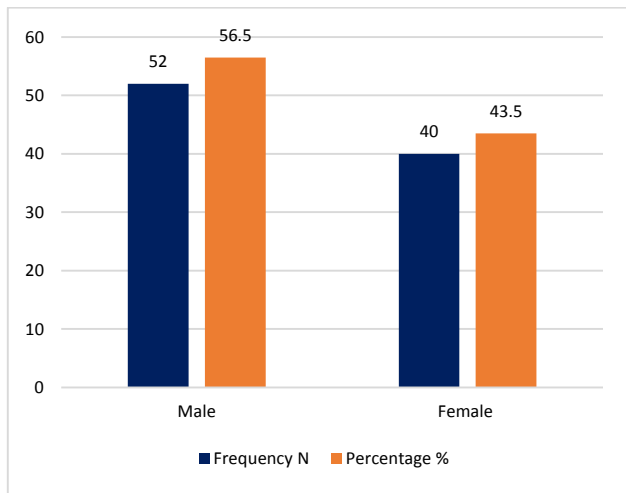


Figure-1: Gender distribution (n=92)

Table-1: Patients demographic and clinical details

Parameters	Value
Age (years)	5.9±0.8
Gender (M/F)	52/40
Completed laparoscopy N (%)	88 (95.7)
Conversion to open appendectomy N (%)	4 (4.3)
Hospitalization stay (days)	4.8±3.3
Operative time (minutes)	72.8±26.4

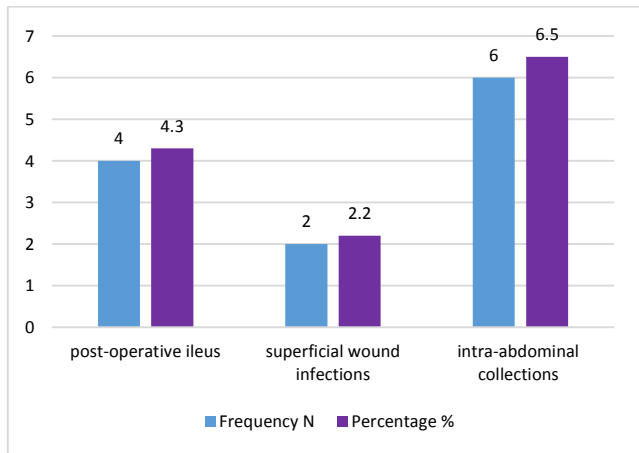


Figure-2: Post-operative complications

DISCUSSION

The present study investigated the clinical outcomes of complicated appendectomy among young children who underwent laparoscopic appendectomy and found that Laparoscopic appendectomy can help children with complicated appendicitis. This surgery is related with minimum post-operative morbidity, in addition to its practicality, safety, speedy recovery, and outstanding aesthetic outcomes. The present study investigated the 92 cases, out of which 52 (56.5%) were male and 40 (43.5%) were females. The overall mean age was 5.9±0.8 years with an age range from 4.2 to 7.8 years. Acute appendicitis is a childhood condition that is more frequent in boys [15, 16]. These findings are consistent with ours, which discovered an average age of 9.5 years and 63% males. In our analysis, the grounds for laparoscopy were more prone to acute appendicitis, nonetheless, there are more difficult cases in our setting [17]. The high prevalence of complex appendicitis is due to a protracted diagnostic lag. Because the wait is so considerable, the risk of problems is high [18]. The most common causes of these problems are extended delays, conventional medications, and incorrect antibiotic usage [17, 19].

According to certain studies [20, 21], there is a lack of strong data supporting the laparoscopic method for complex appendicitis. Others, however, contended that LA is superior to open OA for complicated appendicitis [22, 23]. In comparison to open appendectomy, laparoscopic appendectomy results in less tissue damage, greater abdominal space visibility, avoidance of wound incision, less exposure of wound surface to contaminated fluids, and accurate peritoneal irrigation.

Numerous studies have demonstrated that younger children with appendicitis are more likely to develop complications and have higher rates of perforation due to delayed diagnosis. This may be due to the fact that several nonsurgical disorders such as mesenteric adenitis, gastroenteritis, and constipation can mimic appendicitis, as well as a lack of verbal communication abilities [24, 25].

Numerous findings suggest that as compared to OA, LA significantly decreased the likelihood of postoperative wound infection (1.3% vs. 12.5%) [26, 27]. In this study, the rate of wound infection was 2.2%. As a result of tiny incisions, trocar entry points, and retrieval of the perforated appendix within a retrieval bag, postoperative wound infection is relatively low in LA.

In severe appendicitis, a concern about the postoperative intra-abdominal collection increased risk exist. In our investigation, six (6.6%) individuals had postoperative intraabdominal collection. Jen et al. [28] performed a retrospective analysis of 118 children with complex appendicitis, finding that the incidence of intra-abdominal collection was lower in LA than in OA (5.5 and 7.8%, respectively). Similarly, Horvath et al. [29] discovered a comparable incidence (5.7 vs. 4.3%). This might be because laparoscopy allows the surgeon to investigate the whole intra-abdominal recess and aspirate any visible accumulation.

In the present study, the laparoscopic conversion to open appendectomy was 4.35 that is in normal conversion range varies from 0% to 115 with an average 2.8%. Numerous authors [30, 31] have reported on other conversion grounds such as coagulation problems and technological difficulties. Laparoscopy allows the surgeon to work more comfortably and precisely, fulfilling one of the most basic criteria of surgery: "to see in order to correctly operate" [32].

CONCLUSION

The present study concluded that children with complicated appendicitis can benefit from laparoscopic appendectomy. In addition to its feasibility, safety, rapid recovery and good cosmetic results, this procedure is associated with minimal post-operative morbidity.

REFERENCES

1. Kassem R, Shreef K, Khalifa M. Effects and clinical outcomes of laparoscopic appendectomy in young children with complicated

- appendicitis: a case series. *The Egyptian Journal of Surgery*. 2017 Apr 1;36(2):152-5.
2. Rakhsha M, Hosseinzadeh R, Hosseinzadeh D, Behnamfar M, Kazemi K. Case report of open appendectomy in treating acute perforated appendicitis with necrotizing fasciitis of the abdominal wall: A rare complication of a common disease. *Clinical Case Reports*. 2022 Feb;10(2):e05354.
 3. Romanoff A, Freed J, Heimann T. A case report of necrotizing fasciitis of the abdominal wall: a rare, life-threatening complication of a common disease process. *Int J Surg Case Rep*. 2016; 28: 355-356. doi:10.1016/j.ijscr.2016.09.005.
 4. Bhangu A, Søreide K, Di Saverio S et al (2015) acute appendicitis: modern understanding of pathogenesis, diagnosis, and management. *Lancet* 386:1278–1287. [https://doi.org/10.1016/S0140-6736\(15\)00275-5](https://doi.org/10.1016/S0140-6736(15)00275-5).
 5. Cameron DB, Andalwar SP, Graham DA, Melvin P, Serres SK, Dunlap JL, Kashtan M, Hall M, Saito JM, Barnhart DC, Kenney BD, Rangel SJ (2018) Development and implications of an evidence-based and public health-relevant definition of complicated appendicitis in children. *Ann Surg* 1, 271:–968. <https://doi.org/10.1097/SLA.0000000000003059>.
 6. Bolmers MD, van Rossem CC, Gorter RR et al (2018) Imaging in pediatric appendicitis is key to a low normal appendix percentage: a national audit on the outcome of appendectomy for appendicitis in children. *Pediatr Surg Int* 34:543–551. <https://doi.org/10.1007/s00383-018-4244-2>
 7. Gorter RR, Eker HH, Gorter-Stam MAW, Abis GSA, Acharya A, Ankersmit M, Antoniou SA, Arolo S, Babic B, Boni L, Bruntink M, van Dam DA, Defoort B, Deijen CL, DeLacy FB, Go PMNYH, Harmsen AMK, van den Helder RS, Iordache F, Ket JCF, Muysoms FE, Ozmen MM, Papoulas M, Rhodes M, Straatman J, Tenhagen M, Turrado V, Vereczkei A, Vilallonga R, Deelder JD, Bonjer J (2016) Diagnosis and management of acute appendicitis. EAES consensus development conference 2015. *Surg Endosc* 30: 4668–4690. <https://doi.org/10.1007/s00464-016-5245-7>.
 8. Cameron DB, Williams R, Geng Y, Gosain A, Arnold MA, Guner YS, Blakely ML, Downard CD, Goldin AB, Grabowski J, Lal DR, Dasgupta R, Baird R, Gates RL, Shelton J, Jancelewicz T, Rangel SJ, Austin MT (2018) Time to appendectomy for acute appendicitis: a systematic review. *J Pediatr Surg* 53:396–405. <https://doi.org/10.1016/j.jpedsurg.2017.11.042>.
 9. Tiboni S, Bhangu A, Hall NJ, Paediatric Surgery Trainees Research Network and the National Surgical Research Collaborative (2014) Outcome of appendectomy in children performed in paediatric surgery units compared with general surgery units. *Br J Surg* 101:707–714. <https://doi.org/10.1002/bjs.9455>.
 10. Markar SR, Blackburn S, Cobb R, Karthikesalingam A, Evans J, Kinross J, Faiz O (2012) Laparoscopic versus open appendectomy for complicated and uncomplicated appendicitis in children. *J Gastrointest Surg* 16:1993–2004. <https://doi.org/10.1007/s11605-012-1962-y>
 11. Fujishiro J, Watanabe E, Hirahara N, Terui K, Tomita H, Ishimaru T, Miyata H (2020) Laparoscopic versus open appendectomy for acute appendicitis in children: a nationwide retrospective study on postoperative outcomes. *J Gastrointest Surg*:1–9. <https://doi.org/10.1007/s11605-020-04544-3>.
 12. Jason Fisher (2016) Comparison of medical and surgical treatment of uncomplicated acute appendicitis in children – Clinical Trials. gov. In: Last Updat. December 9, 2016
 13. Xu J, Liu YC, Adams S, Karpelowsky J (2016) Acute uncomplicated appendicitis study: rationale and protocol for a multicentre, prospective randomized controlled non-inferiority study to evaluate the safety and effectiveness of non-operative management in children with acute uncomplicated appendicitis. *BMJ Open* 6:e013299. <https://doi.org/10.1136/bmjopen-2016-013299>.
 14. Knaapen M, van der Lee JH, Bakx R et al (2017) Initial non-operative management of uncomplicated appendicitis in children: a protocol for a multicenter randomized controlled trial (APAC trial). *BMJ Open* 7:e018145. <https://doi.org/10.1136/bmjopen-2017-018145>.
 15. Hall NJ, Eaton S, Abbo O et al (2017) Appendectomy versus non-operative treatment for acute uncomplicated appendicitis in children: study protocol for a multicenter, open-label, non-inferiority, randomized controlled trial. *BMJ Paediatr Open* 1:e000028.
 16. Van Rossem CC, Bolmers MDM, Schreinemacher MHF, van Geloven AAW, Bemelman WA, the Snapshot Appendicitis Collaborative Study Group (2016) Prospective nationwide outcome audit of surgery for suspected acute appendicitis. *Br J Surg* 103:144–151. <https://doi.org/10.1002/bjs.9964>.
 17. Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, de Santibañes E, Pekolj J, Slinkamenac K, Bassi C, Graf R, Vonlanthen R, Padbury R, Cameron JL, Makuuchi M (2009) The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg* 250:187–196. <https://doi.org/10.1097/SLA.0b013e3181b13ca2>.
 18. Dindo D, Demartines N, Clavien P-A (2004) Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 240:205–213. <https://doi.org/10.1097/01.sla.0000133083.54934.ae>
 19. Masoomi H, Nguyen NT, Dolich MO, Mills S, Carmichael JC, Stamos MJ (2014) Laparoscopic appendectomy trends and outcomes in the United States: data from the Nationwide Inpatient Sample (NIS), 2004-2011. *Am Surg* 80:1074–1077
 20. Georgiou R, Eaton S, Stanton MP, Pierro A, Hall NJ (2017) Efficacy and safety of nonoperative treatment for acute appendicitis: a meta-analysis. *Pediatrics* 139:e20163003. <https://doi.org/10.1542/peds.2016-3003>
 21. Knaapen M, Hall NJ, van der Lee JH et al (2019) Establishing a core outcome set for treatment of uncomplicated appendicitis in children: study protocol for an international Delphi survey. *BMJ Open* 9(5):e028861. <https://doi.org/10.1136/bmjopen-2018-028861>
 22. Salminen P, Tuominen R, Paajanen H, Rautio T, Nordström P, Aarnio M, Rantanen T, Hurme S, Mecklin JP, Sand J, Virtanen J, Jartti A, Grönroos JM (2018) Five-year follow-up of antibiotic therapy for uncomplicated acute appendicitis in the APPAC Randomized Clinical Trial. *JAMA* 320:1259–1265. <https://doi.org/10.1001/jama.2018.13201>
 23. Rollins KE, Varadhan KK, Neal KR, Lobo DN (2016) Antibiotics versus appendectomy for the treatment of uncomplicated acute appendicitis: an updated meta-analysis of randomised controlled trials. *World J Surg* 40:2305–2318. <https://doi.org/10.1007/s00268-016-3561-7>
 24. Harnoss JC, Zelienska I, Probst P, Grummich K, Müller-Lantzsch C, Harnoss JM, Ulrich A, Büchler MW, Diener MK (2017) Antibiotics versus surgical therapy for uncomplicated appendicitis: systematic review and meta-analysis of controlled trials. *Ann Surg*. 265(5):889–900. <https://doi.org/10.1097/SLA.0000000000002039>.
 25. Huang L, Yin Y, Yang L, Wang C, Li Y, Zhou Z (2017) Comparison of antibiotic therapy and appendectomy for acute uncomplicated appendicitis in children: a meta-analysis. *JAMA Pediatr*. 171(5):426–434. <https://doi.org/10.1001/jamapediatrics.2017.0057>
 26. Kessler U, Mosbahi S, Walker B, et al. Conservative treatment versus surgery for uncomplicated appendicitis in children: a systematic review and meta-analysis. *Arch Dis Child*. 2017;archdis child-2017-313127. 10.1136/archdischild-2017-313127.
 27. Vaos G, Dimopoulou A, Gkioka E, Zavras N (2018) Immediate surgery or conservative treatment for complicated acute appendicitis in children? A meta-analysis. *J Pediatr Surg*. 54:1365–1371. <https://doi.org/10.1016/j.jpedsurg.2018.07.017>
 28. Jen HC, Shew SB (2010) Laparoscopic versus open appendectomy in children: outcomes comparison based on a statewide analysis. *J Surg Res* 161:13–17. <https://doi.org/10.1016/j.jss.2009.06.033>
 29. Horvath P, Lange J, Bachmann R, Struller F, Königsrainer A, Zdichavsky M (2017) Comparison of clinical outcome of laparoscopic versus open appendectomy for complicated appendicitis. *Surg Endosc* 31:199–205. <https://doi.org/10.1007/s00464-016-4957-z>.
 30. Wang X, Zhang W, Yang X, Shao J, Zhou X, Yuan J. Complicated appendicitis in children: is laparoscopic appendectomy appropriate? A comparative study with the open appendectomy – our experience. *J Pediatr Surg* 2009; 44:1924–1927.
 31. Tashiro J, Einstein SA, Perez EA, Bronson SN, Lasko DS, Sola JE. Hospital preference of laparoscopic versus open appendectomy: effects on outcomes in simple and complicated appendicitis. *J Pediatr Surg* 2016;52:804–809.
 32. Horvath P, Lange J, Bachmann R, Struller F, Königsrainer A, Zdichavsky M. Comparison of clinical outcome of laparoscopic versus open appendectomy for complicated appendicitis. *Surg Endosc* 2016; 31:199–205.