

## Laparoscopic Appendectomy in Complicated Appendicitis of Children

Leily Mohajerzadeh<sup>1,\*</sup>; Mohsen Rouzrokh<sup>1</sup>; Ahmad Khaleghnejad Tabari<sup>1</sup>; Alireza Mirshemirani<sup>1</sup>; Khashayar Atqiaee<sup>1</sup>; Naghi Dara<sup>1</sup>

<sup>1</sup>Pediatric Surgery Research Center, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran

\*Corresponding author: Leily Mohajerzadeh, Pediatric Surgery Research Center, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran. Tel/Fax: +98-2122924488, E-mail: mohajerzadeh@yahoo.com

Received: December 4, 2013; Accepted: December 9, 2013

**Background:** Laparoscopy is not an accepted procedure for complicated appendicitis in children for most pediatric surgeons. This procedure is associated with a higher incidence of postoperative abdominal abscess reported in some studies.

**Objectives:** In this study, we investigated the security, efficacy and complications of laparoscopy in children with complicated appendicitis in Mofid Children's Hospital.

**Patients and Methods:** From April 2010 to January 2013, we performed laparoscopic appendectomy (LA) in all cases of non-complicated and complicated appendicitis (including perforated appendicitis and localized or generalized peritonitis based on the operation findings and pathological reports). Primary outcomes were incidence of complications, intra-abdominal abscess and wound infection. Secondary outcomes were length of operation, length of hospital stay, resumption of diet, incidence of bowel obstruction, duration of antibiotic use and readmission. Laparoscopy appendectomy was performed with two working ports.

**Results:** LA was performed in 123 children aged 2 to 14 years (mean of eight years) over a 3-year period, of whom only 34 cases had complicated appendicitis (either localized or generalized peritonitis). There was one conversion to open appendectomy (OA) in a patient with appendicular abscess with a mass, which excluded from our analysis. There were 6 patients with generalized peritonitis and 26 patients with localized abscess, and two patients with appendicular mass. The Average duration of symptoms was four days (ranged 3-6 days). The mean length of operation was 52 minutes (ranged 40-80 minutes). The average length of hospital stay was 4.4 days (ranged 4-7 days). They were able to restart oral intake from 16 to 48 hours postoperatively. Two patients (5%) had postoperative complications; one patient with intra-abdominal abscess who underwent reoperation and the second patient with umbilical wound infection was resolved with antibiotherapy. The average follow-up was 14 months (ranged from 4-36 months).

**Conclusions:** We recommend laparoscopic approach for all children presenting complicated appendicitis as the initial procedure of choice.

**Keywords:** Abdominal Abscess; Follow-Up Studies; Hospitals, Community; Laparoscopy; Laparotomy

### 1. Background

Minimally invasive laparoscopic technique is possible, secure, and effective for children with appendicitis. It is associated with a considerably shorter length of hospital stay, lower incidence of wound infection, and reduced postoperative pain compared with open appendectomy. On the other hand, atypical localization of the appendix or wrong diagnosis in open surgery may lead to a large or second incision. Although laparoscopic appendectomy (LA) for uncomplicated appendicitis, has now become accepted in many pediatric surgical centers (1, 2), there are several hypothetical advantages for laparoscopic approach in complicated appendicitis. It facilitates evaluation of the entire abdominal space, diminishes the operative trauma and meticulous peritoneal lavage. The role of laparoscopic surgery in the treatment of complicated appendicitis has been more controversial (3).

### 2. Objectives

The purpose of this study was to assess the safety and efficacy of laparoscopic appendectomy in children with complicated appendicitis.

### 3. Patients and Methods

A retrospective review was performed for all children who underwent laparoscopic appendectomy for complicated appendicitis between April 2010 and January 2013 in our referral hospital. Complicated appendicitis in this study was defined as acute appendicitis followed by perforation or an intra-abdominal abscess. Perforated appendicitis was diagnosed by perforation with intra-abdominal purulence, or a fecalith in the abdomen (4), and purulent appendicitis was based on localized abscess found intraoperatively in abdominal cavity.

#### Implication for health policy/practice/research/medical education:

In this study, we investigated the security, efficacy and complications of laparoscopy in children with complicated appendicitis.

Copyright © 2014, Colorectal Research Center and Health Policy Research Center of Shiraz University of Medical Sciences; Published by Safnek. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

There was no selection bias and all suspected patients were admitted. We performed laparoscopic appendectomy in all cases of non-complicated and complicated appendicitis except for those whose parents were not satisfied. We identified complicated cases based on operative findings and pathological reports. A Foley catheter and a nasogastric tube were used in all children routinely. The Foley catheter was removed after the procedure. All the operations were performed using three trocar techniques. The peritoneal cavity was insufflated with a Veress needle through umbilicus. Pneumoperitoneum was achieved with carbon dioxide to a pressure of 10 to 12 mmHg. After visualization of the entire intraperitoneal space via a 5 mm telescope, two 5 mm ports were made into the right rectus muscle at about the umbilicus level and the left lower quadrant (LLQ). In some cases we used 10 mm ports in LLQ. The mesoappendix was dissected using a Ligasure. The appendix was removed, and its stump was secured with homolock. Intraoperative cultures of the peritoneal fluid were not regularly obtained. All areas of the intra-abdominal purulence were aspirated and abdominal irrigation was performed with saline solution until the aspirated liquid became clear. Abdominal drain was used postoperatively.

After surgery, each case was given cefazolin, 100 mg/kg/24 hours, and metronidazole, 30 mg/kg/24 hours, till the patient became afebrile and tolerated a normal oral diet and continued on oral cephalexin and metronidazole for one week postoperatively. Oral intake was reintroduced as soon as bowel function was restored and the nasogastric tube was left in place until bowel function returned. Analgesia was achieved with intravenous/rectal Paracetamol for the first and second postoperative days. The patients were discharged when were afebrile and able to tolerate oral feeding.

Data pertaining sex, age, duration of symptoms, operative time, operative findings, complications, length of hospital stay, resumption of diet, duration of antibiotic use and readmission, and pathological results were reviewed.

#### 4. Results

We routinely performed laparoscopy in all cases of acute appendicitis or localized or generalized peritonitis suspected to complicated appendicitis. All the operations were performed by a same group of pediatric surgeons. Totally, 123 laparoscopy operations were performed in urgent condition in children aged 2 to 14 years (mean of eight years) over three years. There were 77 (62.6%) boys and 46 (37.4%) girls of whom only 34 (28%) cases had complicated appendicitis (either localized or generalized peritonitis). There was one conversion from LA to OA in a patient with appendicular abscess with a mass, which excluded from our analysis. There were six patients with generalized peritonitis and 26 patients with localized abscess and two patients with appendicular mass. Two-

port-instruments were used in all patients. The average duration of symptoms was four days (ranged 3-6 days). The mean length of operation was 52 minutes (ranged from 40-80 minutes). The average length of hospital stay was 4.4 days (ranged 4-7 days). They were able to restart oral intake from 16 to 48 hours after the operation. Two patients (5%) had postoperative complications; one case with intra-abdominal abscess who underwent reoperation (the first patient of complicated appendicitis in our study), and one case with umbilical wound infection who resolved with antibiotherapy. The average follow-up was 14 months (ranged from 4-36 months). Pathologic reports were gangrenous in 14 cases and acute supportive appendicitis in 20 cases.

Eighty-nine patients had acute appendicitis (non-complicated), 66 were discharged the day after surgery (20 hours after surgery), of whom only two cases were reoperated due to intra-abdominal abscess. Wound infection was not seen in this group. The mean length of operation was 20 minutes (15-35). The average follow-up was 14 months (ranged 4-36 months), we had no partial or complete obstruction within this period time.

#### 5. Discussion

Many controversies exist regarding the most favorable management modality of patients with complicated appendicitis. These include length of antibiotic therapy, single or multiple antibiotic regimens, intraoperative irrigation, drain usage and skin closure. Newly, laparoscopic appendectomy for complicated appendicitis has been supplementary to the catalog of disagreements (5). Previous reports have proposed significant postoperative complications following laparoscopic appendectomy in children (3, 6).

Probable hypothesis for this might be the extend of localized infection throughout the abdominal cavity during pneumoperitoneum or separation of the appendix within the peritoneal cavity. If dissection and division of the appendix is made cautiously, it diminishes the probability of peritoneal contamination (7). We extracted appendix through the port, thus minimizing the chance of wound infection. Current studies supported the use of laparoscopy in complicated appendicitis in children due to less wound infections, less analgesia requirements, minimum hospital stay, early return to work and better overall recovery (8-11).

Appendicitis together with peritonitis is mostly managed with open surgery with a midline or large transverse incision and wound would be open for many days as a rule (12).

Today with low activity of children, most of them are very obese and wound infection and complications are more probable after complicated appendicitis. Garey et al. reported that obesity could prolong the operative time, length of stay, and increase abscess rate in perforated appendicitis (13).

Our study showed that, LA was associated with early return to oral intake, short hospital stay, and a low rate of wound infections and intra-abdominal abscess. Horwitz et al. and others interdicted laparoscopic approach in complicated appendicitis followed by increased risk of intra-abdominal abscesses (3, 14), but our study showed only one case with intra-abdominal abscess in complicated appendicitis who was the first case of our experience. Enough irrigation of abdominal cavity can mostly prevent postoperative abdominal abscess. We tried to wash all segments of abdomen carefully with excess normal saline, so our morbidity was acceptable.

Appendicular mass can be one of the contraindications of LA, because mass dissection without manual palpation may lead to bleeding and visceral injuries. We had 13 cases of appendicular mass who were managed with gentle dissection, but only one case converted to open surgery. Paya K et al. (15), reported 102 children with suspected acute appendicitis randomly recruited to either a laparoscopic, or an open appendectomy approach. The outcome of 25 children with complicated appendicitis (13 in the laparoscopic group and 12 in the open appendectomy group) were analyzed, that showed two major complications in the laparoscopic group in children with appendiceal masses.

Mohammad Reza Vahdad et al. (16) assessed the results of laparoscopic (LA) and open appendectomy (OA) in children with perforated appendicitis. They evaluated the medical records of 221 children who experienced LA (n = 75), OA (n = 122) and conversion (CO) (n = 24) and reported that LA is better than OA due to lower incidence of readmission, reoperation and wound infection. Another advantage of laparoscopy is its 30% lower rate of adhesions, which is a particularly common late complication, especially in children with perforated appendicitis (14). In our 123 patients who underwent laparoscopy, only two developed intra-abdominal abscess but the others had no partial or complete obstruction in follow-up period.

It is concluded that laparoscopic approach could be well used in cases of complicated appendicitis. Laparoscopic appendectomy for complicated appendicitis is possible and secure. It is associated with low incidence of infectious complications and short duration of hospital stay. Therefore, it can be the first choice for cases of complicated appendicitis in children.

## Acknowledgements

We would like to thank Ms. Ghavam for typing the manuscript.

## Authors' Contribution

All authors except Dr Dara performed the laparoscopies.

## Financial Disclosure

The authors had nothing to declare.

## Funding/Support

This study was financially supported by the office of the Vice chancellor for Clinical Research of Mofid Children Hospital.

## References

1. McBurney C. IV. The Incision Made in the Abdominal Wall in Cases of Appendicitis, with a Description of a New Method of Operating. *Ann Surg.* 1894;**20**(1):38-43.
2. Paterson HM, Qadan M, de Luca SM, Nixon SJ, Paterson-Brown S. Changing trends in surgery for acute appendicitis. *Br J Surg.* 2008;**95**(3):363-8.
3. Horwitz JR, Custer MD, May BH, Mehall JR, Lally KP. Should laparoscopic appendectomy be avoided for complicated appendicitis in children? *J Pediatr Surg.* 1997;**32**(11):1601-3.
4. St Peter SD, Sharp SW, Holcomb GW, 3rd, Ostlie DJ. An evidence-based definition for perforated appendicitis derived from a prospective randomized trial. *J Pediatr Surg.* 2008;**43**(12):2242-5.
5. Mallick MS, Al-Qahtani A, Al-Bassam A. Laparoscopic appendectomy is a favorable alternative for complicated appendicitis in children. *Pediatr Surg Int.* 2007;**23**(3):257-9.
6. 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.
7. Menezes M, Das L, Alagtal M, Haroun J, Puri P. Laparoscopic appendectomy is recommended for the treatment of complicated appendicitis in children. *Pediatr Surg Int.* 2008;**24**(3):303-5.
8. Yagmurlu A, Vernon A, Barnhart DC, Georgeson KE, Harmon CM. Laparoscopic appendectomy for perforated appendicitis: a comparison with open appendectomy. *Surg Endosc.* 2006;**20**(7):1051-4.
9. Li P, Xu Q, Ji Z, Gao Y, Zhang X, Duan Y, et al. Comparison of surgical stress between laparoscopic and open appendectomy in children. *J Pediatr Surg.* 2005;**40**(8):1279-83.
10. Partrick DA. Prospective evaluation of a primary laparoscopic approach for children presenting with simple or complicated appendicitis. *Am J Surg.* 2006;**192**(6):750-5.
11. Esposito C, Borzi P, Valla JS, Mekki M, Nouri A, Becmeur F, et al. Laparoscopic versus open appendectomy in children: a retrospective comparative study of 2,332 cases. *World J Surg.* 2007;**31**(4):750-5.
12. Pearl RH, Hale DA, Molloy M, Schutt DC, Jaques DP. Pediatric appendectomy. *J Pediatr Surg.* 1995;**30**(2):173-8.
13. Garey CL, Laituri CA, Little DC, Ostlie DJ, St Peter SD. Outcomes of perforated appendicitis in obese and nonobese children. *J Pediatr Surg.* 2011;**46**(12):2346-8.
14. Paik PS, Towson JA, Anthone GJ, Ortega AE, Simons AJ, Beart RW, Jr. Intra-abdominal abscesses following laparoscopic and open appendectomies. *J Gastrointest Surg.* 1997;**1**(2):188-92.
15. Paya K, Rauhofer U, Rebhandl W, Deluggi S, Horcher E. Perforating appendicitis. An indication for laparoscopy? *Surg Endosc.* 2000;**14**(2):182-4.
16. Vahdad MR, Troebbs RB, Nissen M, Burkhardt LB, Hardwig S, Cernianu G. Laparoscopic appendectomy for perforated appendicitis in children has complication rates comparable with those of open appendectomy. *J Pediatr Surg.* 2013;**48**(3):555-61.