

ORIGINAL RESEARCH

Open Access

Early appendectomy for appendicular mass: operative findings and outcome in 220 children—a developing country perspective



M. A. Mushfiqur Rahman, Tanvir Kabir Chowdhury^{*} , Mohammad Zonaid Chowdhury and Md. Abdullah Al Farooq

Abstract

Background: Lump or mass formation due to delayed presentation after appendicitis is common, and it is frequently complicated by perforation, gangrene, pus, or abscess formation. Care of patients and management vary between developed world and developing country. The aim of the study is to analyze outcome of early surgery for appendicular mass from a developing country perspective. 220 patients of appendicular mass who underwent early appendectomy over a period of 5 years in the Department of Pediatric Surgery, at author's institute were retrospectively reviewed. Early appendectomy was defined as appendectomy done within 24 h of admission. Presentation, examination findings, investigations, type of surgery, operative findings, post-operative complications, and hospital stay were analyzed.

Results: Age of patients ranged from 2 to 12 years (mean 9.04 ± 2.54 years) and male to female ratio was 2:1. Abdominal pain was the most common presentation followed by vomiting and fever. Mean pain duration was 4.35 ± 4.23 days. There was raised temperature in 140 (63.64%) patients, 154 (74.04%) had tachycardia, and 75.86% had raised WBC count. Laparoscopic appendectomy was done in 31 (14.09%) patients, and the rest 189 (85.91%) patients underwent open surgery. Perforated appendix was the most common (171 patients, 77.73%) peri-operative finding followed by formation of pus (135 patients, 61%). Pus was found more in patients less than 5 years old (18 patients out of 23) than patients more than 5 years old (114 patients out of 197) ($P = 0.045$). Younger patients also had significantly more complications (39.13% vs 17.26%, $P = .000$) and hospital stays (mean 15.61 days vs 9.87 days, $P = 0.014$) than older boys. Complications developed in 42 (19.09%) patients, and wound dehiscence (26 patients, 11.82%) was the most common complication.

Conclusion: Early appendectomy for appendicular mass is a feasible option in the developing world, and laparoscopic appendectomy has good prospect.

Keywords: Appendicular mass, Early appendectomy, Perforation, Laparoscopy

Background

Acute appendicitis is the leading cause of acute surgical abdomen in children. Approximately 10% of patients admitted with acute appendicitis present with an appendicular mass and about 20 to 70% may have perforation [1–4]. An appendix mass ranges from a simple inflammatory mass (phlegmon) to appendicular perforation or gangrene with peri-appendiceal collection of pus (appendiceal abscess) [5].

The management of appendix mass has always been controversial. Some prefer to do early appendectomy (within 24 h of admission) while others prefer non-operative management with or without percutaneous drainage of an abscess with CT (computed tomography) or USG (ultrasonography) guidance, and after a successful non-operative management, a delayed appendectomy is usually done 6–8 weeks later (interval appendectomy) [6]. Some centers discourage early drainage of pus if the volume is small [7]. There are contradicting evidences to prove superiority of one over another. We prefer early appendectomy

* Correspondence: ivan_tanvir@yahoo.com

Department of Pediatric Surgery, Chittagong Medical College and Hospital, 1 KB Fazlul Kader road, Chattogram 4203, Bangladesh

for appendix mass since there are some evidences that it avoids prolonged hospital stay and readmission and reduces cost of care and parenteral suffering and stress which are very important factors in a resource limited society [4]. We present our series of appendicular mass managed by early appendectomy and analyze some factors relevant to the developing world.

Methods

We retrospectively reviewed 220 patients of appendicular mass who underwent early appendectomy over a period of 5 years (January 2015 to December 2019) in the department of pediatric surgery at author’s institute. Early appendectomy was defined as appendectomy done within 24 h of admission. Appendicular mass was diagnosed clinically or with ultrasonography or during surgical exploration. Children who had lump in the right iliac fossa due to worm bolus, ileo-caecal tuberculosis, or carcinoid tumor who underwent appendectomy were excluded from the study. Presentation, examination findings, investigations, type of surgery, operative findings, post-operative complications, and hospital stay were analyzed. Follow-up records for 2 weeks and readmission records until 6 weeks were checked. Categorical variables were described as frequency and percentage, and continuous variables were expressed as mean ± standard deviation or median. Student *t* test and chi-squared test were done using SPSS version 22. The level of significance was set at 5% (*P* < 0.05).

Results

Among the 220 patients, there were 147 male and 73 female patients (male to female ratio: 2.01:1). The age ranged from 2 to 12 years (mean 9.04 ± 2.54 years). Twenty-three (10.45%) patients aged less than 5 years (Fig. 1).

Abdominal pain was the most common presentation (98.18%). The mean pain duration was 4.35 ± 4.23 days which ranged from less than a day to 35 days. One hundred and nineteen (54.09%) patients presented within 3 days, and 101 (45.91%) patients presented after 3 days of pain. Other predominant symptoms were vomiting (72.27%) and fever (66.36%). Table 1 demonstrates the presenting complaints of the patients.

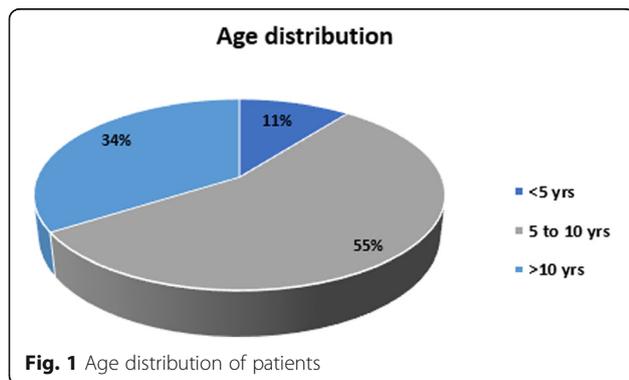


Fig. 1 Age distribution of patients

Table 1 The presenting complaints of the patients

| Symptoms | Number of patients | % |
|----------------------|--------------------|-------|
| Abdominal pain | 216 | 98.18 |
| Vomiting | 159 | 72.27 |
| Fever | 146 | 66.36 |
| constipation | 29 | 13.18 |
| Nausea | 13 | 5.91 |
| Anorexia | 11 | 5.00 |
| Diarrhea | 9 | 4.09 |
| Abdominal distension | 7 | 3.18 |
| Dysuria | 4 | 1.82 |
| Cough | 3 | 1.36 |
| Hematemesis | 1 | 0.45 |
| Melena | 1 | 0.45 |

On admission, temperature was elevated in 140 (63.64%) patients and 154 (74.04%) had tachycardia. In 182 (82.73%) patients a lump was palpable clinically. Complete blood count (CBC) was done in only 87 (39.55%) patients. Raised total count of WBC (more than 11,000/dl) was found in 66 (75.86%) patients and neutrophilia (more than 75%) in 62 (71.26%). In 100 (45.445%) patients, USG was not performed and the patient was directly taken to theater based on clinical evidence. USG could comment about appendicular mass in only 27 (22.50%) patients. CT scan was not

Table 2 Findings of important clinical examination and investigations

| Features | Number | % |
|--------------------------------|--------|-------|
| Raised temperature | 140 | 63.64 |
| Tachycardia (n = 208) | 154 | 74.04 |
| Palpable lump | 182 | 82.73 |
| WBC count (n = 87) | | |
| Leukocytosis | 66 | 75.86 |
| Neutrophilia | 62 | 71.26 |
| Abdominal USG (n = 120) | | |
| Acute appendicitis | 46 | 38.33 |
| Appendicular lump | 27 | 22.50 |
| Intestinal obstruction | 10 | 8.33 |
| Pelvic collection | 10 | 8.33 |
| Normal findings | 7 | 5.83 |
| Perforated appendix | 6 | 5.00 |
| Appendicular abscess | 5 | 4.17 |
| Ascariasis | 3 | 2.50 |
| Chronic appendicitis | 2 | 1.67 |
| Gall bladder sludge | 1 | 0.83 |
| Right hydronephrosis | 1 | 0.83 |
| Liver abscess | 1 | 0.83 |
| Intussusception | 1 | 0.83 |

done in any patient. Table 2 shows important examination and investigations findings among the patients.

Laparoscopic appendectomy was done in 31 (14.09%) patients, and the rest 189 (85.91%) patients underwent open surgery. Open appendectomies were mostly performed in the earlier 3 years, and laparoscopic surgeries were mostly performed in the later 2 years of the study period. Perforated appendix was the most common (171 patients, 77.73%) peri-operative finding followed by the presence of pus (135 patients, 61%) around appendix as an abscess or free pus. The presence of pus was significantly more in patients less than 5 years old (18 patients out of 23) than patients more than 5 years old (114 patients out of 197) ($P = 0.045$). However, there was no difference in perforation rate between these age groups ($P = 0.119$). Table 3 summarizes operative findings.

Abdominal pain more than 1 week was observed in eighteen patients (8.18%), and they had significantly more complications (7/18, 38.89% vs 36/202, 17.82%; $P = 0.000$).

Forty-seven (21.82%) complications developed in 42 (19.09%) patients, and wound dehiscence (25 patients, 11.36%) was most common. Table 4 shows the complications between patients treated with open vs laparoscopic appendectomy (45/189 vs 2/31, respectively, $P = 0.029$). Four patients needed conversion to open surgery due to inability to separate the mass laparoscopically (12.90% conversion rate). Hospital stay ranged from 3 to 42 days with a median hospital stay of 8 days.

Discussion

Appendicitis along with its complications is a major health burden for the developing world. Appendicular mass comprises a spectrum of conditions. The appendix may be surrounded by the omentum, edematous caecal wall, sigmoid colon, terminal ileum, or coils of the intestine in the vicinity of appendix which may wall off the inflamed appendix. The mass can be complicated with abscess formation usually when the appendix perforates. If the barrier cannot wall off the inflammation, generalized peritonitis may develop. Although management of appendicular mass is primarily conservative in adult population, there is a general trend among a group of pediatric surgeons for early exploration of appendicular mass [1, 8]. The reasons behind are as follows: earlier perforation of appendix and abscess formation, less capability of omentum to confine the infection, and consequently easier separation of appendix from the mass in children than in

Table 4 Complications of early appendectomy for appendicular mass

| Complications | Open appendectomy | Laparoscopic appendectomy | Total numbers | % |
|-----------------------------|-------------------|---------------------------|---------------|--------------|
| Wound infection | | | | |
| Without dehiscence | 10 | 2 | 12 | 5.45 |
| With dehiscence | 25 | 0 | 25 | 11.36 |
| Burst abdomen | 5 | 0 | 5 | 2.27 |
| Post-operative adhesions | 2 | 0 | 2 | 0.91 |
| Respiratory tract infection | 2 | 0 | 2 | 0.91 |
| Fecal fistula | 1 | 0 | 1 | 0.45 |
| Total | 45 | 2 | 47 | 21.36 |

adult. Blakely et al. reported that the duration of operation was not significantly longer with early than interval appendectomy [9]. However, many centers also practice conservative approach for appendicular mass [10]. Evidences to suggest the best option are conflicting, and both groups have some evidences to support their approaches.

This study has some observations that are pertinent to developing countries. *Firstly*, delay in presentation is common. The mean duration of abdominal pain in this study was 4.35 ± 4.23 days, and about 46% patients presented after 3 days of symptoms. However, there was no significant association of duration of pain with the peri-operative condition of appendix ($P = 0.118$). In most other studies with appendix mass, perforated appendix or appendicular abscess, the mean duration of presentation was between 3 and 4 days [3, 7, 9, 10]. There were 18 patients in this study who had abdominal pain for more than a week, and they had a higher complication rate. *Secondly*, many patients with appendix mass who underwent conservative treatment in studies from developed world did not meet the criteria of systemic sepsis. On the contrary, most patients in this study had features of systemic sepsis (raised temperature in 64%, tachycardia in 74%, vomiting in 72%). *Thirdly*, CBC was done in only 87 (39.55%) patients due to the fact that there would be more chance of delay in surgical procedure because of delay in getting the results which usually takes a day. Moreover, operating theaters are shared by different units and are not always available when needed. For these reasons, we cannot always perform standard preoperative investigations for all patients. The reason behind more patients having USG than CBC was that many patients were admitted with an USG performed in remote areas by unqualified sonologists. This is why the findings of USG were very diverse; it could comment about complicated appendicitis in only 40% of patients. The repetition of an USG

Table 3 Operative findings in appendicular mass

| Operative finding | Number | % |
|---|--------|-------|
| Perforated appendix | 171 | 77.73 |
| Pus | 135 | 61.36 |
| Appendix phlegmon | 24 | 10.91 |
| Gangrenous appendix without visible perforation | 17 | 7.73 |

needs out-of-pocket money, and most of the parents are reluctant to do this. No patients underwent a CT scan. On the other hand, USG is usually used in clinically suspicious cases and CT scans are occasionally performed for equivocal cases in developed world. Due to poor laboratory support, clinical judgement is usually given more emphasis in decision making in the developing world. *Fourthly*, laparoscopic appendectomy was done in only 14% of the patients. In most developed countries, almost all cases of appendicular mass are now performed laparoscopically. However, it takes more time for the people in developing country to enjoy the benefits of advanced technology. Consistent with other studies, patients who underwent laparoscopic appendectomy had less complications than open surgery (5/31 vs 38/189, $P = 0.000$) [8, 10].

It has long been established that appendectomy can be performed during the index admission in most patients with an appendicular mass [1]. The reasons behind our choice of early appendectomy over conservative treatment are many-fold. About 10 to 50% of patients, who receive conservative treatment, fail and ultimately needs potentially more difficult appendectomies, extended length of stay, and more complications [1]. Moreover, among the patients who had been discharged after conservative treatment, about 23% have a risk of recurrent appendicitis and 30% need urgent readmissions [6, 11]. Another problem of non-operative management for the developing countries is that these patients need frequent imaging which is costly and may need referral to other centers. Peter et al. reported that patients treated in their series of conservative approach underwent a mean of 3.5 CT scans per patient which is a major cost burden and also major exposure to radiation [12]. Several studies have reported that cost of care is relatively less in early appendectomy versus conservative treatment [4]. Another disadvantage of non-operative management of appendicular masses is misdiagnosis. Early surgery can avoid consequences of misdiagnosis which is not rare [1]. It has also been reported that patients and families suffer from more stress if their appendix had not been removed after an attack of appendicitis [13]. Moreover, many of the patients who present late had already tried some oral or parenteral antibiotics prescribed by a rural doctor or a physician. Another regimen of standard conservative approach would require 7–14 days of antibiotic therapies with uncertain results which is often difficult for parents to accept.

Many centers prefer to do image-guided drainage of appendicular abscess. The set-up for image-guided procedure is not well established in developing countries, and it will surely increase the cost. It has some limitations such as failure or inadequate drainage, non-target puncture or injury to adjacent viscera, bleeding, and infection [14]. However, a prospective randomized trial done in Kansas, USA, did not find any significant difference between image-guided drainage versus early laparoscopic

appendectomy with regard to total hospitalization, recurrent abscess rate, or total charges [12].

Several studies have shown that younger patients develop complications early, and they should undergo early surgery [6, 9]. In this study also, patients aged 5 years or less (23 patients) developed pus more frequently ($P = 0.45$). They also had significantly higher rate of complications (39.13% vs 17.26%, $P = .000$) and hospital stays (mean 15.61 days vs 9.87 days, $P = 0.014$). Complications developed in 21.36% patients, mostly related to wound in open appendectomies, which is consistent with reported complication rates of 15 to 50% and more in younger age group. This finding reemphasizes the need for early referral of young children with suspected acute appendicitis to surgical facilities and performing early appendectomy in them.

In many studies that compared early appendectomy with conservative approach, the comparative groups were unequal and there was allocation bias, because patients who underwent surgery were actually the more toxic ones and thus had more complications, delayed hospital stays, and more cost. From the findings of many contradicting studies, it may be assumed that either conservative or early appendectomy is feasible in cases of complicated appendicitis. However, developing countries have some problems, such as delayed presentation, lack of patient compliance and reluctance to repeated hospital admissions, cost of care, and inadequate logistic support, and for them, treatment needs to be definitive and earlier.

Conclusion

Early appendectomy can be considered for appendicular mass in the resource-limited setting which provides a definitive diagnosis and early treatment within acceptable complication rates. By increasing the volume of laparoscopic procedures, the complications can be further minimized.

Abbreviations

CBC: Complete blood count; CT: Computed tomography; USG: Ultrasonography

Acknowledgements

Not applicable

Consent of publication

Not applicable

Authors' contributions

MAMR: Study conception and critical analysis of the manuscript. TKC: Data analysis and manuscript writing. MZC: Data collection. MAAF: Study concept, critical analysis, and approval of the final version. The authors read and approved the final manuscript.

Funding

This study did not receive any funding from any source.

Availability of data and materials

All data and materials are available based on reasonable request according to the guideline of the institution in which the study was conducted.

Ethics approval and consent to participate

Consent was taken from data authority. Ethical approval from institutional review board and consent from patient/parent are not applicable since this is a retrospective review and no personal identity was exposed.

Competing interests

The authors declare no competing interests.

Received: 5 June 2020 Accepted: 6 October 2020

Published online: 03 December 2020

References

1. Senapathi PSP, Bhattacharya D, Ammori BJ. Early laparoscopic appendectomy for appendicular mass. *Surg Endosc Other Interv Tech*. 2002; 16:1783–5. <https://doi.org/10.1007/s00464-001-9232-1>.
2. Ponsky TA, Kittle K, Eichelberger MR, Gilbert JC, Brody F, Newman KD. Hospital- and patient-level characteristics and the risk of appendiceal rupture and negative appendectomy in children. *JAMA*. 2004;292:1977–82. <https://doi.org/10.1001/jama.292.16.1977>.
3. Furuya T, Inoue M, Sugito K, Goto S, Kawashima H, Kaneda H, et al. Effectiveness of interval appendectomy after conservative treatment of pediatric ruptured appendicitis with abscess. *Indian J Surg*. 2015;77:1041–4. <https://doi.org/10.1007/s12262-014-1121-7>.
4. Church JT, Klein EJ, Carr BD, Bruch SW. Early appendectomy reduces costs in children with perforated appendicitis. *J Surg Res*. 2017;220:119–24. <https://doi.org/10.1016/j.jss.2017.07.001>.
5. Bonadio W, Peloquin P, Brazg J, Scheinbach I, Saunders J, Okpalaji C, et al. Appendicitis in preschool aged children: regression analysis of factors associated with perforation outcome. *J Pediatr Surg*. 2015;50:1569–73. <https://doi.org/10.1016/j.jpedsurg.2015.02.050>.
6. Simillis C, Symeonides P, Shorthouse AJ, Tekkis PP. A meta-analysis comparing conservative treatment versus acute appendectomy for complicated appendicitis (abscess or phlegmon). *Surgery*. 2010;147:818–29. <https://doi.org/10.1016/j.surg.2009.11.013>.
7. Tsai HY, Chao HC, Yu WJ. Early appendectomy shortens antibiotic course and hospital stay in children with early perforated appendicitis. *Pediatr Neonatol*. 2017;58:406–14. <https://doi.org/10.1016/j.pedneo.2016.09.001>.
8. Agrawal V, Acharya H, Chanchlani R, Sharma D. Early laparoscopic management of appendicular mass in children: still a taboo, or time for a change in surgical philosophy? *J Minim Access Surg*. 2016;12:98–101. <https://doi.org/10.4103/0972-9941.178518>.
9. Blakely ML, Williams R, Dassinger MS, Eubanks JW, Fischer P, Huang EY, et al. Early vs interval appendectomy for children with perforated appendicitis. *Arch Surg*. 2011;146:660–5. <https://doi.org/10.1001/archsurg.2011.6>.
10. Tanaka Y, Uchida H, Kawashima H, Fujiogi M, Suzuki K, Takazawa S, et al. More than one-third of successfully nonoperatively treated patients with complicated appendicitis experienced recurrent appendicitis: is interval appendectomy necessary? *J Pediatr Surg*. 2016;51:1957–61. <https://doi.org/10.1016/j.jpedsurg.2016.09.017>.
11. Fugazzola P, Coccolini F, Tomasoni M, Stella M, Ansaloni L. Early appendectomy vs. conservative management in complicated acute appendicitis in children: a meta-analysis. *J Pediatr Surg*. 2019;54:2234–41. <https://doi.org/10.1016/j.jpedsurg.2019.01.065>.
12. St. Peter SD, Aguayo P, Fraser JD, Keckler SJ, Sharp SW, Leys CM, et al. Initial laparoscopic appendectomy versus initial nonoperative management and interval appendectomy for perforated appendicitis with abscess: a prospective, randomized trial. *J Pediatr Surg*. 2010;45:236–40. <https://doi.org/10.1016/j.jpedsurg.2009.10.039>.
13. Schurman JV, Cushing CC, Garey CL, Laituri CA, St SD. Quality of life assessment between laparoscopic appendectomy at presentation and interval appendectomy for perforated appendicitis with abscess: analysis of a prospective randomized trial. *J Pediatr Surg*. 2011;46:1121–5. <https://doi.org/10.1016/j.jpedsurg.2011.03.038>.
14. Forsyth J, Lasithiotakis K, Peter M. The evolving management of the appendix mass in the era of laparoscopy and interventional radiology. *The Surgeon*. 2016;2–8. <https://doi.org/10.1016/j.surge.2016.08.002>.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Submit your manuscript to a SpringerOpen[®] journal and benefit from:

- Convenient online submission
- Rigorous peer review
- Open access: articles freely available online
- High visibility within the field
- Retaining the copyright to your article

Submit your next manuscript at ► [springeropen.com](https://www.springeropen.com)