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Original Article

Non-Operative Management of Acute Non-Complicated Appendicitis in Children

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Abstract

Background: Acute appendicitis is one of the most common pediatric surgical emergencies worldwide. Classically, it is managed by early appendectomy, either by open or laparoscopic surgery. In the last few years there has been a gradual shift towards conservative or non-operative management of these children.We aimed to compare both approaches of management of acute non-complicated pediatric appendicitis, the operative and non-operative in a more extensive manner.

Patients & methods: We conducted a randomized prospective comparative study in Sohag university hospital comparing appendicectomy versus non-operative treatment for children who were presented with non-complicated acute appendicitis between Jan 2022 and Dec 2024.

Results: The study finally included 75 patients with acute non-complicated appendicitis aged between 5 and 16 years. Forty-five of them received appendectomy (25 by open appendectomy and 20 cases by laparoscopy) while the remaining 30 cases were managed conservatively.

Conclusion: Non-operative treatment is a feasible, effective, and safe option for management of acute non-complicated appendicitis in children with similar success rates, lower morbidity, less duration of hospital admission and abstinence from school, work and social activities compared to appendectomy.

Keywords: appendicitis, conservative, children

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Introduction

Acute appendicitis is one of the most common pediatric surgical emergencies worldwide. [1] Classically, it is managed by early appendectomy, either by open or laparoscopic surgery. [2] In the last few years there has been a gradual shift towards conservative or non-operative management of these children. [3] This was pushed by the desire to avoid the operative and anesthetic risks of surgery e.g., bleeding, ileus, surgical site infection, and pneumonia. The non-operative approach, however, is not completely free of complication i.e. longer duration of treatment, readmissions, recurrent attacks of abdominal pain, absence of school or social activities. [4] [5]

Aim of the work:

We aimed to compare both approaches of management of acute non-complicated pediatric appendicitis (the operative and non-operative) in a more extensive manner.

Methods

Approval and design:

Ethical approval was obtained from the research ethics committee of Sohag Faculty of Medicine, Sohag University. We conducted a randomized prospective comparative study in Sohag university hospital comparing appendicectomy versus non-operative treatment for children who were presented with non-complicated acute appendicitis between Jan 2022 and Dec 2024.

Diagnostic workup

- History and clinical examination: appendicitis was diagnosed by history of acute onset of right lower abdominal pain or periumbilical pain gradually shifting to the right lower quadrant of the abdomen. Examination showing localized tenderness over the right iliac region or positive signs of appendicitis (Psoas sign, Rovsing`s sign)
- Radiological assessment by US showing evidence of blind ended tubular non compressible structure and excluding complications e.g., localized, or diffuse peritonitis, appendicular mass as well as other diagnoses e.g., ureteric stones, adnexal pathologies in females.
- CT abdeomen and pelvis with oral contrast was done for equivocal cases with non-conclusive ultrasonographic findings.
- Labs: WBC, CRP were obtained in addition to other routine labs (Prothrombin, Random blood sugar, blood urea, serum creatinine, liver enzymes and serum electrolytes)

Eligibility to the study:

Inclusion criteria:

- Children aged between 5-16 years who were diagnosed clinically and radiologically to have non-complicated acute appendicitis were included after signing a written informed consent by their parents or guardians.

Exclusion criteria:

- Any clinical or radiological signs suggesting complicated appendicitis e.g., high-grade fever, diffuse peritonitis, significant turbid peri-appendicular or pelvic collection; appendicular mass.
- History of conservative treatment for a previous similar attack of appendicitis or appendicular mass.
- Any known factors or risks that prevent free allocation of the patient to either of the two groups e.g. Major anesthetic risk (cardiorespiratory problems) precluding allocation to the appendicectomy arm; allergic reaction to antibiotics that prevents allocation to non-operative treatment plan.

Randomization

Patients eligible to the study were counseled about the two options and consented to be randomly allocated to either of the two arms using a computer-based system with their completely preserved rights to withdraw from the study at any time.

Outcome measures:

Primary outcome:

- Successful treatment means complete resolution of patients' symptoms and their return to their normal activities within 10 days of treatment.

Secondary outcomes:

- Total duration of hospital admission during the first presentation.
- Recurrent admission for the same reason within 6 months following hospital discharge
- Total duration of abstinence of the child from school or social activities.
- Total duration of parents or guardians' abstinence from their work or social activities.
- Any significant complications related to the problem.
- Decision regret (Rate of negative appendectomies in the operative group versus the rate of shifting to surgery in the conservative group)

Interventions

Group A: Operative or Appendectomy group:

Children randomized to this group underwent either open or laparoscopic appendectomy. All our staff are efficient at doing open appendectomy; laparoscopic appendectomy however is usually done by more senior staff and on a more elective basis (i.e., a patient may be observed overnight on iv fluids and antibiotics and operated on the next morning). All removed appendices were routinely sent for histopathological examination.

All patients were started on IV antibiotics and IV fluid resuscitation from the onset of diagnosis. A combination of broad-spectrum antibiotics covering most of the possible organisms (gram positive, gram negative as well as anaerobes) was given. Our protocol of antibiotics is to start with IV amoxicillin-clavulanic (50mg/kg/dose every 8 hourly) + Ceftazidime (50mg/kg/dose 12 hourly) + metronidazole (15 mg/kg/dose 12 hourly) and then shift to oral forms when oral intake is allowed. The duration of the treatment course was usually 10 days from the time of admission.

A second line of antibiotics in the form of imipenem and vancomycin was given in cases of non or weak response or in patients whose swabs or cultures revealed atypical or resistant organisms We used to apply an enhanced recovery protocol; no urinary catheters, no nasogastric tubes were inserted, and patients were encouraged to mobilize as early as possible after recovery from the anesthetic. Oral fluids were allowed gradually and advanced as tolerated.

Group B Non-operative or conservative group:

The management protocol for this group included hospital admission and observation with a minimum period of 24-48 hours of IV fluids, NPO, and broad-spectrum antibiotics (the same regimen as group A). Patients were examined regularly every 6 hours to detect any symptoms or signs of disease progression, e.g., rising temperature, increasing heart rate, or increasing tenderness. Stable patients with no evidence of deterioration were allowed to start oral fluids as tolerated. After completing 48 hours of observation, patients who showed signs of improvement were discharged home on oral antibiotics and non-steroidal analgesia for the next 5 days. They were reviewed in the outpatient clinic after 5 days of discharge. The total duration of the antibiotics course was 10 days from the onset of the presentation. Patients were alarmed at the possible risk of recurrence of the same symptoms either earlier or later.

Patients who did not improve by 48 hours of observation or who showed signs of deterioration at any time from the onset of admission or even after hospital discharge were shifted towards appendectomy. Interval appendectomy, however, was not offered as an option for those who responded well to medical treatment.

Follow-up visits were routinely arranged in the outpatient clinic 5 days, 10 days, and one month after hospital discharge. No radiological or laboratory investigations were done routinely but rather to exclude suspected complications in selected cases. At 6 months patients were recruited to reassess and collect data related to their condition and any events that occurred after their last visit. If this was not possible, they were contacted by phone.

Patients who were not possible to contact at all were excluded.

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp, Armonk, NY). Statistics are presented as weighted mean ± standard deviation. Parametric variables were analyzed by independent t-test and non-parametric variables by Mann-Whitney U test. The Kolmogorov-Smirnov test was performed to assess normal distribution. The homogeneity of variance was determined by Levene's test. The level of statistical significance for descriptive statistics was set at $p<0.05$.

Results

During the study period from January 2022 to December 2024, 133 cases of acute appendicitis were admitted to our hospital. Eighty-four cases only were eligible to be included in the study. Nine cases of them were excluded later due to withdrawal or incomplete follow-up. The remaining 75 cases who completed the study were randomly allocated to the two treatment groups; 45 cases were in the appendectomy group (26 males and 19 females) and 30 cases in the non-operative group (17 males and 13 females). Twenty-five children of the operative group received open appendectomy while the remaining 20 cases were operated on laparoscopically. Their demographic data and duration of symptoms are presented in the following table.

Table 1 : Demographic data

		Operative group (N= 45)	Non-operative group (N= 30)	P-value
Age (in years)		5-15 (6.2 ± 1.6)	5.5-16 (7.1 ± 1.3)	(0.34)
Sex (male: female)		26:19	17:13	(0.65)
Duration of Symptoms (in days)		0-3 (2 ± 1.2)	0-4 (2.2 ± 1.1)	(0.53)
WBC		(13.67 ± 3.2) $\times 10^9$/L	(14.07 ± 4.3) $\times 10^9$/L	(0.07)
CRP		65 ±13	59 ± 9	(1.2)
US findings	Appendix diameter (mm)	8 ± 3	7.5 ± 2.9	(0.9)
	Presence of fecalith	6 (13%)	5 (16 %)	(0.22)

Complete resolution of symptoms was successfully achieved within 10 days in 39 cases (86.6%) of the operative group and 27 cases (90%) of the non-operative group. Three cases of the non-operative group showed progressive symptoms with increasing pain, tenderness, fever, and vomiting, so they were subjected to appendectomy. Two of them had fecalith on US scan done on admission and all of them had evidence of acute inflammation of the removed appendices on histological examination.

Six cases of the operative group developed complications and required readmission within the next 6 months. Two of them had wound infection and gapping after open appendectomy and required admission to receive parenteral antibiotics and frequent daily dressings and delayed primary sutures. Two cases presented with pelvic abscess that were managed by US guided drainage and a course of antibiotics. The fifth case presented with a picture of adhesive intestinal obstruction that was successfully managed conservatively. The last case was presented with a port site hernia that required surgical repair later. Of the non-operative group, 4 cases were readmitted within the next 6 months with recurrent symptoms of right iliac pain and were subjected to appendectomy without any complications. Their histopathology showed mild catarrhal inflammation in 2 cases and normal appendix in the other 2 cases.

The duration of hospital admission in the initial presentation was (8.3 ± 2.2) days in the operative and (6 ± 2.6) days in the non-operative group with a p-value of (0.02). The total duration of hospital admission was 10 ± 3.2 in the operative group and 9 ± 2.6 in the non-operative group with p value of 0.06 . The total duration of child absence of school and social activities was (17 ± 3) days in the operative and (11 ± 4.3) days in the non-operative group with a p-value of (0.04). Parents absence from work and social activities ranged from (13 ± 5.2) in the operative group and (9 ± 3.8) in the non-operative with a p value of 0.05

Postoperative histopathology of the removed appendices proved normal in 10 cases of Group A and 2 cases of Group B patients.

Table 2: Outcome measures

Outcome measures	Operative group (N=45)	Non-operative group (N=30)	p-value
Success of treatment plan	39 (86.6 %)	27(90%)	(0.95)
Duration of initial hospital admission	8.3 ± 2.2	6 ± 2.6	(0.02)
Total duration of hospital admission	10 ± 3.2	9 ± 2.6	(0.05)
Recurrent admission	5 (11 %)	3 (10 %)	(0.09)
Child absence (days)	17 ± 3	11 ± 4.3	(0.04)
Parent absence (days)	13 ± 5.2	9 ± 3.8	(0.06)
Complications	6 (13%)	3 (10%)	0.12
Negative appendectomy	10 (22%)	2 (6%)	(0.04)

Discussion

Appendectomy has always been the classic option of treatment for acute appendicitis in all ages. In the very recent era, however, there has been a gradual shift towards a conservative approach of management, especially in adult patients. This was guided by two factors. The first is the risks associated with surgery especially with negative appendectomy which was shown to raise the mortality rate to 10 folds compared to 6.2 folds after appendectomy for perforated appendicitis.[6] The second is the change in the understanding of the pathophysiology of appendicitis as a form of inflammation that can be managed and controlled by antibiotics rather than a progressive pathology that necessitates immediate amputation of the appendix.[7]

The introduction of the non-operative option for management of acute appendicitis especially in children was a kind of challenge to the widespread and well-established dogma of surgery as the only gold standard. This was led by two eminent studies. One of them was a feasibility study done in the UK and proved that non-operative treatment as an option for treatment of acute non-complicated appendicitis was both feasible and safe. [8]

The other was a pilot RCT assessing the conservative treatment of acute non-complicated appendicitis in children that showed a 92% initial success rate and 64 % success rate at 1 year follow up (i.e., Without the need for appendectomy). Acute appendicitis was histologically confirmed in only 17% of those who needed appendectomy, and none of the children previously treated conservatively represented complicated appendicitis. This trial showed that non-operative management was attainable with a high safety profile.[4]

In our study, the success rate for non-operative treatment was 90% compared to 86% for the operative strategy. Readmission and appendectomy were required in 13.3% of this group and none of them presented with complicated appendicitis. So, the final 6 months success rate in this group was 77.3%.

A recent meta-analysis showed that non-operative treatment had a 92% success rate during initial hospital stay and only 16% incidence of recurrent

appendicitis or recurrent abdominal pain with normal appendix. The reported hospital stays, and complications rate were similar in patients treated conservatively and those undergoing an appendectomy. [5]

The overall success rate of non-operative approach in management of pediatric appendicitis is variable among different studies. The higher rates were usually associated with more strict inclusion and exclusion criteria e.g., early presentation within the first 24 hours of onset of symptoms and absence of fecalith on US scan. [10]

In comparison to (Hall et al,2021) we used radiological assessment routinely to confirm diagnosis and exclude other differentials and complications because they found that relying on clinical assessment only resulted in a 30% of complicated appendicitis wrongly diagnosed as non-complicated. [8]

In our study we didn`t consider an appendicular fecalith as an exclusion criterion to either of the two options of treatment, however we noticed that 2 of the 3 cases that failed initial non-operative treatment had a fecalith as well as 2 cases of the 4 who presented later with recurrent abdominal pain and required appendectomy. This makes fecalith a risk factor for failure of non-operative treatment rather than contraindication.

We found also that an appendix diameter in the range of 4-11 mm had no significant impact on the final outcomes.

One drawback of our study was the short duration of follow-up (6 months) due to difficulty in contacting or recruiting patients in our community. Another drawback was the use of 2 different surgical approaches (laparoscopic and open) in the operative group even though the laparoscopic approach is superior to the conventional open approach. This may had had some impact on the results as 4 of the complicated cases that required readmission and treatment or intervention were in the subgroup of open appendectomy (namely two cases of wound infection and gapping, one case of adhesive intestinal obstruction and one case of pelvic abscess).

Conclusion and recommendations:

Non-operative treatment is a feasible, effective, and safe option for management of acute non-complicated appendicitis in children with success rates comparable to appendectomy and significantly lower morbidity, less duration of hospital admission, less duration of abstinence of school ,work or social life and lower costs.

We recommend larger comparative studies with more adherence to the laparoscopic approach in the operative arm and longer duration of follow up.

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