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Original Research Article

Primary appendectomy in appendicular masses of children: an institutional experience

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ABSTRACT

Background: Early appendectomy (EA) for appendicular mass (AM) has been found to be a safer alternative in various studies in adults, while very few studies report such advantages in pediatric population. The purpose of this study was to assess the safety, efficacy and practical implications of EA in pediatric patients with AM.
Methods: All patients with acute appendicitis or its complications that underwent EA between January 2016 and December 2018 were retrospectively reviewed. AM was defined if any or combination of the following criteria were satisfied with other signs of appendicitis: palpable mass in right iliac fossa (RIF), sonologically identified mass in RIF, per-operatively confirmed as a mass by surgeon.
Results: 37 patients (among a total of 642 patients) were determined to have AM per-operatively and were included in the analysis. 29.7% (n=11) had a contained appendicular abscess. Age group ranged from 4-12 years (mean 7.8 years). The key per-operative findings were fecolith (21.6%), gangrenous appendix (56.8%), difficult adhesiolysis (48.6%), and full thickness bowel injury (2.7%). Postoperatively, wound infection in 9 (24.3%), intra-abdominal abscess in 1 (2.7%), prolonged ileus in 2 (5.4%) and sepsis in 2 (5.4%) were managed medically.
Conclusions: EA approach in AM is a safe option in children as it avoids misdiagnosis, treats complicated appendicitis early, avoids second admission, and has shorter hospital stay with better compliance. Failures of non-operative management and potentially lethal complications of complicated appendicitis are also eliminated.

Keywords: Appendicitis, Appendicular abscess, Appendicular mass, Open appendectomy, Pediatric appendicitis, Phlegmon

INTRODUCTION

Appendicular mass (AM) is a relatively common presentation of appendicitis and is seen in approximately 2-6% of children with acute appendicitis.[1] It can be a simple phlegmon where it is an inflammatory mass consisting of the inflamed appendix, its adjacent viscera, and the greater omentum or an appendicular abscess when it contains pus. Both can present as a mass, which results from both inflammation and walled off perforation of the appendix.[2] Traditionally, particularly in adult surgery, AM has been routinely managed conservatively.[3] No rigid guidelines have been proposed in pediatric cases, even though most surgeons prefer a conservative approach initially, followed by an interval appendectomy (IA) few weeks later.[4] However there are some studies which advocate an early appendectomy (EA) even with AM, in contrary to the traditional line of management.[5] The advantages reported with the former line of treatment includes lessened number of total hospital stay and the obvious exclusion of a planned second admission for IA and disadvantages include the possibly increased technical difficulty in primary surgery and higher incidence of other complications such as wound infection, bowel perforation etc. The purpose of this study was to determine the efficacy and the outcomes

when EA approach is followed in pediatric cases, which is routinely followed in our institution.

METHODS

A retrospective hospital database review was performed to identify patients admitted to our tertiary referral centre with features of acute appendicitis that were histologically confirmed, for a period of three years between January 2016 and December 2018.

Inclusion criteria

Only patients below 12 completed years of age and those who were operated in our institution were included.

Exclusion criteria

Those with confirmed other pathologies, like Crohn's disease, tuberculosis, malignancies were excluded.

Ethical approval for this study had been obtained from the institutional ethics review committee and appropriate consent guidelines were followed.

AM was determined to be present if any one or a combination of the following criteria was/were satisfied with other signs of appendicitis: clinically palpable mass in right iliac fossa (before surgery or under GA), sonologically identified conglomerated mass in right iliac fossa composing of bowel, omentum with surrounding hyperechoic mesentery (appendix may or may not be visualized), peroperatively reported as a mass formation by the operating surgeon. Pus may have been present on ultrasound or on surgical exploration. Abscess that is contained in the mass was considered AM related but any abscess elsewhere (for example, pelvic abscess, sub-diaphragmatic and interloop abscess) were excluded from analysis.

Demographic, clinical, biochemical, radiologic, and operative data were collected from hospital medical records. Data collected comprised of age, gender, clinical features, antibiotics prior to referral, ultrasound findings, blood markers, operative findings (presence of mass/fecolith/abscess formation/peritonitis, bowel gangrene, blood transfusion, operative time, need for extending the initial incision in case of per-operative difficulties, need for conversion to open in case of laparoscopic approach), any complications following surgery (wound infection, intraabdominal collection, postoperative ileus, adhesive obstruction, re-laparotomies) and number of days of hospital stay. The presenting symptoms included abdominal pain, vomiting, fever, anorexia and occasionally abdominal distension, dysuria and diarrhoea (Table 1).

Antibiotics at our institution were administered only after decision for appendectomy was taken by the attending surgeon. As a routine, we perform primary operative management (EA), within 24 hours, for all appendicular inflammatory pathologies regardless of the presence of mass formation or other complications. All cases were operated either laparoscopically or through laparotomy, depending upon the choice and expertise of the surgeon. Standard operative techniques for laparoscopic or open appendectomy were employed. Conversion to open appendectomy, when necessary, was determined by the attending surgeon. No drains were left in situ, as thorough wash was always followed, especially in perforated cases. Patients were started on oral fluids 24-48 hours after the surgery and normal diet resumed as tolerated. For simple appendicitis, intravenous antibiotics were given for the first 24 hours and for complicated appendicitis the same was given for a minimum period of 5 days (and till afebrile for 24 hours). After discharge, patients were followed up at 1 week, 1month, 6 months and 1 year intervals. The collected data were verified, coded, entered and analyzed using SPSS (Statistical Package for Social Sciences) software v21. The continuous variables were shown as median or mean with standard deviation. Range and percentages were also mentioned where relevant.

RESULTS

Overall, 658 patients with clinical features of inflammatory appendicular pathology were admitted and operated but 16 were found misdiagnosed upon exploration and so were excluded. Of the remaining 642 patients who had histologically confirmed appendicitis, 26 patients (4.05%) were found to have appendicular phlegmon as per the criteria above and 11 (1.71%) had a contained abscess within this phlegmon (appendicular abscess). These 37 patients (5.76%) were then grouped as AM and included in the analysis. Among them, 25 patients (68%) were males and 12 (32%) were females. Mean age was 7.8 years (range 4-12 years). 30% cases (n=11) received antibiotics before referral. Mean duration of symptoms was 5.4 days (range 3-12 days) in AM when compared to 2.2 days (range 8 hours to 4 days) in case of other appendicular pathologies. The types of symptoms and other clinical characteristics of cases with AM when compared with other appendicular pathologies are mentioned in Table 1.

Symptoms included abdominal pain (100%), vomiting (86%), fever (84%), anorexia (81%), abdominal distension, palpable clinical mass (3.7%). 27 cases (73%) were diagnosed preoperatively through on clinical examination or ultrasound (US) and 10 cases (27%) were confirmed upon exploration. 78% had an elevated total leucocytes count (>11000). 11 (29.7%) out of the total 37 patients with AM had recurrent attacks of appendicitis before they were operated.

Table 1: Patient characteristics.

Patient characteristics	Other appendicular pathologies (n=605)	Appendicular mass cases (n=37)
	N (%)	N (%)
Referred from elsewhere	554 (92)	37 (100)
Preoperative antibiotics before referral	55 (9)	11 (30)
Duration of symptoms (days)	2.2	5.4
Abdominal pain	605 (100)	37 (100)
Vomiting	504 (83)	32 (86)
Fever	498 (82)	31 (84)
Anorexia	551 (91)	30 (81)
Abdominal distension	58 (10)	6 (16)
Dysuria	32 (5)	2 (5)
Diarrhoea	8 (1)	1 (3)
Palpable mass (clinically or under GA)	0 (0)	24 (65)
Mass on US	0 (0)	27 (73)
Per operative mass	0 (0)	37 (100)
WBC >11000	428 (71)	29 (78)

Table 2: Operative findings.

Operative details	Other forms of appendicitis (n=605) (%)	Appendicular mass cases (n=37) (%)
Appendicular phlegmon	0 (0)	26 (70.3)
Appendicular abscess	0 (0)	11 (29.7)
Peri-appendicular abscess	68 (11.24)	0 (0.0)
Fecolith	98 (16.2)	8 (21.6)
Gangrene appendix	102 (16.86)	21 (56.8)
Need to extend incision	28 (4.63)	6 (16.2)
Difficulty with adhesiolysis	12 (1.98)	18 (48.6)
Serosal tear	17 (2.81)	9 (24.3)
Full thickness bowel injury	0 (0.00)	1 (2.7)
Open	554 (91.5)	28 (75.6)
Laparoscopic	51 (8.5)	9 (24.4)
Operative time (min.)	51.2	92.8
Conversion to open if lap done	8 (15.6)	2 (22.2)
Need for drain	0 (0.00)	0 (0.00)

Table 3: Postoperative complications.

Postop details / all cases	All cases other than mass (n=605) (%)	Appendicular mass cases (n=37) (%)
Wound infection	78 (12.89)	9 (24.32)
Sepsis	3 (0.50)	2 (5.41)
Prolonged Ileus	9 (1.49)	2 (5.41)
Intestinal obstruction during same admission	2 (0.33)	0 (0.00)
Enterocutaneous fistula	0 (0.00)	0 (0.00)
Intra-abdominal abscess	4 (0.66)	1 (2.70)
Appendicular stump blowout	0 (0.00)	0 (0.00)
Mortality	0 (0.00)	0 (0.00)
Readmission for adhesions	53 (8.76)	0 (0.00)
Incisional hernia	0 (0.00)	0 (0.00)
Hospital stay (days)	5.5	8.2
Age (years)	6.5	7.8
Males	386 (63.80)	25 (68)

Per operatively, fecolith (21.6%), gangrenous appendix (56.8%) were the key findings. 16.2% (n=6) required extending the incision due to operative difficulties. There was difficulty in adhesiolysis in 18 (48.6%) patients, serosal tear in 9 (24.3%) patients and full thickness bowel injury in 1 (2.7%) patient during dissection. Average operating time was 92.8 minutes (Range 65-130 minutes). No drains were placed in any cases. 60 underwent laparoscopic EA and 10 were converted to open due to per-operative difficulties (Table 2).

Postoperatively, 9 (24.3%) patients had wound infection, 2 (5.4%) had sepsis and 2 (5.4%) had prolonged ileus, all of which were managed medically. There were no cases of postoperative intestinal obstruction, enterocutaneous fistula or appendicular stump blowout. There was no mortality (Table 3). There were no cases of readmission for adhesive obstruction or incisional hernia. Patients were followed up for a minimum period of 1 year (clinic visit or through correspondence).

Average hospital stay was 8.2 days (Range: 8-15 days) which was a bit longer than that for patients with other appendicular pathologies where it was 5.5 days (Range: 3-10 days).

DISCUSSION

Appendicitis refers to inflammation of the appendix and is one of the most common causes of acute abdominal pain in children. Acute appendicitis can be broadly divided into two subgroups: simple appendicitis (e.g. early or uncomplicated appendicitis) and complicated appendicitis (e.g. gangrenous appendicitis and appendiceal phlegmon or abscess). The most common type is simple appendicitis, which is the early stage of acute appendicitis. In case of a missed or delayed diagnosis of simple appendicitis, the appendix may become gangrenous, potentially leading to perforation and localized or generalized peritonitis (inflammation of the peritoneum), resulting in complicated appendicitis. When managing a child with AM, the clinical dilemma exists whether to treat the patient conservatively with antibiotics or proceed with immediate operation. Conservative treatment may also include radiologic drainage of a contained abscess. Moreover, after successful conservative management, some surgeons proceed with elective IA, whereas others do not.[11] Currently, although no consensus exists among surgeons regarding the optimal treatment for pediatric patients with AM, trend has mostly been in favor of EA globally, in contrast to a primary conservative line followed by IA, as in adult patients. The benefits of either approach or conclusions are however contentious, and continues to be debatable among surgeons worldwide.[12] The principal motives for justifying EA or IA are to prevent recurrence and to avoid misdiagnosing a possible alternative pathology, malignancy for example.

In general, conservative approach for AM comprises close observation of the patient, monitoring the vital and blood parameters, serial abdominal examination, keeping nil by mouth, administering intravenous fluids, antibiotics and analgesics.[13] If the child recovers and the mass resolves, then an IA is performed after a few weeks. However if this line of management fails in resolving the mass, EA is accomplished as originally described by Ochsner et al.[14] Even though this may appear rational and has an overall success rate of IA of about 90%, such patients are exposed to substantial morbidity as this literally takes the patient to the fringe of spreading the infection, making surgical management more difficult while the disease would have advanced.[15] Various reports have suggested a failure rate of 10-20% when the conservative line is opted eventually resulting in potentially avoidable complications such as abscess, perforation and sepsis, which are more cumbersome to manage and obviously carries higher morbidity.[16]

Notwithstanding the above, if the treating surgeon steadfastly adheres to the conservative line of management, alternate diagnosis if present, like Meckel's diverticulum related pathology, enteric fever with perforation, intussusception, and rarely appendiceal tumors, that deserves immediate attention could be missed.[17] Besides, in resource poor settings, there is a possibility of patient being lost to follow up before the IA is carried out once their primary symptoms have resolved and they have been discharged.

On the contrary, the reported benefits of EA for AM include reduced hospital stay, better patient compliance, reduced cost and the evident exclusion of a planned second admission for IA. In such instances, EA can be technically difficult, and per-operative complications like intestinal injury, wound infection, intra-abdominal abscess, enteric fistula, and respiratory complications are likely to be higher.[18,19]

In addition to the two most commonly followed approaches, EA or IA, few authors have lately deliberated on the option of active observation after nonsurgical management of AM. These investigators have shown that delayed appendectomy is not necessary for AM unless the person presents with recurrent symptoms. Hall et al, in their prospective randomized study, compared routine interval appendectomy with just active observation for eligible children who had acute appendicitis with an AM and were successfully treated without appendectomy or other surgical intervention. They conclude that in children, who do not have routine IA, the risk of recurrent histologically confirmed appendicitis is 12% in the first year and more than 75% of children will have avoided appendectomy 1 year later. Observation alone results in fewer days in hospital, fewer days away from normal daily activities, and is cheaper than routine IA. The principal limitation here is that active observation group was followed up for only for 1 year, while the risk of recurrent appendicitis or need for subsequent

appendectomy is clearly lifelong. In addition, recurrence of appendicitis is also possible when IA is delayed for a few months.[20] Similarly, Deakin et al have also shown that after initial successful conservative management, routine use of IA is not justified in asymptomatic patients.[21] A few other investigators have however questioned this approach.[22]

Given the pros and cons for both EA and IA, the timing of appendectomy for AM therefore remains controversial. The primary objective of this study was to assess the effects of EA in children for AM, in terms of overall morbidity and mortality and to compare outcomes with published literature, specifically on pediatric patients. As an institutional protocol, we have been using the EA approach for AM and has been the norm for last few years. Percutaneous abscess drainage was not performed at any stage. There were no mortalities recorded. The EA was performed within 48 hours or as soon as the diagnosis was confirmed, after serial examination if necessary, and the medical condition was stabilized. The justification for this approach, in addition to the benefits stated above, is that AM is often difficult to diagnose in children and the treatments prolonged with no certainty in diagnoses. While there may be signs of appendicitis, mass may not be palpated without causing pain and discomfort to the child. They are often primed with antibiotics before referral making diagnosis trickier. Early definitive treatment is also more acceptable to parents in our setting. Dropout and delays in surgery by the parents are also known which to increased morbidity and cost of treatment along with loss of school days.

In our series, 11 patients (29.7%) had evidence of recurrent episodes of acute appendicitis in the past, which was managed non-operatively and later on presented with AM. This reflects the reluctance of many parents to opt for IA. So whenever there are signs of acute appendicitis that would otherwise qualify for an appendectomy, it was carried out regardless if mass is palpable or not. But at the same time, it should be noted that one has to be experienced enough to manage AM by open or laparoscopic means. If not, it is always safer to follow the traditional regimen.

Very few studies have actually compared outcomes of EA versus IA in AM, specifically related to children. A broad comparison with other research in this direction is shown in Table 4. In the present study, post-operative complications were found in 4 (10.8%) patients; among these, major complication was observed in only 2 patient (5.4%) in the form of sepsis and prolonged ileus, and yet another patient (2.7%) with pelvic abscess, both of which were managed non-operatively. The hospital stay of 8.2 days, complication rate of 10.8%, intra-abdominal infection rate of 1% and prolonged ileus/adhesions of 2% are comparable to the results of EA performed for non-mass-forming complicated appendicitis. This supports the statement that EA is a safe option for management of AM in children.

We have herein also attempted to relate our own outcomes with general trend of EA for AM, as outlined in the meta-analysis by Vaos et al that compared immediate surgery with conservative treatment for complicated acute appendicitis in children, which included appendicular phlegmon/abscess and perforation.[23] Immediate surgery was defined as a prompt appendectomy performed on admission or within the first 48 hours of hospitalization after patient stabilization with intravenous fluids and antibiotics. Yet another comparison employed was the meta-analysis of conservative treatment versus acute appendectomy for complicated appendicitis (abscess or phlegmon) by Simillis et al.[3] To our knowledge there are no meta-analysis comparing outcomes of AM alone (with respect to IA and EA) exclusively for pediatric patients.

Both Vaos et al and Simillis et al have revealed a lower complication rate in the conservative group, regarding overall complication rate and wound infection.[3,23] However, Vaos et al also demonstrated that there was no statistical difference regarding the development of intra-abdominal abscess or postoperative ileus.[23] They have further pointed out that this finding could be associated with the differences in the severity of the disease between patients studied by Similis et al and their own.[3] Further, according to the meta-analysis of Duggan et al, the severity of the disease had a negative impact on the development of post-operative complications, because the absence of abscess on admission decreased considerably the odds of having a postoperative adverse event in children treated with EA.[24] However, in the same study, wound infection was not affected by the presence of abscess on admission in children treated either with EA or conservative option.

Table 4: Comparison with other published studies.

Study	Year	Length of hospital stay (Mean±SD)	Any complication (%)	Wound infection (%)	Abdominal infections (%)	Ileus or adhesions (%)
Tsai HY et al[6]	2017	6.4±2.2	6.8			
Tanaka et al[7]	2016	12.9±5.2	21.2		1.1	
Furuya et al[8]	2015	26.2±7.6	86.7	40	33	13.3
Calvert CE et al[9]	2014	6.5±6.7	31.0	9.5		11.9
Blakely ML et al[10]	2011	9±5.3	29.7	9.4	18.8	
Current study	2020	8.2	10.8	24.32	1	2

Due to the lack of sufficient Level I evidence for this common problem, no clear guidelines have been made so far and the management guidelines for pediatric AM need change. The present study has a number of limitations. First, it comprised mainly retrospective data from a single centre with a shorter follow up duration. Another drawback of this study is that there is no control group since EA management has been the norm for AM in our institution for long time. More multicentre randomized controlled trials and systematic reviews are required to reach a consensus on management.

However, this study shows that the optimal treatment of AM has not yet been clarified. Each method of treatment has its advantages and disadvantages. In our cohort the overall postoperative complication rate and wound infection rate were broadly comparable to the published meta-analytic literature on pediatric patients. EA shows a slight trend for shorter hospital stay than the IA group and did not affect intra-abdominal abscess or postoperative ileus any more than what would have achieved through the IA option.

CONCLUSION

EA approach in children with AM is a safe, feasible and preferable option to the conventional conservative approach with IA as it avoids misdiagnosis, treats complicated appendicitis its outset, avoids second hospital admission, has a shorter hospital stay and has better patient compliance. Failures of non-operative management and potentially lethal complications of complicated appendicitis are also eliminated. Complication rates are comparable to other forms of complicated appendicitis.

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