Complicated Appendicitis in Children: Current Management. Review Article

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Abstract

Complicated appendicitis in children is a challenging condition to treat and the treatment options that are available include conservative treatment followed by interval appendectomy and immediate appendectomy. Both these treatment options are effective but as there is no consensus on the management of complicated appendicitis, the treatment option is often decided by the treating surgeon. We have conducted this review article to look at the treatment options that are available, from conservative treatment to immediate appendectomy. We have also looked at the role of percutaneous drainage of appendicular abscess and the role of interval appendectomy.

Introduction

Complicated appendicitis in children is a challenging and serious condition as its early diagnosis is essential and there is significant morbidity if the diagnosis is delayed. The management of this condition can be divided into conservative treatment with intravenous antibiotics and/or percutaneous drainage of abscess or immediate appendectomy. Each of these methods has its pros and cons. The need for an interval appendectomy is also being reviewed due to the low recurrence rates [1].

The delay in diagnosis and management of complicated appendicitis can lead to an increase in morbidity, mortality, length of hospital stays and total cost. The incidence of complicated appendicitis is higher in children below the age of five years if the diagnosis is delayed [2].

The late clinical presentation of patients to the hospital, elevated total white cell count, elevated C-reactive protein levels, presence of hyponatremia are all predictors of complicated appendicitis in children, and this will influence its management [3,4].

The presence of an appendicolith on imaging is often associated with obstruction of the lumen and associated with a higher risk of perforation of the appendix. The presence of an appendicolith is a risk factor for failure of conservative treatment and an indicator of recurrent attacks of abdominal pain. Hence in these patients an appendectomy will need to be performed as an immediate or interval procedure [5,6].

The definition of complicated appendicitis often includes perforation of the appendix, but it also includes abscess formation and an inflammatory mass that includes the cecum and terminal ileum. The incidence of complicated appendicitis is affected by the age, gender, socio-economic status, and racial background of the patients [7].

The management of complicated appendicitis can be divided into conservative treatment with intra-venous antibiotics and analgesics followed by an interval appendectomy in eight weeks’ time. Due to the low recurrence rates the need for an interval appendectomy was questioned and there was a trend in treating these patients with conservative treatment alone. The third option is to perform an immediate appendectomy either through an open or laparoscopic method [8–10].

The introduction of laparoscopic appendectomy has seen a trend towards immediate appendectomy in the management of complicated appendicitis in children. It

More Information


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is the recommended treatment of choice by the World Society of Emergency Surgeons (WSES) [11]. As there is no current consensus in the management of complicated appendicitis in children, we have conducted this review article looking into the definition, diagnosis, and management of complicated appendicitis in children. We conducted a literature review using PUBMED, the Cochrane database of systematic reviews, Google scholar and semantic scholar looking for randomized control trials, non-randomized trials, observational and cohort studies, clinical reviews, systemic reviews, and meta-analysis from 1990 to 2023. The following keywords were used, “complicated appendicitis in children”, “appendicular mass in children”, “appendicular abscess in children”, “open appendectomy “and “laparoscopic appendectomy in the pediatric patient”. All articles were in English, and all articles were assessed by manual cross referencing of the literature. Commentaries, case reports and editorials were excluded from this review. Only pediatric patients were included in this review.

Discussion

Conservative treatment for complicated appendicitis

Non operative or conservative treatment of complicated appendicitis involves the use of intravenous antibiotics and fluids, and it is usually followed by an interval appendectomy in 8 weeks’ time. Conservative treatment is well tolerated by patients, and it has a success rate of up to 80%. It was performed to reduce the risk of complications that may occur with immediate surgery [12,13]. The use of non-operative treatment of complicated appendicitis in children was found to be more effective in patients with a complicated appendicitis with an abscess formation rather than those who present with a complicated appendicitis with a mass and without an abscess [14].

Predictors of failure of conservative treatment include lack of an abscess and the presence of an appendicolith which serves as a nidus for infection. These patients may benefit from other forms of therapy. In patients who have an appendicolith that was discovered by imaging would be advised to undergo an interval appendectomy due to the high recurrence rate. Other factors include presence of free peritoneal fluid, presence of high band count and an early indication for nasogastric tube insertion may increase the risk of failure of conservative treatment. The presence of small bowel obstruction and an excess level of white blood band cells on presentation are also risk factors for failure of conservative treatment [15–19].

A systemic review and meta-analysis by van Amstel et al compared the management of complicated appendicitis by initial non-operative management or early appendectomy, concluded that initial non-operative treatment may reduce the overall complication when compared with immediate appendectomy, but the evidence was uncertain due to considerable heterogeneity from the studies that were involved in this review [20].

A meta-analysis by Fugazzola et al on early appendectomy versus conservative treatment in complicated appendicitis in children concluded that conservative treatment was associated with lower complication rates and better outcomes with complicated appendicitis with abscess formation. For patients with complicated appendicitis with mass formation, immediate appendectomy was associated with better outcomes [21].

Conservative treatment was compared with immediate appendectomy for the management of complicated appendicitis in children by Erdogan et al. This study concluded that the immediate appendectomy group had a complication rate of 26.3% and there was no complication in the conservative group who underwent an interval appendectomy [22].

The role of Percutaneous drainage in complicated appendicitis

Percutaneous drainage of intra-abdominal abscess is performed in children who present with complicated appendicitis with abscess formation. This is used with intra-venous antibiotics in conservative treatment of complicated appendicitis, and it is associated with a good success rate. The procedure is safe and can be done via an ultrasound or computerized tomography [23].

Children presenting with complicated appendicitis of more than 5 days duration may benefit from conservative treatment and percutaneous drainage of abscess and followed by an interval appendectomy [24]. Failure of conservative treatment will require imaging to detect the presence of an intra-abdominal abscess and depending on the size of the abscess, percutaneous drainage may be performed [25].

Studies have shown that percutaneous drainage of complicated appendicitis with abscess formation is safe and effective. It is also associated with faster recovery and early ambulation, but they may also present with recurrent attacks of abdominal pain and hence an interval appendectomy may be indicated in these patients [26,27].

Interval appendectomy after conservative treatment for complicated appendicitis

The indication for performing an interval appendectomy in patients who have completed conservative treatment was initially indicated as a routine due to the high recurrence rate in these patients. The incidence of recurrence has been reported to be up to 50% in some cases [28–30].
A systematic review was performed by Hall et al on whether an interval appendectomy was justified after successful conservative treatment for complicated appendicitis. This study had included 3 retrospective studies, and the conclusion was that the recurrence rate after conservative treatment was 20.5% and the incidence of complications after interval appendectomy was 3.4%. This systemic review was not able to conclude if an interval appendectomy was justified due to lack of prospective studies [31].

An open label randomized control trial was performed by Hall et al comparing active observation and interval appendectomy after successful conservative treatment for complicated appendicitis in children. This study included 106 patients who were divided into 52 who underwent interval appendectomy and 54 who underwent active observation. The results of this trial showed that the recurrence rate after active observation was 12% and the complication rate from interval appendectomy was 6%. This study concluded that interval appendectomy need not be done as a routine and is reserved for patients who present with recurrent attacks [32].

Immediate appendectomy for complicated appendicitis

Immediate appendectomy has often been reserved for cases of complicated appendicitis with a late presentation or in hemodynamically unstable patients. It can be performed as an open or as a laparoscopic procedure. The factors that influence this include the onset of presentation of complicated appendicitis, the timing of the procedure, or whether irrigation is indicated or not [33,34].

Laparoscopic appendectomy was introduced in the management of complicated appendicitis because it allowed proper visualization of the peritoneal cavity, it was minimally invasive and associated with early ambulation [35]. Several studies have compared laparoscopic appendectomy versus open appendectomy in the management of complicated appendicitis and the results showed that there was no difference with regards to the operative technique and complication rates. Hence both surgical techniques are effective and safe but laparoscopic appendectomy is associated with a shorter hospital stay [36–39].

Caution is recommended during the initial learning curve for laparoscopic appendectomy in complicated appendicitis, a high index of suspicion of development of complications is essential. Several retrospective studies have shown the benefit of laparoscopic appendectomy in complicated appendicitis especially with post operative intestinal recovery and reduced analgesia intake. Laparoscopic appendectomy is also associated with minor complication like vomiting and diarrhea [40–43].

Esposito et al conducted a literature review on open versus laparoscopic appendectomy in the pediatric population and they concluded that laparoscopic appendectomy was associated with lower wound infection rates, reduced analgesia use, early ambulation and reduced hospital stay. There was however no difference in the intra-abdominal abscess rate in both the procedures [44].

The timing of appendectomy is important as immediate appendectomy was compared with delayed appendectomy in patients with complicated appendicitis. The patients who had undergone immediate appendectomy had a lower complication rate, reduced length of hospital stay and reduced cost [45].

A meta-analysis by Vaos et al compared immediate surgery with conservative treatment in the management of complicated appendicitis in children. A total of 1,243 patents were included in this meta-analysis and this study concluded that conservative treatment was associated with reduced complications and wound infections. Immediate surgery was associated with reduced stay in the hospital and the incidence of intra-abdominal abscess rate was equal in both groups. This meta-analysis could not conclude what was the best form of management for complicated appendicitis due to heterogenicity in the studies that were included [46].

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Study Type</th>
<th>Wound infection-immediate surgery (%)</th>
<th>Wound infection-Conservative treatment</th>
<th>Abdominal Infection-Immediate surgery</th>
<th>Abdominal Infection-Conservative treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bufo et al</td>
<td>1998</td>
<td>Retrospective study</td>
<td>6.5%</td>
<td>6%</td>
<td>10.8%</td>
<td>0%</td>
</tr>
<tr>
<td>Erdogan et al</td>
<td>2005</td>
<td>Retrospective study</td>
<td>5.3%</td>
<td>0%</td>
<td>15.8%</td>
<td>0%</td>
</tr>
<tr>
<td>Blakeley et al</td>
<td>2011</td>
<td>Retrospective study</td>
<td>9.4%</td>
<td>9%</td>
<td>18.3%</td>
<td>37%</td>
</tr>
<tr>
<td>Furuya et al</td>
<td>2015</td>
<td>Retrospective study</td>
<td>40%</td>
<td>0%</td>
<td>33.3%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Conclusion
The management of complicated appendicitis has undergone an evolution from conservative treatment to immediate appendectomy. The introduction of laparoscopic appendectomy has seen a move towards using this method to treat all cases if the expertise is available. There is a role though for percutaneous drainage of intra-abdominal abscess and interval appendectomy need not be performed as a routine and it is reserved for cases who present with recurrent attacks. The treating surgeon will often decide which form of management will be required to treat complicated appendicitis in the pediatric population due to the absence of any consensus on its management. This review demonstrates that there is a trend towards immediate appendectomy in the treatment of complicated appendicitis in the pediatric population. Most hospitals will continue to perform open appendectomies due to cost of performing laparoscopic appendectomy in complicated appendicitis in children and the longer learning curve that is required.

Conflict of Interest
There is no conflict of interest.

References


