Conservative Treatment in Uncomplicated Appendicitis in Pediatrics at Tertiary Center Hospital

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Abstract

Background: Acute appendicitis is common in children, with appendectomy as the traditional treatment. Scoring systems like Alvarado and RIPASA help assess patient eligibility for conservative treatment, considering symptoms and additional factors like age, sex, and symptom duration. Recent studies recommend antibiotics as an initial treatment for uncomplicated cases, to avoiding surgery in many cases.

Objectives: To evaluate non-operative management of appendicitis in pediatrics.

Patients and methods: A cohort study done at pediatric surgery unit in Qena University Hospitals from Sep 2022 to Mar 2023 included children with acute uncomplicated appendicitis. Diagnosis was based on the available scores for diagnosis of appendicitis. Conservative management involved diagnosis antibiotics, clinical evaluation and radiological evaluation.

Results: Thirty patients were included in this study. Common symptoms: abdominal pain (100%), appetite loss (56.67%), nausea/vomiting/diarrhea (60%). All diagnosed with appendicitis. Pediatric Appendicitis Score: tenderness (80%), leukocytosis (90%), cough/percussion (66.67%), nausea/vomiting (60%), anorexia (83.33%), pain migration (86.67%), median score 8. IV antibiotics: median 1.925 g (range: 0.35-5.9 g). Outcomes: 90% symptom resolution, median 4-day hospital stay (range: 2-7 days), 6.67% recurrence, 6.67% appendectomy. Post-intervention, significant improvement in signs/symptoms, ultrasonography, CRP; WBC count improved variably.

Conclusion: Conservative treatment for uncomplicated pediatric appendicitis is safe, successful (90% cure rate), cost-effective, and efficient with short hospital stays. Although it has a high success rate but may require a few patients undergo appendectomy.

Keywords: Conservative treatment; Uncomplicated; Appendicitis; Pediatrics.

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Introduction

Acute appendicitis is a common surgical condition in children **(Maita et al., 2020),** and appendectomy has been the treatment of choice for some time. In recent years, however, numerous observational studies have examined the feasibility of conservative antibiotic therapy as an initial treatment for children with uncomplicated appendicitis. These studies revealed that a substantial proportion of patients in the 'antibiotics-first' cohort could avoid appendectomy **(Armstrong et al., 2014; Svensson et al., 2015; Tanaka et al., 2015).**

Various assessment systems, such as the Alvarado score **(Mandeville et al., 2011)**, have been developed to evaluate the suitability of conservative treatment for patients. This score takes into account variables such as anorexia, nausea, vomiting, right iliac fossa tenderness, and rebound tenderness. Additionally, alternative scoring systems like RIPASA (Raja Isteri Pengiran Anak Saleha appendicitis score) have been introduced, which integrate additional diagnostic criteria, including age, gender, and symptom duration **(Siddiqui et al., 2011; Malik et al., 2017).**

In the present study, confirmed cases of uncomplicated appendicitis in minors were evaluated prospectively. Our primary hypothesis focused on the safety and efficacy of conservative treatment for acute appendicitis in children, with the expectation that the majority of patients would be able to avoid appendectomy. We aim to evaluate the efficacy of conservative treatment of acute appendicitis.

Patients and methods

This was a prospective study that conducted from September 2022 – to March 2023. All patients presented with final diagnosis of acute uncomplicated appendicitis admitted to pediatric surgery unit at Marzogy - emergency hospital at Qena University Hospital for 6 months were included in the study.

Inclusion criteria: Children with acute non complicated appendicitis diagnosed by pediatric appendicitis scores **(Tables 1, 2).**

Table 1. Alvarado Score for acute appendicitis **(Tan et al., 2020)**

Clinical Factor	Points
Migration of pain to right lower quadrant	1
Anorexia	1
Nausea and vomiting	1
Right lower quadrant tenderness	2
Rebound tenderness	1
Elevated temperature (>37.3°C or 99.1°F)	1
Leukocytosis (WBC >10,000/mm³)	2
Shift to the left (neutrophil count >75%)	1
Total Possible Score	10
Interpretation: • 0-4 points: Low likelihood of appendicitis. • 5-6 points: Intermediate likelihood. • 7-10 points: High likelihood.	

Table 2. RIPASA score for acute appendicitis **(Regar et al., 2017)**

Parameter	Score
Sex:	
- Male	1

- Female	0.5
Age:	
- <39.9 years	1
- >40.0 years	0.5
RIF pain	0.5
Migration of RLQ pain	0.5
Anorexia	1
Nausea and vomiting	1
Duration of symptoms:	
- <48 hours	1
- >48 hours	0.5
RIF tenderness	1
RIF guarding	2
Rebound tenderness	1
Rovsing's sign	2
Fever	1
Raised WBC	1
Negative urinalysis	1
Foreign NRIC	1

Exclusion criteria: Children with acute complicated appendicitis necessitate surgical intervention.

Study design:

- The parents' of included patients were appropriately informed about the conservative treatment approach.
- Every patient was evaluated using the Pediatric Appendicitis Score **(Samuel, 2002)**
- All patients presented by uncomplicated appendicitis were treated with a conservative approach

-The primary outcome assessment was the success rate of non-operative management, defined as the percent of patients treated non-operatively who didn't undergo an appendectomy.

-The secondary outcomes were the need for surgical treatment

Non operative management

- Intravenous administration of antibiotics (cefotaxime 50–100 mg/kg, daily). After 24 hours, a clinical reevaluation was performed to monitor the presence of symptoms and signs indicative of acute appendicitis.

After 48 h: Ultrasonography: A 5- to 12-MHz linear transducer was used for appendix US. The sonographer gently performed anterior graded compression with the transducer to displace air-filled intestinal loops, minimize the distance to the appendix, and identify the inflamed appendix. Slowly compressing the transducer allowed expiration-induced pressure. The non-preinstalling haustrated ascending colon and the much smaller compressible preinstalling terminal ileum were identified to reduce the distance from the transducer to the appendix and improve visualization if the previous methods failed.

Laboratory investigations: a) White blood cells count (WBCs), b) C-Reactive Protein (CRP).

In case of resolution of clinical picture: Less pain, fever below 38^{o}C, patient was able to mobilize, fluid oral intake tolerated, normal ultrasonography and laboratory findings, a normal diet, intravenous

antibiotic maintained at least 72 h, and patients discharged with oral antibiotics for 5 days and clinical control after 1 week, according to **Caruso et al., (2017).**

After non-operative release, parents were instructed to contact the Pediatric Surgery Department with any signs of Acute Appendicitis (AA). The outpatient clinic saw all participants one week following discharge.

Ethical Approval: SVU-MED-SUR011-1-22-8-428

Statistical Analysis

In order to analyze the data, version 24 (May 2016) of IBM-SPSS was utilized. Statistical significance was determined using the Kristall-Wallis and Wilcoxon tests, as well as Spearman's correlation and logistic regression analysis. Each variable was analyzed (parametrically or nonparametrically) based on the data it contained. When the P-values were less than 0.05 (five percent), we regarded the findings to be statistically significant.

Results

Among 243 pediatric patients presented to our center by acute appendicitis, thirty patients that met the inclusion criteria were included in this study, their demographic data is demonstrated in (**Table.3**).

(Table.3) presents demographic and baseline characteristics of the 30 patients included in the study. The age range was 5 to 18 years. Of the patients, 60% were male, and 40% were female. All patients presented with abdominal pain, while 56.67% reported a loss of appetite, and 60% experienced nausea and/or vomiting and diarrhea. The diagnosis for all patients was acute appendicitis. Regarding the Pediatric Appendicitis Score data, 80% of patients had tenderness over the right iliac fossa, 90% had leukocytosis, 66.67% showed cough/percussion, and 60% had nausea/vomiting. Anorexia was present in 83.33% of patients, and 86.67% reported the migration of pain. The total Pediatric Appendicitis Score ranged from 5 to 10, with a median score of 8. The total dose of intravenous antibiotics administered had a median of 1.925 g, with a range of 0.35 to 5.9 g. The outcomes for the included subjects showed that 90% experienced resolution of symptoms, and the median length of hospital stay was 4 days (ranging from 2 to 7 days). Additionally, 6.67% of patients experienced recurrence of appendicitis, leading to 6.67% of patients undergoing appendectomy.

Table 3. Patients' demographic data and basal characteristics

Item	(N of patients = 30)	Percentage
Age (in years)	(5-18)	
Sex		
• **Male**	**18**	60%
• **Female**	**12**	40%
General evaluation		
• **Abdominal Pain**	**30**	100%
• **Loss of appetite**	**17**	56.67%
• **Nausea or/and vomiting**	**18**	60%
• **Diarrhea**	**18**	60%
Diagnosis		
• **Acute Appendicitis**	**30**	100%
Pediatric Appendicitis Score data		
• **Tenderness over the right iliac fossa**	**24**	80%

• **Leukocytosis**	**27**	90%
• **Cough/percussion**	**20**	66.67%
• **Nausea/ vomiting**	**18**	60%
• **Anorexia**	**25**	83.33%
• **Migration of pain**	**26**	86.67%
• **Total Score**	8 (5-10)	
Intravenous antibiotics total dose (g)		
• **Median (Range)**	1.925 (0.35-5.9)	
Outcomes of included subjects		
• **Resolution**	27	90%
• **Length of hospital stay (Days)**	4 (2-7)	
• **Recurrence of appendicitis**	2	6.67%
• **Appendectomy**	2	6.67%

There was significant improvement in Signs and symptoms of acute appendicitis and Ultrasonography evaluation. Also CRP showed significant improvement post intervention. WBCs count improved but not significantly mostly due to individual variability in the timing and degree of the body's recovery process. CRP level decrease significantly after intervention, (**Table.4)**

Table 4. Comparison between pre and post intervention regarding local and lab. evaluations

Parameter	Pre-Intervention (N = 30)	Post-Intervention (N = 30)	P. Value
Signs and symptoms of acute appendicitis	30 (100%)	3 (10%)	<0.0001
Ultrasonography			
• **Inflammation**	30 (100%)	3 (10%)	<0.0001*
• **Length (Cm)**	10 (8-12)	4 (2-12)	<0.0001*
• **Diameter (mm)**	10 (9-12)	3 (2-13)	<0.0001*
WBCs (*10^3 cells/mm^3)	10.9795 (9.563-21.438)	9.1825 (7.172-24.017)	0.0865
CRP (mg/L)	56 (49-62)	9 (5-62)	<0.0001*

WBCs: White Blood Cells, CRP: C-reactive protein.

Discussion

Acute appendicitis is the most common surgical emergency in children and is most frequently treated with appendicectomy. Recently non-operative treatment of appendicitis (with antibiotics alone and without an appendicectomy) has come to the fore as an alternate treatment approach but has not yet entered mainstream clinical practice **(Jumah and Wester, 2022)**. Barriers to the more widespread adoption of non-operative treatment include concerns over safety and efficacy and the fact that many surgeons are unfamiliar with this treatment strategy. Although appendicectomy is a tried and tested treatment, is familiar to surgeons and has a well-understood safety and efficacy profile, it does require a general anesthetic and an abdominal operation with inherent risks **(Rolle et al., 2021)**.

In our study, 30 patients were included. The age range was 5 to 18 years. Of the patients, 60% were male, and 40% were female. This age range is slightly broader than the one documented in study, which specifically focused on children aged 4 to 15

years. Notably, **Hall et al. (2021)** also reported a male predominance with 36 males and 20 females, a finding consistent with our own results.

Turning to the study by **Mudri et al. (2017)** they investigated 26 patients under non-operative management (NOM) and 26 under operative management (OM). In their NOM group, 30% were female, with a mean age of 12 years, while the OM group had a higher female majority at 73%, with a mean age of 11. In contrast, our study included 30 patients without specifying the management approach, revealing 60% male and 40% female patients, and a broader age range spanning 5 to 18 years. This discrepancy could potentially be attributed to random sample collection methods.

Regarding symptoms, our study observed that all patients presented with abdominal pain, with additional symptoms such as a loss of appetite (56.67%), nausea and/or vomiting (60%), and diarrhea. These findings resonate with the diagnosis of acute appendicitis in our patient cohort. Our results align with the work of **Minneci et al. (2014)**, who reported abdominal pain as the most common presenting symptom, followed by fever, vomiting, and nausea. Similarly, **von Mersi et al. (2021)** noted clinical symptoms of acute appendicitis in a pediatric population, including abdominal pain, abdominal tenderness, fever, nausea, emesis, diarrhea, and constipation.

In our study, we assessed the Pediatric Appendicitis Score (PAS) data and found that 80% of our patients exhibited tenderness over the right iliac fossa, 90% had leukocytosis, 66.67% showed positive results for cough/percussion, and 60% experienced nausea/vomiting. Additionally, anorexia was reported in 83.33% of our patients, and 86.67% noted pain migration. The total Pediatric Appendicitis Score in our cohort ranged from 5 to 10, with a median score of 8.

Comparing these findings to those of **Caruso et al. (2017)** they reported a mean PAS of 8.6 ± 1.4 which comes in close alignment with ours, indicating a similar level of diagnostic utility of the Pediatric Appendicitis Score in both studies.

In this study, the total dose of intravenous antibiotics administered had a median of 1925 ml, with a range of 350 to 5900 ml. The outcomes for the included subjects showed that 90% experienced resolution of symptoms, and the median length of hospital stay was 4 days (ranging from 2 to 7 days). Additionally, 6.67% of patients experienced recurrence of appendicitis, leading to 6.67% of patients undergoing appendectomy.

Our findings are in harmony with several prior studies. **Simillis et al. (2010)** reported no significant difference in the length of hospitalization between patients treated conservatively and those who underwent surgery, despite some heterogeneity among the studies analyzed.

Our results closely align with **Patkova et al. (2020)** who highlighted the safety of antibiotics over the intermediate term. None of the children previously treated nonoperatively developed complicated appendicitis during a follow-up period of at least 5 years. While there were no failures in the appendectomy group, 11 failures occurred in the nonoperative group, predominantly during the first year after inclusion, with two cases having histologically confirmed appendicitis. Additionally, two patients experienced recurrent acute appendicitis 1 to 5 years after inclusion, leading to uncomplicated laparoscopic appendectomies.

Similarly, **Sippola et al. (2021)** conducted a randomized study with patients suffering from acute uncomplicated appendicitis, reporting a 70.2% success rate for oral antibiotics alone and a 73.8% success rate for intravenous antibiotics followed by an oral antibiotics course. Notably, there were no

statistically significant differences in hospital stay or sick leave between the two treatment groups, further supporting the effectiveness and safety of antibiotics in treating acute uncomplicated appendicitis.

Georgiou et al. (2017) found an initial treatment efficacy of 97% in children with acute uncomplicated appendicitis treated non-operatively. While the recurrence rate was 14%, the success rate evaluated among patients who did not require an appendectomy was 82%. Complication rates were similar between the conservatively treated group and those who underwent surgery, but children treated with appendectomy had shorter hospital stays. They did, however, caution that making practice-changing conclusions from their analysis may be limited due to varying study quality.

In this study, there was significant improvement in Signs and symptoms of acute appendicitis and Ultrasonography evaluation. Also, CRP showed significant improvement post intervention. WBCs count improved but not significantly mostly due to individual variability in the timing and degree of the body's recovery process. CRP level decrease significantly after intervention

A recent meta-analysis by **Rollins et al. (2016)** evaluating nonoperative versus surgical treatment of acute uncomplicated appendicitis in adults suggested that antibiotic treatment without surgery is an effective alternative in this group of patients with significant improvement in signs and symptoms.

Similarly, **Malik & Bari (2009)** published a trial where 80 patients were randomized 40 to conservative treatment and 40 to surgical intervention. significant improvement in Signs and symptoms of acute appendicitis. Also, inflammation laboratory markers including WBC and CRP levels showed significant improvement post conservative treatment.

As well, **Steiner et al. (2017)** who aimed to evaluate the success rate of conservative treatment for children with uncomplicated appendicitis was prospectively evaluated among 197 children. They reported significant improvement in symptoms, laboratory signs, and sonographic findings after conservative treatment.

Another published 5-year follow-up of the randomized controlled trial (RCT) by **Salminen et al. (2018)** comparing nonoperative treatment with surgery for acute uncomplicated appendicitis supports nonoperative treatment with significant improvement in symptoms and laboratory signs.

Conclusion

Conservative therapy for children uncomplicated appendicitis is successful and safe. Conservative therapy cures 90% of patients. Conservative therapy is cost-effective and efficient since hospital stays are brief. Conservative appendicitis therapy has a high success rate and low complication rate, although a small number of patients may return or need an appendectomy. To find the best therapy for each patient, conservative treatment should be thoroughly reviewed.

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Author contribution: Authors contributed equally in the study.

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