



Evaluation of Necessity of Appendectomy After Conservative Treatment of Uncomplicated Acute Appendicitis in Children

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Received: 05 May 2022
Revised: 03 June 2022
Accepted: 11 June 2022
Published: 23 June 2022

Abstract

Background: Acute appendicitis is one of the most common emergency clinical conditions among children. It has two-way treatment options, one is surgical procedures, and another is a conservative approach. In the modern arena conservative treatment approach for acute appendicitis is one of the most preferred options. The aim of the study was to find out the solution to clinical conditions and reduce the procedure of injudicious appendectomy. **Material & Methods:** This prospective observational study was carried out at the Department of Paediatric Surgery, Dhaka Medical College Hospital, Dhaka to assess the necessity of appendectomy following conservatively managed uncomplicated acute appendicitis. A total of 62 children with uncomplicated acute appendicitis were included in the study. Then a conservative treatment started with the combination of inj. Ceftriaxone (100 mg/kg per day), inj. Metronidazole (1.5 mg/kg/ tds) and inj. Amikacin (7.5 mg/kg/ bd) therapy for five days with associated supportive management. The patients were assessed after 24 hours of treatment, who responded to the above management were the continued for same treatment at least five days then discharged and were followed up for 6 months. **Results:** Mean age was 8.95 ± 2.10 years within range from 4 years 12 years. The male-female ratio was 1.58:1. The mean duration of hospital stay was 5.26 ± 0.63 days. On day 5, 59 (95.1%) were discharged and 3 (4.9%) underwent surgery during the conservative treatment period. A total of 8(13of .0%) cases have recurred during the first 6 months after treatment. **Conclusions:** Antibiotic treatment in patients with acute appendicitis is quite effective, the success rate is 95.1% during the period of treatment, and the recurrence rate is 13.0%.

Keywords:- Acute appendicitis, Surgical procedures, Conservative approach, Appendectomy, Ceftriaxone, Metronidazole.

INTRODUCTION

Appendicitis results from acute inflammation of the appendix. Acute appendicitis is the most common surgical emergency in children.^[1] The

lifetime risk of developing appendicitis is 7%-8%, with a peak incidence in the teenage years. Surgical removal of the appendix has been deemed necessary to effectively treat acute



appendicitis, for over 100 years Appendectomy remains the cornerstone of treatment for acute appendicitis.^[2] Appendectomy itself is associated with intra and post-operative morbidities including vascular injuries, urinary tract complications, hematomas, colonic fistulas, surgical site infections, adhesions, bowel obstructions, and a significant length of hospital stay.^[3,4] The postoperative complication rate ranges from 2% to 23% and more than 3% of patients are readmitted with intestinal obstruction and postoperative adhesion.^[5,6] Without surgery may be an effective treatment, for acute appendicitis in adults and more recently in children, in recent years this surgical dogma has been challenged and there is a growing literature to suggest antibiotics. This non-operative management of acute appendicitis remains controversial and unproven due to the lack of well-designed large prospective randomized controlled trials (RCTs).^[7] It requires general anesthesia and is an abdominal operation with inherent risks and potential complications, although appendectomy is generally a simple procedure. Complications related to surgery or anesthesia occur in over 10% of children within 30 days of appendectomy.^[8] This would not be a viable alternative to surgery unless it is effective at curing acute appendicitis, although a non-operative approach may avoid these risks and reduce the complication rate. With a clinical and/or radiological diagnosis of acute appendicitis some patients may not actually have acute appendicitis. Even with current imaging methods, 6.3% of children in Canada and 4.3% in the USA undergoing appendectomy are subsequently found to have a normal appendix.^[9] Consequently, this could be considered to be an unnecessary operation.

Psychological stress and distress in their parents, surgery cause trauma, physiological stress, and physical scarring in the child. A non-operative approach might reduce these. For the healthcare system and society, arising from reduced time away from normal daily activities including schooling and parental time off work, there may be social and economic benefits to the child and family and there may be benefits. However, there is the issue of recurrent appendicitis. Children would be left with an appendix and be at risk of recurrent appendicitis, following successful non-operative treatment. The benefits of successful non-operative treatment would only be realized if the rate of recurrent appendicitis is low. There is likely to be less benefit from an initial non-operative approach if a high proportion of children will develop a recurrence. From adult patients, the existing literature relating to the efficacy of non-operative treatment of acute appendicitis is predominant. Several trials and systematic reviews have been reported.^[10,11] In a meta-analysis¹⁰ concluded that while there were benefits to non-operative treatment including fewer complications, better pain control, and shorter sick leave, the combined failure and recurrence rates in non-operative patients made this approach less effective overall.^[10] However, in the same year,^[11] concluded from their meta-analysis that 'antibiotics can be used safely as primary treatment in patients presenting with acute uncomplicated appendicitis' since 63% of patients respond to non-operative treatment. In children, the literature is limited. While antibiotic therapy appears successful in the majority of children with acute uncomplicated appendicitis, no large randomized study of acute appendicitis in children has yet been

performed. As initial treatment in 97% of cases, a recent systematic review and meta-analysis of the efficacy of non-operative treatment of acute uncomplicated appendicitis in children demonstrated that non-operative treatment is effective.^[12]

Objective

General objective:

To assess the necessity of appendectomy following conservatively managed uncomplicated acute appendicitis

Specific objectives:

- To see the recurrence rate of appendicitis after conservative management.
- To find out the duration of symptom relief.
- To see the time of recurrence of signs & symptoms.
- To find out the duration of hospital stay.

MATERIAL AND METHODS

This was a prospective observational study conducted in the Department of Pediatric Surgery at Dhaka Medical College Hospital, Dhaka, Bangladesh from the period of July 2017 to March 2019. The patients with uncomplicated acute appendicitis were admitted to the Department of Pediatric Surgery, Dhaka Medical College Hospital was recruited as the study population. A total of 62 children with acute appendicitis have been recruited as the study sample. A purposive sampling method was followed for sample selection.

Inclusion criteria:

Patients with uncomplicated acute appendicitis,
Age up to 12 years in both sex

Exclusion criteria:

- Patients of age > 12 years
- Patients with the obstructed appendix
- Patients with appendicular lump/abscess

The patients were encouraged to voluntarily participate. Written informed consent was taken from each patient. Then a conservative treatment started with admitted uncomplicated acute appendicitis patient combination by inj. cefinaxone (100 mg/kg per day), inj. metronidazole (1.5mg/kg/ tds) and inj. amikacin (7.5 mg/kg/ bd) therapy for five days with associated supportive management. The patients were assessed after 24 hours of treatment, who responded to the above treatment continued the same treatment for at least five days then discharged and followed up and investigation (CBC, Ultra sonogram of whole e abdomen) were wise after 15 days, 1 month, 3 months and 6 months. Above all other necessary information was taken. Demographic and clinical information was recorded. Ethical approval of the study had been taken from the Institutional Review Board (IRB) of DMCH, Dhaka. For data analysis by SPSS version 22.0. The results were presented in tables and figures. Statistical significance was set at $p < 0.05$ and the confidence interval was set at a 95% level. Continuous variables were expressed as mean with standard deviation and categorical variables as the frequency with percentage.

RESULTS

This prospective observational study was conducted in the Department of Pediatric Surgery, Dhaka Medical College Hospital,

Dhaka from July 2017 to March 2019 to assess the necessity of appendectomy following conservatively managed uncomplicated acute appendicitis. The results are as follows:

Table 1: Demographic profile of the study subjects (N=62)

Age (years)	Frequency (n)	Percentage (%)
4 - 6 yrs.	8	12.9
6 - 10 yrs.	28	45.2
11 - 12 yrs.	26	41.9
Mean \pm SD	8.95 \pm 2.10 (4 - 12)	

[Table 1] showed the age of the study population. The mean age was 8.95 \pm 2.10 years within a range from 4 years to 12 years.

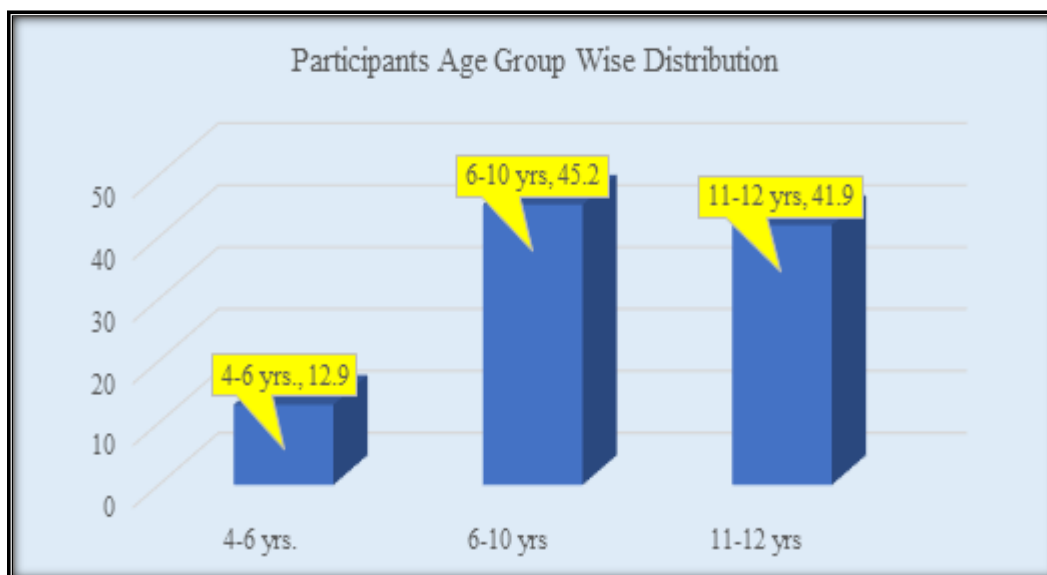


Figure 1: Participants Age Group Wise Distribution (N=62)

Table 2: Demographics of gender profile of the study participants (N=62)

Gender	Frequency (n)	Percentage (%)
Male	38	61.3
Female	24	38.7

[Table 2] showed the gender of the study subjects. Males were more predominant than females. Male to female ratio was 1.58:1.

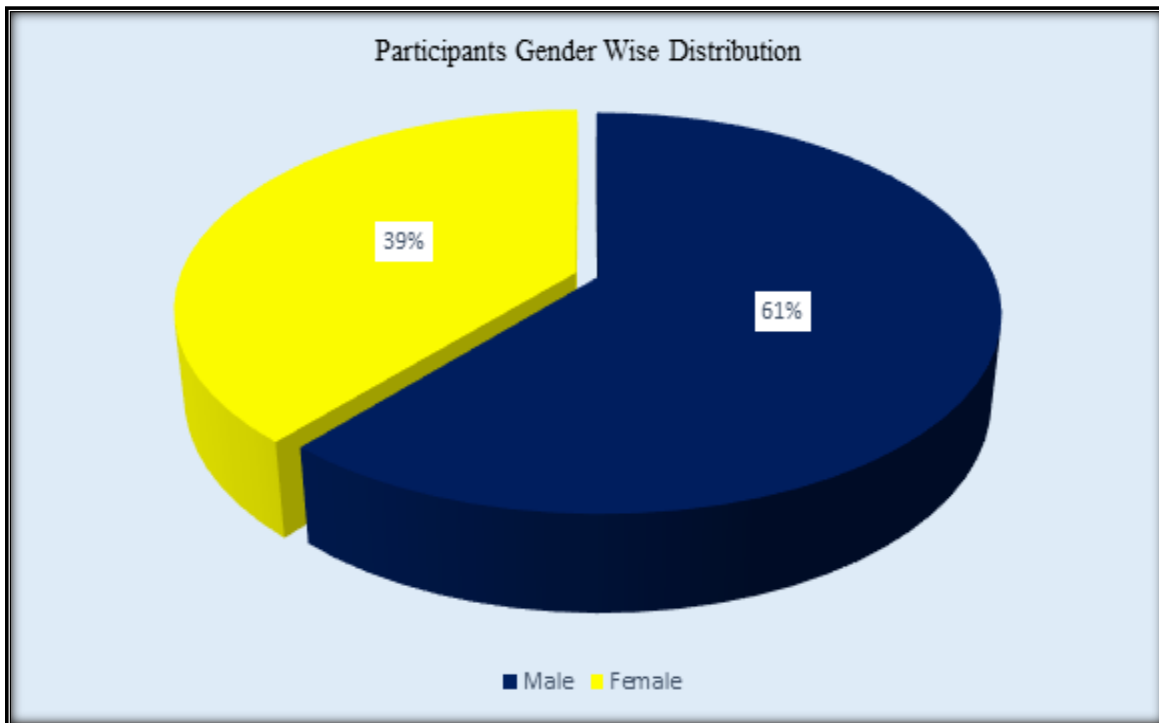


Figure 2: Participants Age Group Wise Distribution (N=62)

Table 3: Duration of hospital stay of the Participants (N=62)

	Mean \pm SD	Min-max
Duration of hospital stay (days)	5.26 \pm 0.63	3.00 - 7.00

[Table 3] showed the duration of hospital stay per day. The mean duration of hospital stay was 5.26 \pm 0.63 days.

Table 4: Clinical Presentation of the Participants (N=62)

Clinical features	Mean \pm SD	Min-max
Pain (VAS)		
1 st day	9.42 \pm 0.92	8.00 - 10.00
2 nd day	7.13 \pm 1.00	6.00 - 8.00
3 rd day	4.77 \pm 0.98	4.00 - 6.00
5 th day	0.77 \pm 0.98	0.00 - 2.00

[Table 4] showed the clinical presentation of the study subjects and the duration of hospital stay. Pain reduced gradually from 1st day to 5th day.

Table 7: Diameter of the appendix (by USG) of the study population (N=62)

Diameter of the appendix (mm)	Mean \pm SD	Min-max
At admission	6.97 \pm 0.36	6.10 - 7.50
At day 15	5.71 \pm 0.82	0.20 - 7.10
At day 30	5.55 \pm 0.67	4.20 - 7.40
At 3 months	5.05 \pm 0.76	3.60-7.00

[Table 7] showed the diameter of the appendix of the study subjects at admission, on day 15, and on day 30 of conservative treatment. The diameter of the appendix was reduced after 15 days after 30days, and 90 days compared at admission.

Table 8: Symptom Recurrence of the study Population (N=62)

Time of symptoms recurrence	Frequency (n)	Percentage (%)
At day 15	4	6.5
At day 30	2	3.2
After 3 months	2	3.2
After 6 months	0	0.0

[Total 8] showed 8 (13.0%) cases recurred during the first 6 months after treatment, 4 (6.5%) recurrence was observed between the period after discharge and day 15, 2 (3.2%) recurrence was observed between day 15 to day 30 and another 2 (3.2%) recurrence was observed between day 30 to day 90, another 0(0.0%) recurrence was observed between day 90 to 180 day.

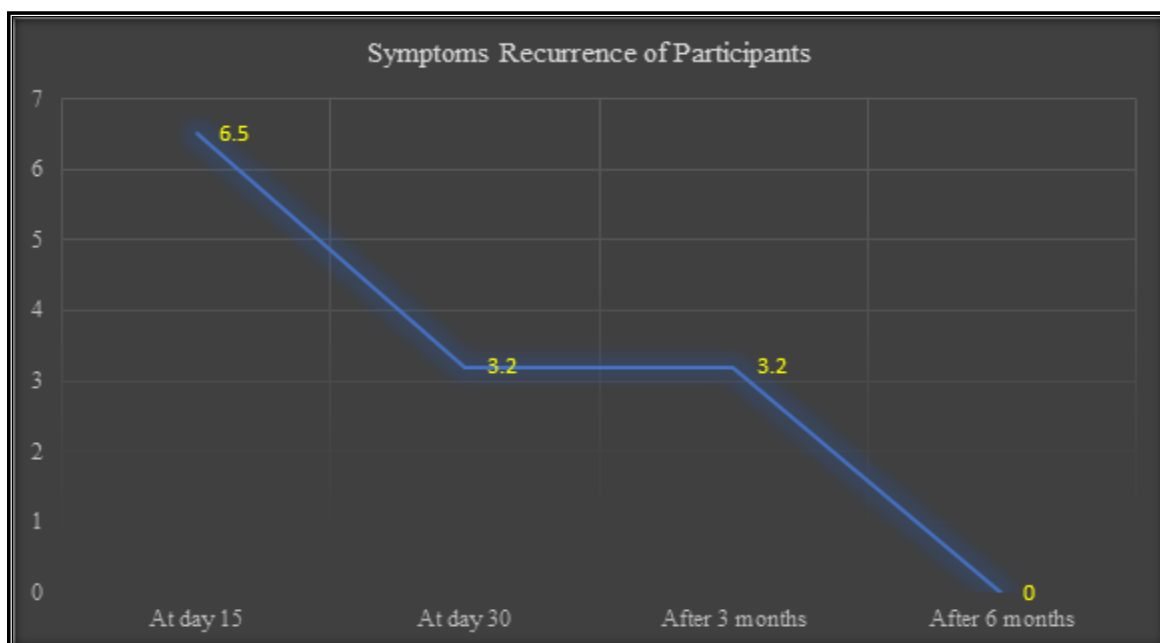


Figure 4: Symptoms Recurrence of Participants (N=62)

Table 9: Outcome at end of conservative treatment (after 5 days) of the study Population (N=62)

Outcome	Frequency (n)	Percentage (%)
Discharged	59	95.1
Underwent surgery	3	4.9

[Table 9] showed the outcome of conservative treatment. On day 5, 59 (95.1%) were discharged and 3 (4.9%) underwent surgery during the conservative treatment period.

DISCUSSION

Appendectomy is considered the treatment of acute appendicitis for many decades. Though it is common, most of the time appendicitis is misdiagnosed and appendectomy was done. Incidental appendectomy has been debated for many years. A child usually has a longer life expectancy than an adult, on the other hand, the appendix can be utilized in the future. It advocates for appendix preservation for a number of procedures. Such as a conduit for urinary tract, biliary tract reconstruction, and ante-grade colonic enemas.^[13] Moreover, postoperative complications can also be avoided. So, to avoid unnecessary appendectomy we have a plan to do this research study. Conservative antibiotic therapy as the primary treatment of uncomplicated acute appendicitis in children was studied. In this study, the mean age was 8.95 ± 2.10 years within a range from 4 years to 12 years. Males were more predominant than females. The male to female ratio was 1.6:1. The median age was 11.4 years and the male-to-female ratio was 1.5:1 in the study by Bachur et al., (2017). In the study of,^[14] the male-to-female ratio was 2:1, and the mean age was 13.3 years. At admission mean diameter shows of the uncomplicated acute appendix was 6.97 ± 0.36 mm in this study. A study showed the mean diameter of the appendix was 7.4 ± 1.0 mm.^[15] At admission

mean, CRP was 28.13 ± 11.56 in this study. The mean CRP at admission was 44.0 ± 44.0 . The mean length of hospital stay was 5.26 ± 0.63 days in this study.^[16] In this study Length of hospital stay was 3 days in the study of.^[14] The length of hospital stays was 2.95 ± 0.38 in conservative treatment with antibiotics.^[17] In this study 59 (95.1%) patients responded to antibiotic therapy and were safely discharged from the hospital after 48 hours (4.8%), after 72 hours (51.6%), after 96 hours (35.5%), and after 120 hours (3.1%). Three patients (4.9%) underwent surgery during the conservative treatment period. The success rate of conservative treatment with antibiotics was 86.0% in the study of,^[18] 91.0%, 95.0%, 95.0% and 92.0% reported that treatment efficacy was 90.8% for antibiotic therapy.^[19,20,21] We observed a 13.0% recurrence of appendicitis in conservatively treated children within six months. The recurrence rate of symptoms within one year was 15.0%¹⁶ and 5.0% within 18 months.^[15] 4(10.0%) patients were readmitted within 1 year as a result of recurrent appendicitis and had to undergo surgery when appendicitis was confirmed.^[21] The recurrence rate was 13.9%, a third of recurrences appeared within 10 days and two-thirds between 3 and 16 months after hospital discharge 18-20 observed only 5.0% recurrence of appendicitis. There was 3 (4.9%) complication during conservative therapy in this study. The rate of complication

was 11.9%¹⁴ 2 (5.0%) patients required surgery after 12 and 24 h respectively. Only 17 patients (12%) from the antibiotic treatment group went on to operation within 24 hours.^[16] Acute appendicitis can be treated successfully with antibiotics with a short hospital stay, minimal sick leave, and limited duration of pain.

Limitations of the study:

Due to the limited study period, a long-time follow-up could not be performed. The sample size of 62 cases analyzed in this study was not adequate to calculate the exact figure. Failure to attend on an exact day of follow-up, due to problems with transportation, remote areas from the center of study, and standard follow-up schedule could not be maintained in all cases.

REFERENCES

1. St Peter SD, Sharp SW, Holcomb GW 3rd, Ostlie DJ. An evidence-based definition for perforated appendicitis is derived from a prospective randomized trial. *J Pediatr Surg.* 2008;43(12):2242-5. doi: 10.1016/j.jpedsurg.2008.08.051.
2. Emil S, Laberge JM, Mikhail P, Baican L, Flageole H, Nguyen L, et al. Appendicitis in children: a ten-year update of therapeutic recommendations. *J Pediatr Surg.* 2003;38(2):236-42. doi: 10.1053/jpsu.2003.50052.
3. Omundsen M, Dennett E. Delay to appendectomy and associated morbidity: a retrospective review. *ANZ J Surg.* 2006;76(3):153-5. doi: 10.1111/j.1445-2197.2006.03673.x.
4. Emil S, Duong S. Antibiotic therapy and interval appendectomy for perforated appendicitis in children: a selective approach. *Am Surg.* 2007;73(9):917-22.
5. Vons C, Barry C, Maitre S, Pautrat K, Leconte M, Costaglioli B, et al. Amoxicillin plus clavulanic acid versus appendectomy for treatment of acute uncomplicated appendicitis: an open-label, non-inferiority, randomised controlled trial. *Lancet.* 2011;377(9777):1573-9. doi: 10.1016/S0140-6736(11)60410-8.
6. Leung TT, Dixon E, Gill M, Mador BD, Moulton KM, Kaplan GG, et al. Bowel obstruction following appendectomy: what is the true incidence? *Ann Surg.* 2009;250(1):51-3. doi: 10.1097/SLA.0b013e3181ad64a7.
7. Wilms IM, de Hoog DE, de Visser DC, Janzing HM. Appendectomy versus antibiotic treatment for acute appendicitis. *Cochrane Database Syst Rev.* 2011;(11):CD008359. doi: 10.1002/14651858.CD008359.pub2.
8. Tiboni S, Bhangu A, Hall NJ; Paediatric Surgery Trainees Research Network and the National Surgical Research Collaborative. The outcome of appendectomy in children performed in pediatric surgery units compared with general surgery units. *Br J Surg.* 2014;101(6):707-14. doi: 10.1002/bjs.9455.
9. Cheong LH, Emil S. Outcomes of pediatric appendicitis: an international comparison of the

CONCLUSIONS

From the observations of this study, it can be concluded that immediate appendectomy is not always essential in all children presented with acute appendicitis. Most cases can be safely managed conservatively. Moreover, routine interval appendectomy is also not necessary in the majority of cases. This protocol reduces surgery and surgery-related complications, hospital stay, and cost. In this study success rate is 95.1% during the period of treatment and the recurrence rate is 13.0%. Though we have some limitations in the management of uncomplicated acute appendicitis conservative treatment can be recommended but it needs further study to establish this conservative management.



- United States and Canada. *JAMA Surg.* 2014;149(1):50-5. doi: 10.1001/jamasurg.2013.2517.
10. Mason RJ, Moazzez A, Sohn H, Katkhouda N. Meta-analysis of randomized trials comparing antibiotic therapy with appendectomy for acute uncomplicated (no abscess or phlegmon) appendicitis. *Surg Infect (Larchmt).* 2012;13(2):74-84. doi: 10.1089/sur.2011.058.
 11. Varadhan KK, Neal KR, Lobo DN. Safety and efficacy of antibiotics compared with appendectomy for treatment of uncomplicated acute appendicitis: meta-analysis of randomised controlled trials. *BMJ.* 2012;344:e2156. doi: 10.1136/bmj.e2156.
 12. Georgiou R, Eaton S, Stanton MP, Pierro A, Hall NJ. Efficacy and Safety of Nonoperative Treatment for Acute Appendicitis: A Meta-analysis. *Pediatric.* 2017;139(3):e20163003. doi: 10.1542/peds.2016-3003.
 13. Morrow SE, Newman KD. Current management of appendicitis. *Semin Pediatr Surg.* 2007;16(1):34-40. doi: 10.1053/j.sempedsurg.2006.10.005.
 14. Maini SK, Jain NK, Jain MG, Khobragade V. Conservative management of early uncomplicated appendicitis in children. *Int Surg J.* 2017; 4:1024-7
 15. Park HC, Kim BS, Lee BH. Efficacy of short-term antibiotic therapy for consecutive patients with mild appendicitis. *Am Surg.* 2011;77(6):752-5.
 16. Styrud J, Eriksson S, Nilsson I, Ahlberg G, Haapaniemi S, Neovius G, et al. Appendectomy versus antibiotic treatment in acute appendicitis. a prospective multicenter randomized controlled trial. *World J Surg.* 2006;30(6):1033-7. doi: 10.1007/s00268-005-0304-6.
 17. Liu K, Ahanchi S, Pisaneschi M, Lin I, Walter R. Can acute appendicitis be treated by antibiotics alone? *Am Surg.* 2007;73(11):1161-5.
 18. Oh SJ, Pimentel M, Leite GGS, Celly S, Villanueva-Millan MJ, Lacsina I, et al. Acute appendicitis is associated with appendiceal microbiome changes including elevated *Campylobacter jejuni* levels. *BMJ Open Gastroenterol.* 2020;7(1):e000412. doi: 10.1136/bmjgast-2020-000412.
 19. Winn RD, Laura S, Douglas C, Davidson P, Gani JS. Protocol-based approach to suspected appendicitis, incorporating the Alvarado score and outpatient antibiotics. *ANZ J Surg.* 2004;74(5):324-9. doi: 10.1111/j.1445-1433.2004.02993.x.
 20. Hansson J, Körner U, Khorram-Manesh A, Solberg A, Lundholm K. Randomized clinical trial of antibiotic therapy versus appendectomy as primary treatment of acute appendicitis in unselected patients. *Br J Surg.* 2009 May;96(5):473-81. doi: 10.1002/bjs.6482. Erratum in: *Br J Surg.* 2009;96(7):830.
 21. Coccolini F, Fugazzola P, Sartelli M, et al. Conservative treatment of acute appendicitis. *Acta Biomed.* 2018;89(9-S):119-134. doi:10.23750/abm.v89i9-S.7905
- Source of Support: Nil, Conflict of Interest: None declared