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Original Research Article

Surgical outcome in patients with complicated appendicitis treated at a medical college hospital

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ABSTRACT

Background: Acute appendicitis is the most common surgical emergency requiring operative intervention. Most of the cases are simple; however complicated appendicitis with perforation, abscess and gangrene of appendix is seen in up to 1/4th of adults and 1/3rd of cases in children. It is associated with post operative complications with considerable morbidity. The aim is to study the clinical presentation of complicated appendicitis, the intra-operative findings, post-operative complications and the overall surgical outcome.
Methods: It is a cross sectional study of 35 patients who had complicated appendicitis and who were treated with surgery.
Results: 83% of patients with complicated appendicitis were younger than 40 years of age, with children constituting about 43% of total cases. All the patients had typical right iliac fossa pain, with tenderness and localized guarding in 37%. Ultrasound diagnosed appendicitis in 80% of cases. Leukocytosis was seen in 71% with neutrophil shift in 85% of patients. 60% of patients had perforation and abscess formation, gangrene in 45% and mass in 37%. Post operative complications were noted in 51% of the patients, commonly paralytic ileus (46%) and wound infection (20%). There was no mortality in our study and the general overall outcome of treatment was good.
Conclusions: Complicated appendicitis with gangrene, perforation and abscess form a considerable proportion of cases. Early surgical intervention is the definitive treatment after initial resuscitation. Overall morbidity is considerable, but mortality is less than 1% and the general overall outcome is good with early surgical intervention.

Keywords: Complicated appendicitis, Gangrene, Perforation, SSI

INTRODUCTION

Acute appendicitis is the most common emergent abdominal condition requiring surgical intervention.[1] Most of the appendicitis cases are simple and uncomplicated; however, complicated appendicitis can be seen in up to one fourth of adult patients and up to one third in pediatric patients.

While uncomplicated appendicitis was characterized with any phlegmonous and catarrhal stage appendicitis without any serious periappendicular infection, complicated appendicitis has been defined as the presence of perforation, gangrene, serious periappendicular inflammation, mass formation (a plastron) or intra-abdominal abscess.[1]

Those with acute uncomplicated appendicitis can expect an uneventful recovery with a short hospital stay, while those with perforated or gangrenous appendicitis are fraught with potential complications, primarily infectious in nature.[2] Peritonitis mandates urgent surgery but phlegmon is managed by conservative approach and

antibiotic therapy for couple of days till clinical and para clinical signs subside.[2]

Complicated appendicitis has been associated with a significant risk of postoperative septic complications, including wound infections and intra-abdominal abscess formation.[3,4] Wound dehiscence and faecal fistula are rare but difficult complications of the disease following surgery.

The aim of this study is to study the clinical presentation of complicated appendicitis, the intra-operative findings, post-operative complications and the overall surgical outcome in our hospital.

METHODS

It is a record based retrospective cross sectional study done among the cases which had a diagnosis of complicated appendicitis intraoperatively who were operated at a medical college hospital from January 2016 to December 2017. A total of 35 cases with the diagnosis of complicated appendicitis were the study subjects. All the cases with the diagnosis during the study period were considered suggesting universal sampling method.

Inclusion criteria

All the cases which had the diagnosis of complicated appendicitis intra operatively were included as the study sample. Complicated appendicitis was defined as appendicitis with perforation, or abscess, or gangrene or mass formation, or a combination of the above findings.

A standardised format was prepared to compile the data available from the 35 case records. The demographic details, clinical findings, laboratory findings, intra operative findings, post operative findings and clinical outcome were documented into the standardised format.

Statistical analysis

All the data were entered into Microsoft office excel sheet and was analysed using SPSS version 20 software. The descriptive data presented as frequency and proportions. The mean and SD were estimated for the continuous variables. Chi square test was used to compare the variables and $p<0.05$ was considered as statistically significant.

Ethical approval

The ethical permission was obtained to conduct the study from the Institutional ethics committee.

RESULTS

We had 21 male and 14 female patients totalling 35 patients who underwent surgery for complicated appendicitis during the study period. Most of our patients (up to 83%) with complicated appendicitis were younger than 40 years of age, with students less than 18 years (paediatric age group) constituting about 43%. The youngest patient in our study was 10 yr old child, and oldest patient was 68 yr old male patient About 83% of our patients come from below poverty line students constituted about 48% of our patients with complicated appendicitis.

Table 1: Demographic details of the patients treated for complicated appendicitis (n=35).

Parameter	Frequency	Percentage (%)
Age (Median age = 21±13.36)		
<18 years	15	42.9
18-40 years	14	40.0
>40 years	06	17.1
Gender		
Male	21	40
Female	14	60
Socioeconomic status		
BPL	29	82.9
APL	6	17.1
Occupation		
Employed	11	31.5
Student	17	48.5
Housewife	7	20.0
Education status		
Primary and high school	18	51.4
PU	14	40.0
Degree	3	8.6

Table 2: Clinical presentation (symptoms) of patients treated for complicated appendicitis (n=35).

Parameter	Frequency	Percentage (%)
H/O pain abdomen	35	100
Grade		
Mild	8	22.9
Moderate	18	51.4
Severe	9	25.7
H/O nausea & vomiting	26	74.3
Grade		
Mild	20	57.1
Moderate	6	17.1
Fever	9	25.7
Grade		
Mild	7	20
Moderate	1	2.9
Severe	1	2.9
Site of pain		
Right iliac fossa	33	94.3
Right iliac fossa & loin	1	2.9
Right iliac fossa & umbilicus	1	2.9

All the patients came with abdominal pain with more than half of them having moderate degree pain, with 94% of patients had pain localized to right iliac fossa. About 3/4th of the patients complained of nausea and vomiting. Only 1/4th of the patients had fever, most of them with mild degree. More than 90% of the patients had no other symptoms apart from the above three symptoms. Only 2 patients had diarrhoea and one patient with constipation at presentation.

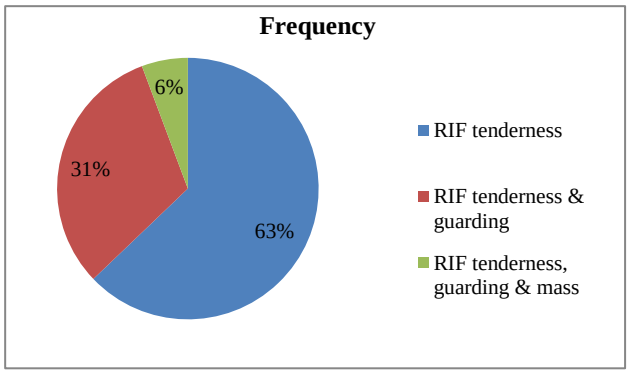

Figure 1: Abdominal signs.

All patients had typical right iliac fossa tenderness, with up to 37% of patients had guarding on examination and 2 patients had a palpable mass.

Table 3: Laboratory investigations findings (n=35).

Parameter	Frequency	Percentage (%)
Total count		
Elevated	25	71.4
Normal	10	28.6
Neutrophils		
Elevated	30	85.7
Normal	5	14.3
USG findings		
Appendicitis	12	34.3
Appendicitis with collection	7	20
Appendicitis with bowel dilatation	3	8.6
Appendicitis with collection & bowel dilatation	6	17.2
Probe tenderness	7	20

Leukocytosis was seen in 71% of our patients whereas neutrophil shift was seen in 85% of the patients. The highest WBC count seen was 43600 in a 68 year old diabetic and anemic patient with perforation and abscess, who later developed postoperative renal failure and had to be referred to higher centre for further treatment. Ultrasound of the abdomen and pelvis picked up inflamed appendicitis in 80% of the patients with 37% of the patients having collection during the scan CT scan was not used as a primary modality of investigation as it was not available in the hospital.

Table 4: Mean and SD of continuous data of the patients treated for complicated appendicitis.

Parameter	Mean	SD
Total count	14302	6290
Neutrophils	81	9.9
Lymphocytes	11.74	7.35
Platelets	2.57	0.87
RBS	121.4	27.5
Hb	12.4	1.78
Blood urea	26.4	7.8
Serum creatinine	1.01	0.23

Only 3 out of 35 patients had jaundice during presentation. Anemia was seen in only 5 patients (14%) with hemoglobin less than 10 g/dl.

Table 5: Intra operative findings noted (n=35).

Parameter	Frequency	Percentage (%)
Surgery performed		
Appendicectomy	9	25.7
Appendicectomy with peritoneal lavage	20	57.1
peritoneal lavage	4	11.4
Appendicectomy with omentectomy	2	5.7
Mass	13	37.1
Perforation	21	60
Gangrene	16	45.7
Abscess	21	60
Adhesions	22	62.9
Drain insertion	24	68.6

88% of the patients underwent appendicectomy, and 4 patients who had mass formation with dense adhesions underwent peritoneal lavage. More than 90% of the surgeries required spinal anesthesia, whereas 1 patient required epidural, 1 patient required general, and one patient required both epidural and general anesthesia. Up to 68% of the time, the surgeons used the grid iron incision, 22% lanz incision, and 2 patients required midline incision. Intra operatively, 37% of the patients had mass formation whereas 60% of the patients had perforated appendicitis. Gangrene of the appendix was seen in 45% of the patients and 60% had appendicular abscess. Small bowel and omental adhesions were seen up to 63% of the patients, whereas 28% of the patients had small bowel inflammation and dilatation. Chest tube drains ranging from 24-28 size was used for peritoneal drainage in 68% of the patients. All the patients post operatively received antibiotics for atleast 5 days. Combination of antibiotics were used, most commonly piperacillin tazobactam with amikacin and metronidazole.

Other common combination used was third generation cephalosporin with amikacin and metronidazole. Most of the patients required intravenous fluids for 2-4 days, and were started orally mostly on 2nd postoperative day. All the patients had postoperative wound inspection on 2nd - 3rd day, and drain removal on 3rd to 5th day. 63% of patients were discharged before 10 days, and 34% on 10th day and later. 1 patient had to be referred to higher centre for renal failure.

Postoperative complications were noted in upto 51% of the patients. Paralytic ileus was the most common complication with upto 46% patients post operatively. Surgical site infection was noted in 20% of the patients who required drainage of pus and antibiotics for few days. One patient who had wound dehiscence also had chest infection and paralytic ileus, underwent re exploration and secondary suturing later. Urinary retention was seen in 2 patients. About 14% patients required post operative ICU care. No deaths were recorded in our series, whereas one patient had to be referred to higher centre for renal failure.

Table 6: Postoperative findings noted (n=35).

Parameter	Frequency	Percentage (%)
Any one complication	18	51.4
Parlytic ileus	14	46
Surgical site infection	7	20
Wound dehiscence	1	2.9
Urinary retention	2	5.7
ICU admission	5	14.3
Death	Nil	

Among the 15 patients aged less than 18 years operated around 10 (66.7%) of them developed postoperative complications when compared to 8 (40%) among patients aged more than 18 years which was found to be not statistically significant.

Table 7: Comparison of age distribution with postoperative complications among patients treated with complicated appendicitis (n=35).

Parameter	Post op complications		Total	Chi square value	P value
	Yes frequency (%)	No frequency (%)			
Patients aged <18 yrs	10 (66.7)	05 (33.3)	15	2.440	0.118
Patients aged >18 yrs	8 (40)	12 (60)	20		

DISCUSSION

Acute appendicitis is the most common emergent surgical condition for which urgent surgical removal is the mainstay of treatment to halt the progression to complications. The lifetime risk of developing appendicitis is reported to be 6.7% in females and 8.7% in males.[5] The peak incidence occurs in the first and second decade of life, while it is uncommon to face appendicitis in children younger than 5 years of age. [6] The youngest patient in our study was a 10 year old child.

About one third of appendicitis cases in children younger than 18 years involve a perforated or ruptured appendix.[7] The rate of perforation decreases as the child grows in age.

In our study we had taken only complicated appendicitis in which children formed 43% of the complicated cases, and perforation and abscess was seen in about 60% of the cases.

Etiology appears to be due to appendicolith obstructing the lumen leading to infection or inflammation of the peyers patches finally leading to intraluminal obstruction, venous and arterial congestion leading to perforation. The time from onset of symptoms to occurrence of complication like gangrene or perforation varies from short duration of 1-2 days in children to 3-4 days in adults. The hypertrophy of the lymphoid tissue is precipitating factor in children leading to obstruction of the lumen, thrombosis of the vessel, leading to gangrene and perforation.

Young children have instead specific anatomic and pathophysiologic elements for developing more often complicated appendicitis; moreover it has been established that children less than 6 years old usually are diagnosed with two or three days in delay.[8] Although the diagnosis of appendicitis is clinical, the decision is challenging in children. There is a high incidence of complicated appendicitis, primarily due to delay in seeking treatment. This may be due to ineffective communication from the child, delay from the parents due to ignorance, and lack of localizing signs. The poor immunity especially in a malnourished child may make the condition worse leading to severe morbidity. Our study population was predominantly from lower socio economic status.

A case of appendicitis is usually diagnosed clinically, however often an ultrasound scan is asked by the surgeon to rule out other causes and pelvic pathology in females. CT scan of the abdomen is diagnostic in most cases and must be used when available. Raised WBC count is a valuable guide to correlate the clinical and radiology findings for presence of active infection. Raised C-reactive protein levels in children is a positive indicator. In our study of complicated cases 71% patients had high

leukocyte counts, among which 1/3rd of patients had more than 15000 counts.

The surgery is gold standard for more than a century because of its low incidence of postoperative complications, early recovery and short hospital stay. Nevertheless surgical treatment exposes the patient to risks due to general anaesthesia and other complications such as surgical site infection, adhesions and intestinal obstruction, incisional hernia, infertility in female and pneumonia.[9]

Open surgery had been the gold standard until the last 20 years, when laparoscopic approach has now become easily available and is now the choice of most surgeons. Laparoscopic appendectomy has already proved of its advantages like less pain, lower wound infection rate and short recovery period. In our setup we had no laparoscopic facilities and so restricted only to open surgery. Timing of surgery is important as delayed surgery in complicated cases carry risk of postoperative complications. Most of our surgeries were conducted less than 12 hours after admission after stabilization.

Whereas uncomplicated appendicitis can safely be treated with a low complication rate, complicated appendicitis with perforation, abscess formation, and generalized peritonitis is still associated with an increased postoperative morbidity[10,11] Most of the complicated cases require some resuscitation and stabilization with intravenous fluids, and combination of antibiotics before they proceed to surgery. A patient with an appendicular mass is usually treated with antibiotics and observed for development of complications. A study by Saluja et al showed that children undergoing late appendectomy were more likely to suffer complications, have longer total length of stay, and incur greater charges when compared to those undergoing early appendectomy.[12]

Prompt diagnosis and early surgical intervention is imperative to prevent complications with its attendant high morbidity and mortality. Of concern is the high complication rate, about 40% of the patients had complicated appendicitis.[13]

The rate of postoperative complications follows the severity of the appendicitis. Complications are rare after simple cases and often seen in complicated cases. Complications include wound infection, post op ileus, intra abdominal abscess formation, wound dehiscence, post op intestinal obstruction and rarely enterocutaneous fistula.

Surgical site infection (SSI) is one of the commonest postoperative complication seen after appendicectomy, especially for a complicated appendicitis. Surgical-site infection (SSI) rate was significantly lower in the laparoscopic than in the open group (1.6% *vs* 3.2% respectively) and this gap between the two groups increased in severe forms of appendicitis, such as gangrenous and perforated.[14]

Antibiotics have markedly reduced the incidence of infections, and the mortality rate of complicated cases has drastically reduced to less than 1% in most of the studies. SSI was seen in about 20% of our patients. SSI is seen less in laparoscopic approach because of the use of endobag always in all cases, which prevents exposure of the cut side to the wound edges, whereas in an open approach, the chances of wound infection especially in appendicular abscess is very high. Carefully avoiding spillage of pus or gangrenous material along the wound edges while operating can prevent significant cases of wound infection even after open surgery

The postoperative ileus was seen in 46% of our patients and was the most common complication in our study. Most of the cases were managed conservatively and improved. Only one patient underwent re exploration along with secondary suturing. The chances of ileus increases during a appendicular abscess drainage, but generally the outcome is good, after the resolution of ileus.

The role of laparoscopic surgery in the treatment of complicated appendicitis has been more controversial. Some investigators have advocated that laparoscopy should not be used in children with complicated disease because of increased postoperative morbidity.[15] Some studies more than 2 decades before have shown increased incidence of intra-abdominal abscess post laparoscopic surgery, but now laparoscopic versatility have proved that complicated cases can also be managed without much fear. Other advantages of laparoscopy definitely benefit complicated cases.

Although many studies have proven the advantages of laparoscopy for simple appendicitis, the incidence of intra abdominal abscess following laparoscopy for complicated appendicitis may be high in few studies, but the study by Noorudhen proved otherwise.[16-19]

This maybe because of the experience gained during the two decades of laparoscopy in handling complicated cases and expertise available during the recent years along with advanced instrumentation and fiber optics. Selected complicated cases can still be effectively managed by laparoscopic appendectomy and peritoneal lavage. Also a study by Asmaa et al showed the advantages of the laparoscopic appendectomy approach including shorter hospital stay, decreased need for postoperative analgesia, early food tolerance, earlier return to work, lower rate of wound infection.[20]

Appendicular fistula is one of the rarest complication following surgery. The fistula can be external following a complicated surgery, or become internal into the small bowel, urinary bladder or into the pelvic organs in female. The mechanism of formation of these fistulae has

been described by the Kejellman as spontaneous rupture of inflammed appendix into the adjacent bowel, bladder or skin.[21]

Perforated appendicitis generally increases the risk of postoperative complications.[22]

The study by Kim et al, showed that untreated acute appendicitis frequently progresses to perforated appendicitis with an increased risk of complications.[23] The time of presentation to the hospital from onset of pain also is a factor to be considered with respect to complications. The more the delay, the higher the incidence of complications. Despite new and better antibiotics, advances in imaging and supportive care, a large number of patients with acute appendicitis develop serious complications and have morbid and prolonged recoveries.[24] Silva et al considered surgical wound infections and intraabdominal abscesses as the main morbidity factors and that the perforated phase contributed to the increase of such complications.[25]

A recent study showed that the perforation rate of patients with appendicitis was 16%. The mean duration from onset of symptoms to hospital admission was 4.4 days. The factors that contributed to the appendix perforation included a diagnostic error and initial patient approach (56%), delayed hospitalization (11%) and use of analgesics (9%).[26]

In another study they found a relationship between the duration of symptoms and the development of complications.[27]

The most severe complications of appendicitis are diffuse peritonitis from a perforated appendicitis and intra-abdominal abscess.[28] These patients generally require laparotomy and removal of appendix and complete peritoneal lavage. The morbidity of these patients may be considerable. The overall outcome is generally good with less than 1% mortality even in complicated cases.

CONCLUSION

Complicated appendicitis with gangrene, perforation and abscess form a considerable proportion of all cases of appendicitis. Simple appendicitis has minimal morbidity, whereas complicated cases are associated with postoperative complications. Delay in presentation due to any reason is one of the factors associated with complications. Majority of delayed presentation is seen in children. Most of the cases occur in less than 40 years of age. Although diagnosis is clinical, high leukocyte count correlates with complications. Ultrasound is still the investigation of choice for early diagnosis, though CT scan is diagnostic in doubtful cases. Early surgical intervention is the definitive treatment after initial resuscitation. Post operative antibiotics are necessary to avoid infectious complications. Wound infection and paralytic ileus are the common complications following surgery. Overall morbidity is considerable, but mortality is less than 1% and the general overall outcome is good with early intervention.

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REFERENCES

1. Bat O, Kaya H, Celik HK, Sahbaz NA. Clinical results of laparoscopic appendectomy in patients with complicated and uncomplicated appendicitis. Int J Clin Exp Med. 2014;7(10):3478-81.
2. Jangjoo A, Aminian K, Shojaeian R. Aggressive approach to complicated appendicitis in children. J Surge Trauma. 2013;1(1):26-30.
3. Wullstein C, Barkhausen S, Gross E. Results of laparoscopic vs conventional appendectomy in complicated appendicitis. Dis Colon Rectum. 2001;44:1700–5.
4. Stoltzing H, Thon K. Perforated appendicitis: is laparoscopic operation advisable? Dig Surg. 2000;17:610–6.
5. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol. 1990;132(5):910–25.
6. Bansal S, Banever GT, Karrer FM, Patrick DA. Appendicitis in children less than 5 years old: influence of age on presentation and outcome. The Am J Surg. 2012;204(6):1031–5.
7. Gajbhiye AS, Dakhore SD, Meshram MM, Khathod AP. Perforated Appendicitis in Children." IOSR J Dent Med Sci (IOSR-JDMS). 2013;11(1):09-16.
8. Marzuillo P, Germani C, Krauss BS, Barbi E. Appendicitis in children less than five years old: a challenge for the general practitioner. World J Clin Pediatr. 2015;4(2):19–24.
9. Tugnoli G, Giorgini E, Biscardi A, Villani S, Clemente N, Senatore G, et al. The NOTA study: non-operative treatment for acute appendicitis: prospective study on the efficacy and safety of antibiotic treatment (amoxicillin and clavulanic acid) in patients with right sided lower abdominal pain. BMJ Open. 2011;1:e000006.
10. Cueto J, Dallemagne B, Vázquez-Frias JA, Gomez S, Delgado F, Trullenque L, et al. Morbidity of laparoscopic surgery for complicated appendicitis: an international study. Surg Endosc. 2006;20(5):717–20.
11. Ming PC, Yan TY, Tat LH. Risk factors of postoperative infections in adults with complicated appendicitis. Surg Laparosc Endosc Percutan Tech. 2009;19(3):244–8.
12. Saluja S. Early versus late surgical management of complicated appendicitis in children: A statewide database analysis with one-year follow-up. J Pediatr Surg. 2017;53(7):1339-44.

13. Rahman GA, Debrah SA. Complicated appendicitis: experience from central region of Ghana. Int Surg J. 2018;5:277-80.
14. Ruffolo C, Fiorot A, Pagura G, Antoniutti M, Massani M, Caratozzolo E, et al. Acute appendicitis: What is the gold standard of treatment? World J Gastroenterol. 2013;19(47):8799-807.
15. Lintula H, Kokki H, Vanamo K, Antila P, Eskelinen M. Laparoscopy in Children with Complicated Appendicitis. J Pediatr Surg. 2003;37(9):1317-20.
16. Frazee RC, Bohannon WT. Laparoscopic appendectomy for complicated appendicitis. Arch Surg. 1996;131:509-11.
17. Bonanni F, Reed J, Hartzell G, Trostle D, Boorse R, Gittleman M, et al. Laparoscopic versus conventional appendectomy. J Am Coll Surg. 1994;179:273-8.
18. Krisher SL, Browne A, Dibbins A, Tkacz N, Curci M. Intra-abdominal abscess after laparoscopic appendectomy for perforated appendicitis. Arch Surg. 2001;136:438-41.
19. Noorudheen NK, Ramesh PK. How safe is Laparoscopic Surgery in the Treatment of Acute Appendicitis with Complications Compared to Open Abdominal Surgery? Int J Sci Stud. 2018;5(10):114-7.
20. Nassir AY, Kashha AM, Altrabolsi AH, Ghannam AN, Sindi OA, Alzimaity AM. Laparoscopic Appendectomy between the Advantages and Complications: A Cross Section Study –Jeddah – Saudi Arabia – 2016. The Egyptian J Hospital Med. 2017;67(2):660-5.
21. Kejellman T. Appendiceal fistula and calculi review of literature and a report of three cases. Acta Chir Scand. 1957;113:123-39.
22. Markides G, Subar D, Riyad K. Laparoscopic versus open appendectomy in adults with complicated appendicitis: systematic review and meta-analysis. World J Surg. 2010;34:2026–40.
23. Kim JW, Shin DW, Kim DJ, Kim JY, Park SG, Park JH. Effects of Timing of Appendectomy on the Risks of Perforation and Postoperative Complications of Acute Appendicitis. World J Surg. 2018;42:1295–303.
24. Gomes N, Bridi TL, Ribeiro MAF Jr. Existe lugar para o tratamento clínico de apendicite aguda? Emerg Clin. 2010;5(25):118-21.
25. Silva SM, Almeida SB, Lima OAT, Guimarães GMN, Silva ACC, Soares AF. Fatores de risco para as complicações após apendicectomias em adultos. Rev Bras Coloproct. 2007;27(1):31-6.
26. Öztürk A, Korkmaz M, Atalay T, Karaköse Y, Akinci ÖF, Bozer M. The role of doctors and patients in appendicitis perforation. Am Surg. 2017;83(4):390-3.
27. Iamarino APM, Juliano Y, Rosa OM, Novo NF, Favaro ML, Augusto M et al. Risk factors associated with complications of acute appendicitis. Rev Col Bras Cir. 2017;44(6):560-6.
28. Salminen P, Paajanen H, Rautio T, Nordström P, Aarnio M, Rantanen T, et al. Antibiotic Therapy vs Appendectomy for Treatment of Uncomplicated Acute Appendicitis. The APPAC Randomized Clinical Trial. JAMA. 2015;313(23):2340-8.

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