

# Studying the effect of short-term versus long-term antibiotic therapy after complicated appendicitis surgery on postoperative complication

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## Abstract

**Background:** There is ongoing clinical discussion on the ideal length of antibiotic treatment after appendectomy for complicated appendicitis. With possible advantages including fewer hospital stays, fewer side effects, and cheaper medical expenses, shorter courses have been suggested as efficient substitutes for longer regimens.

**Objective:** This study aimed to compare the clinical outcomes of short-term ( $\leq 3$  days) versus long-term ( $\geq 5$  days) postoperative intravenous antibiotic therapy in patients undergoing surgery for complicated appendicitis.

**Methods:** A prospective observational cohort study was conducted on 180 patients with intraoperatively confirmed complicated appendicitis at an academic hospital in Iran. According to the physician's discretion, patients were not randomized to receive either short-term or long-term antibiotic treatment. Clinical findings, length of antibiotic usage, hospital stay, surgical complications, and demographic information were all documented and examined.

**Results:** Both groups were similar in terms of age, sex, and severity of disease. The mean duration of antibiotic therapy and hospital stay were significantly shorter in the short-term group ( $3.2 \pm 0.7$  days and  $4.2 \pm 0.7$  days, respectively) compared to the long-term group ( $5.7 \pm 1.2$  days and  $6.7 \pm 1.2$  days;  $p < 0.001$ ). Postoperative fever was more frequent in the short-term group (31.1% vs. 17.8%;  $p = 0.037$ ), but there were no statistically significant differences between the groups in terms of surgical site infections or intra-abdominal abscess formation.

**Conclusion:** In patients with complicated appendicitis, short-term postoperative antibiotic treatment seems to be a safe and effective substitute for lengthier regimens, with the added benefits of shorter hospital stays and less exposure to antibiotics. These results underline the necessity of more randomized controlled studies to develop evidence-based recommendations for the length of antibiotics in these situations.

**Keywords:** Appendicitis, Antibiotic therapy, Complicated appendicitis, Postoperative complications

## Introduction

Acute appendicitis is one of the most common operating emergencies encountered worldwide, with a lifetime risk of 7–8% [1]. While an appendectomy—the aggressive surgical removal of the inflamed appendix—is the standard therapy, the clinical pattern can be greatly altered based on how severe the appendicitis is [2]. Gangrene, perforation, peritonitis, or intra-abdominal abscess are characteristics of complicated appendicitis with higher risk of morbidity and requiring more intensive

postoperative treatment [3,4]. Postoperative complications like infection, fever, or abscess development continue to be a dilemma in medical practice, and complicated cases continue to be prevalent, especially among young patients [5,6].

The pillar of treatment in complicated appendicitis is post-op antibiotic treatment aimed at the promotion of healing and reduction in infection morbidity [7,8]. The most effective duration for antibiotic treatment after operation is an unresolved issue [9]. Although it has been the rule to prescribe more extended courses of antibiotics to quiet post-op infection, recent findings indicate that shorter courses can attain equal success [10]. Short courses have other possible advantages, including reduced risk of antibiotic resistance, fewer side effects of medications, reduced hospitalization, and lowered healthcare costs [11]. While all these advantages can be achieved, there is limited good data on well-designed comparative studies, even in low-resource settings, and therapeutic recommendations have varied widely [12].

The aim of the current study was to evaluate the clinical outcome in patients with complicated appendicitis who received intravenous antibiotic therapy both in short and long-term durations post-operatively. In our hospital, individuals with complicated appendicitis typically undergo intravenous antibiotic therapy (ceftriaxone combined with metronidazole as the primary treatment, with escalation if necessary) lasting between 3 to 7 days based on the surgeon's judgment. This study has attempted to assist the existing debate about the correct duration of the antibiotic therapy by analyzing the comparison of the rate of post-operative complications, i.e., infection of the surgery site, intra-abdominal abscess formation, and fever. The findings of this research, which was conducted at a university-affiliated hospital in Iran, may yield valuable data to help increase evidence-based care for managing complex appendicitis in similar healthcare settings. This cross-sectional study has been reported in line with the STROCSS guidelines [13].

## Methods

### Study design and setting

This prospective observational cohort study was conducted at educational and medical centers affiliated with an educational hospital in Alborz, Iran. The study aimed to evaluate the clinical outcomes of short-term versus long-term intravenous antibiotic therapy in patients undergoing surgery for complicated appendicitis. Ethical approval was obtained from the institutional ethics committee prior to the commencement of the study, and informed consent was obtained from all participants.

### Participants

Patients aged 10 years and older who underwent open or laparoscopic appendectomy for intraoperatively confirmed complicated appendicitis (including gangrenous or perforated appendicitis, or appendicitis with localized abscess or peritonitis) were eligible for inclusion. For patients under 18 years of age, informed consent was obtained from parents/guardians in accordance with institutional ethical policy. Exclusion criteria encompassed patients with identified immunodeficiency (e.g., HIV infection, current chemotherapy, long-term corticosteroid or immunosuppressive therapy), individuals who had been on systemic antibiotics for more than 24 hours before admission, pregnant patients, and those with simultaneous intra-abdominal conditions necessitating further surgical treatment.

### Exposure and grouping

Patients were non-randomly allocated into two groups based on the treating physician's discretion and hospital practice patterns:

**Short-term group:** received postoperative intravenous antibiotics for  $\leq 3$  days.

**Long-term group:** received intravenous antibiotics for  $\geq 5$  days.

Grouping into  $\leq 3$  and  $\geq 5$  days reflected the two predominant practice patterns at our hospital. Four-day courses were uncommon and therefore not analyzed separately. All patients received standardized perioperative care including intravenous fluids, pain management, and antibiotics prior to incision. Standard postoperative antibiotics were ceftriaxone plus metronidazole [14]. In selected severe cases, escalation to piperacillin-tazobactam or meropenem was performed.

### Data collection and variables

Data were collected using a structured checklist and included demographic information (age, sex), clinical presentation, intraoperative findings, duration of surgery, type of surgery (open vs. laparoscopic), duration of postoperative antibiotic therapy, and hospital length of stay. The primary outcomes were postoperative complications within 30 days, including surgical site infection (SSI), intra-abdominal abscess, persistent postoperative fever, and need for reoperation or readmission. Follow-up was limited to 30 days; thus, late complications may not have been captured. Postoperative fever was characterized as a body temperature of  $\geq 38^{\circ}\text{C}$  occurring more than 24 hours after surgery [15]. Surgical site infection (SSI) was characterized based on CDC criteria, which involve purulent drainage, a positive culture, or localized signs of infection [16]. Intra-abdominal abscess was identified through clinical suspicion validated by ultrasound or CT imaging [17].

### Statistical analysis

Data were analyzed using SPSS version 20. Continuous variables were expressed as mean  $\pm$  standard deviation (SD) and compared using independent-sample t-tests or Mann-Whitney U tests, as appropriate. Categorical variables were expressed as frequencies and percentages and compared using Chi-square or Fisher's exact test. A p-value  $< 0.05$  was considered statistically significant.

## Results

### Study population

This cross-sectional study was conducted on 180 patients diagnosed with complicated (perforated or gangrenous) appendicitis. These patients underwent appendectomy at an educational hospital in Alborz province, and their information was collected from hospital records. Out of these, 90 patients were placed in the short-term antibiotic group and 90 in the long-term group ( $\geq 6$  days of intravenous antibiotic therapy). In the short-term group, 56 patients (62.2%) were male, and in the long-term group, 58 patients (64.4%) were male. There was no statistically significant difference between the two groups regarding gender or mean age. The length of hospital stay and the duration of intravenous antibiotic administration were significantly shorter in the short-term treatment group (**Table1**).

The mean Alvarado score did not show a statistically significant difference between the short-term and long-term treatment groups (mean $\pm$ SD:  $8.3 \pm 1.5$  vs.  $8.0 \pm 1.5$ ;  $P=0.221$ ), and in both groups, no patients had a score below 6.

**Table 1.** Demographic characteristics of patients in both treatment groups.

Variable		Short-term Group	Long-term Group	P value
Sex	Male	56	58	0.757
	Female	34	32	
Age (years)		28.7±10.6	30.5±10.7	0.222
Hospital Stay (days)		4.2±0.7	6.7±1.2	<b>0.001</b>
Antibiotic therapy duration (days)		3.2±0.7	5.7±1.2	<b>0.001</b>

All patients with complicated appendicitis received postoperative therapeutic antibiotics. Among these, perforated appendicitis was the most frequent pathology, followed by peritonitis and gangrene, with no statistically significant difference between the two study groups in this regard (**Table 2**).

**Postoperative complications**

Fever was the most common complication among patients, occurring significantly more often in those who received short-term treatment (31.1% vs. 17.8%). Although intra-abdominal abscesses (based on ultrasound findings), superficial wound infections, and purulent discharge were more frequent in the short-term antibiotic group, the differences compared to the long-term treatment group were not statistically significant (**Table 3**).

**Discussion**

The postoperative results of short-term versus long-term intravenous antibiotic treatment were evaluated in this study for patients having surgery for complicated appendicitis. According to the results, short-term antibiotic regimens may be safe and effective for certain individuals. This is consistent with previous research that questions the need for long-term postoperative antibiotic treatment [18,19]. Similarly, Laverde *et al.* also demonstrated that short-course antibiotic therapy after complicated appendicitis was effective in preventing postoperative infections, further supporting the growing evidence favoring shorter regimens [7]. Our findings are in line with the recent Lancet 2023 randomized trial comparing 2 versus 5 days of antibiotics for complex appendicitis, which demonstrated non-inferiority of the shorter regimen [18].

The fact that patients in the short-term antibiotic group needed fewer days of IV antibiotics and had far shorter hospital stays than those in the long-term group is one of the study's main

findings [20]. This research lends credence to the idea that shorter antibiotic regimens might increase resource efficiency by lowering total healthcare expenses, which is particularly crucial in areas with limited resources, as well as hospital occupancy and medical resource consumption [8]. These findings are in line with current research that supports shorter antibiotic courses, emphasizing how they may lower the likelihood of antibiotic-related issues such medication side effects and the emergence of antibiotic resistance [21]. Antibiotics can sometimes cause adverse effects like gastrointestinal symptoms, allergic reactions, or secondary infections (e.g., *C. difficile* colitis) [22]. Reducing the duration of exposure may lower these risks.

Furthermore, although the rate of postoperative fever was significantly higher in the short-term group (31.1% vs. 17.8%,  $p=0.037$ ), there were no statistically significant differences between the groups with regard to more serious complications such as intra-abdominal abscesses or surgical site infections. This indicates that, even if fever may serve as a transient inflammatory response, it does not always signify worse clinical outcomes, particularly when it is not accompanied by other infection-related symptoms [23]. Fever by itself, without accompanying clinical or imaging signs of infection, should not always lead to prolonged antibiotic therapy in these situations since it may result in needless treatment and higher healthcare costs without improving patient outcomes [24,25]. We acknowledge that the rate of postoperative fever in our series was greater than what had been reported in several earlier studies. This may result from our stringent standards for defining and documenting fever, along with the observational non-randomized methodology. Significantly, this did not relate to increased occurrences of severe complications like abscess or SSI [26].

In both groups, perforated appendicitis was the most frequent cause for starting antibiotic treatment, followed by peritonitis and appendiceal necrosis [27]. A more direct comparison of the effects

**Table 2.** Histopathology and ultrasound findings.

Finding	Short-term (N=90)	Long-term (N=90)
Perforated appendicitis	57 (63.3%)	47 (52.2%)
Gangrenous (necrotic)	28 (31.1%)	37 (41.1%)
Peritonitis	5 (5.6%)	6 (6.7%)

**Table 3.** Comparison of postoperative outcomes between study groups.

Outcome	Short-term (n = 90)	Long-term (n = 90)	p-value
Surgical Site Infection (SSI)	10 (11.1%)	4 (4.4%)	0.162
Intra-abdominal Abscess	8 (8.9%)	3 (3.3%)	0.212
Postoperative Fever (>48 hrs.)	28 (31.1%)	16 (17.8%)	0.037

of antibiotic duration was made possible by the equal distribution of these indications among the groups, which also decreased the possibility of selection bias [28]. Additionally, none of the patients in either group had an Alvarado score lower than 6, indicating that the illness was moderate to severe and supporting the necessity of post-operative antibiotic treatment in this group [29,30].

Interestingly, although the short-term group experienced slightly higher numerical rates of abscess formation and wound infection, these differences did not reach statistical significance, which adds to the increasing evidence that shorter antibiotic courses may be adequate even in complex cases of appendicitis with appropriate surgical technique and perioperative care [10].

Given that shorter hospital stays and lower antibiotic use can have a substantial influence on healthcare delivery in low-resource healthcare settings, the study's findings are especially helpful for clinical decision-making [28,31]. However, it's important to recognize certain limitations. First, therapeutic bias based on clinician discretion may be introduced by the non-randomized nature of group allocation. Second, bigger randomized controlled trials are required to validate these findings and more accurately stratify individuals who might benefit most from shorter regimens, even if the sample size was sufficient for preliminary analysis. Even though our findings indicated a decrease in hospital duration and antibiotic consumption in the short-term group, a comprehensive cost-benefit analysis was not performed. This continues to be a limitation of our study, and subsequent research should incorporate comprehensive economic assessment. A significant limitation of this research is the absence of randomization, with allocation determined by physician preference. This creates possible selection bias that may have affected results. Another limitation of this study is that multivariate analysis was not performed to adjust for potential confounders such as surgical approach, perforation severity, and comorbidities, which may have influenced outcomes. Our follow-up period was limited to 30 days, which may not fully capture late postoperative complications such as delayed intra-abdominal abscess formation. Future studies with longer follow-up are needed to evaluate long-term outcomes.

## Conclusion

This study showed that, in comparison to lengthier courses, short-term postoperative antibiotic treatment ( $\leq 3$  days) is both safe and efficacious for patients with complicated appendicitis. Although the short-term group experienced a higher incidence of postoperative fever, this did not correspond to a higher incidence of serious side effects including intra-abdominal abscesses or surgical site infections. In healthcare settings with limited resources, the shorter antibiotic duration was linked to considerably fewer hospital stays, which improved resource use and lowered costs. These results imply that, with appropriate postoperative monitoring, shorter antibiotic regimens can be a feasible strategy for treating complicated appendicitis. Nevertheless, more multicenter, randomized research is necessary to confirm these findings and improve patient selection standards for the best possible treatment results.

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## Ethical approval

Ethical approval was obtained from the institutional review board prior to the study.

## Consent

To protect patient privacy, patient information has been deidentified.

## Conflict of Interest

None of the authors have conflicts of interest.

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