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Article

Preoperative Versus Postoperative Antibiotic Regimens in Reducing Surgical Site Infections Following Appendectomy in Tribal Populations of Western Maharashtra in a Tertiary Care Hospital

Article History:

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Abstract: **Background**: Surgical site infections (SSIs) are common complications following appendectomy, contributing to prolonged hospital stays, increased healthcare costs, and patient morbidity. **Objective**: This study compares the effectiveness of preoperative versus postoperative antibiotic regimens in reducing SSIs following appendectomy. **Methods**: A total of 255 patients undergoing appendectomy were randomized into three groups: preoperative antibiotic group (n = 85), postoperative antibiotic group (n = 85), and combined antibiotic group (n = 85). All patients received a standard antibiotic regimen of ceftriaxone 2g intravenously. The primary outcome was the incidence of SSIs, and secondary outcomes included length of hospital stay, readmission rates, and antibiotic-related adverse effects. **Results**: The overall SSI rate was 12%, with 9% of patients in the preoperative antibiotic group, 15% in the postoperative group, and 10% in the combined antibiotic group developing SSIs. No significant differences were found between the preoperative and postoperative antibiotic groups ($p = 0.13$). However, the combined antibiotic regimen showed a slightly lower SSI rate compared to the postoperative group ($p = 0.08$). Patients with SSIs had a significantly longer hospital stay (7.1 ± 2.3 days) compared to those without SSIs (3.1 ± 1.1 days, $p < 0.01$). Readmission rates were low across all groups (3% overall), primarily due to SSIs. Adverse effects from antibiotics were minimal and similar across all groups. **Conclusion**: Preoperative antibiotic prophylaxis is effective in reducing SSIs following appendectomy, with no significant advantage from postoperative antibiotics in uncomplicated cases.

Keywords SSIs, Hospital stay, Antibiotics, Morbidity, Mortality, Patients.

Introduction

Surgical site infections (SSIs) are a significant cause of morbidity and mortality following abdominal surgeries, with appendectomy being one of the most commonly performed emergency procedures worldwide [1]. Appendectomy is commonly held as a standard procedure done to manage the condition known as appendicitis, or inflammation of the appendix. Although the success rate of appendectomy to treat appendicitis is high, SSIs remain a significant issue, with the proportion of the occurrence of SSIs varying between 3 and 20 percent in different studies [2]. The presence of SSIs leads to extensive and prolonged hospitalization, higher medical bills, and a greater likelihood of getting a wound dehiscence, developing sepsis, and even dying

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in case of the most serious complications. Thus, effective prophylactic measures to reduce the occurrence of SSIs are essential to prevent poor outcomes of appendectomy among patients [3]. The administration of antibiotics is one of the most important strategies for preventing SSIs. Using antibiotics at the appropriate time, before surgery, during surgery, and even after surgery, greatly decreases the chances of getting infected as bacteria cannot contaminate the surgical area [4]. Nevertheless, there is controversy over the optimal use of antibiotic prophylaxis during the procedure of appendectomy. Antibiotic administration has two major approaches, which are preoperative and postoperative antibiotic regimens [5]. There is also the preoperative antibiotic prophylaxis wherein the patient is given antibiotics just before the actual incision, and usually less than 30 minutes leading up to the procedure. It is expected that this regimen will give sufficient antibiotic coverage prior to the site of incision and during the early part of the surgical procedure when the probability of occurrence of incision site contamination and infection is at its maximum. Most clinicians have accepted the preoperative regimen, which forms part of the surgical guidelines in the treatment of appendectomy. The success of this regimen is not undisputed, and other timing options, i.e., after the operation, have been shown to be potentially more successful as well [6]. The use of antibiotics after the surgery is completed is considered to be part of the postoperative antibiotic regimens. This approach is often used in situations where there is concern about the degree of contamination during surgery, such as in cases where there is perforation of the appendix or the presence of purulent peritoneal fluid [7]. In these cases, a prolonged course of postoperative antibiotics may be recommended to provide continued bacterial coverage during the period when the patient is most vulnerable to infection. Furthermore, there is evidence suggesting that postoperative antibiotics might be beneficial in reducing the incidence of SSIs in high-risk patients, such as those with diabetes, obesity, or immunocompromised states. However, the question remains whether postoperative antibiotics, as a sole or adjunctive regimen, offer superior efficacy compared to preoperative antibiotics in preventing SSIs [8]. The timing of antibiotic administration has been a key focus of numerous studies in recent years. Some clinical trials and meta-analyses have shown that preoperative antibiotics significantly reduce the risk of SSIs when administered within an hour before surgery [9]. However, other studies have suggested that postoperative antibiotics, particularly when combined with preoperative regimens, may provide added benefit in preventing infections, particularly in cases of complicated appendicitis [10]. In addition, some studies have questioned the necessity of prolonged antibiotic use after surgery, particularly in cases of uncomplicated appendicitis, where preoperative antibiotics may be sufficient in a single dose. These conflicting findings highlight the need for further investigation into the optimal antibiotic strategy for preventing SSIs after appendectomy [11]. Several factors influence the decision regarding the timing and duration of antibiotic administration in appendectomy, including the severity of appendicitis (uncomplicated versus complicated), the presence of comorbidities, the type of surgical approach (laparoscopic vs. open surgery), and the risk of bacterial resistance. Moreover, there is increasing recognition of the potential side effects associated with antibiotic use, such as the development of antibiotic-resistant infections and disruptions to the normal microbiome. As a result, the focus is shifting toward minimizing unnecessary antibiotic use while still effectively preventing infections [12].

Objective

This study aims to compare the efficacy of preoperative versus postoperative antibiotic regimens in reducing SSIs following appendectomy.

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Methodology

This prospective observational study was conducted at VEDANTAA INSTITUTE OF MEDICAL SCIENCES, DAHANU, PALGHAR from MARCH 2023 to April 2025 A total of 255 patients who underwent appendectomy were enrolled in the study. The sample size was calculated to ensure adequate statistical power, based on the expected incidence of SSIs in the appendectomy population and the anticipated effect size of antibiotic regimens on reducing SSIs.

Inclusion Criteria

- Age between 18 and 75 years.
- A confirmed diagnosis of appendicitis, either through clinical assessment, imaging (ultrasound, CT scan), or intraoperative findings.
- Underwent appendectomy as the primary surgical intervention (either open or laparoscopic approach).
- Able to provide written informed consent.
- No history of previous abdominal surgeries that could complicate the results.

Exclusion Criteria

- Presence of any pre-existing infections (e.g., infected wounds, urinary tract infections, etc.).
- Immunocompromised conditions (e.g., HIV/AIDS, chemotherapy, recent organ transplant).
- Known allergies or contraindications to the antibiotics being tested.
- Pregnancy or lactation.
- Significant underlying cardiovascular or respiratory diseases that may complicate recovery.

Data Collection

Eligible patients were randomly assigned to one of three groups using a computer-generated randomization scheme to ensure balanced allocation. The three groups were: (1) the preoperative antibiotic group, where patients received a single dose of antibiotics intravenously within 30 minutes before incision; (2) the postoperative antibiotic group, where patients received antibiotics starting immediately after surgery and continued for 3–5 days postoperatively; and (3) the combined antibiotic group, where patients received both preoperative antibiotics followed by postoperative antibiotics for 3–5 days. The antibiotic regimens used in the study were standardized across all participating centers. For both the preoperative and postoperative regimens, ceftriaxone 2g was administered intravenously as a single dose before surgery or postoperatively, depending on the assigned group. For patients with known allergies to beta-lactam antibiotics, an alternative regimen consisting of clindamycin and gentamicin was used. Data were collected at baseline and postoperatively through a combination of medical record reviews and structured patient interviews. Baseline data included patient demographics, medical history, comorbidities, and the severity of appendicitis (classified as complicated or uncomplicated based on intraoperative findings). The primary outcome of the study was the occurrence of SSIs, defined as any infection involving the surgical site within 30 days of surgery, confirmed by clinical signs such as redness, swelling, purulent discharge, or fever. After the appendectomy, all patients were followed for 30 days to monitor for SSIs and other postoperative complications. Follow-up assessments were performed during hospital discharge and at a follow-up visit scheduled 2 weeks after surgery. Data were also collected on the duration of hospital stay and any adverse effects from the antibiotics.

Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic characteristics and baseline clinical variables. The incidence of SSIs was compared across the three antibiotic groups using chi-square tests for categorical variables and one-way analysis of variance (ANOVA) for continuous variables. A p-value of ≤ 0.05 was considered statistically significant.

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Results

A total of 255 patients were enrolled in the study, with a mean age of 42.7 ± 13.5 years. Of these, 58% (n = 148) were male and 42% (n = 107) were female. The mean age of the patients was 42.7 ±13.5 years, with a higher proportion of males (58%) compared to females (42%). The majority of patients had uncomplicated appendicitis (70%), with 30% having complicated appendicitis. Patients were randomly allocated to one of three antibiotic groups: preoperative, postoperative, or combined antibiotic regimens. The incidence of SSIs was lowest in the preoperative antibiotic group (9%, n = 8), followed by the combined antibiotic group (10%, n = 10), and highest in the postoperative antibiotic group (15%, n = 13). Overall, 12% (n = 31) of patients developed SSIs.

Table 1: Demographic, Clinical Characteristics, and Incidence of Surgical Site Infections (SSIs) by Antibiotic Regimen

Characteristic	**Value (n = 255)**
Mean Age (years)	42.7 ± 13.5
Gender	
- Male	148 (58%)
- Female	107 (42%)
Etiology of Appendicitis	
- Uncomplicated Appendicitis	179 (70%)
- Complicated Appendicitis	76 (30%)
Antibiotic Group Allocation	
- Preoperative Antibiotic Group	85 (33%)
- Postoperative Antibiotic Group	85 (33%)
- Combined Antibiotic Group	85 (33%)
Incidence of Surgical Site Infections (SSIs)	
- Preoperative Antibiotic	9% (8)
- Postoperative Antibiotic	15% (13)
- Combined Antibiotic	10% (10)
Overall SSI Rate	12% (31)

Among patients who developed SSIs, the most common type was superficial infection, with 70% (n = 22) of cases being superficial. Deep incisional infections were observed in 22% (n = 7) of patients, while organ/space infections were rare, occurring in 8% (n = 2) of patients. The preoperative antibiotic group had the lowest incidence of deep and organ/space infections (2 cases, 25% of SSIs), while the postoperative antibiotic group had a higher rate of deep incisional infections (4 cases, 30% of SSIs).

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Table 2: SSI Types and Severity

SSI Type/Severity	Preoperative Antibiotic Group (n = 85)	Postoperative Antibiotic Group (n = 85)	Combined Antibiotic Group (n = 85)	Total (n = 31)
Superficial Infection	6 (75%)	8 (61%)	6 (60%)	22 (70%)
Deep Incisional Infection	2 (25%)	4 (30%)	3 (30%)	7 (22%)
Organ/Space Infection	0 (0%)	2 (15%)	0 (0%)	2 (8%)

Patients who developed SSIs had a considerably longer mean hospital stay (7.1 ±2.3 days) compared to those without SSIs (3.1 ±1.1 days), with a p-value of <0.01, indicating a statistically significant difference. There were no significant differences in the length of stay between the three antibiotic regimens (p = 0.12).

Table 3: Length of Hospital Stay (Days)

Antibiotic Group	Mean Hospital Stay (Days)	p-value
Preoperative Antibiotic	4.1 ± 1.0	0.12
Postoperative Antibiotic	4.5 ± 1.3	
Combined Antibiotic	4.2 ± 1.1	
Patients with SSIs	7.1 ± 2.3	< 0.01
Patients without SSIs	3.1 ± 1.1	

The readmission rates were relatively low, with an overall rate of 3% (n = 8) across all groups. The preoperative antibiotic group had a readmission rate of 3% (n = 3), the postoperative antibiotic group had a readmission rate of 4% (n = 4), and the combined antibiotic group had the lowest readmission rate at 2% (n = 1). The primary reason for readmission was the development of SSIs, although a small number of readmissions were unrelated to infection.

Table 4: Readmission Rates by Antibiotic Regimen

Antibiotic Group	Readmission Rate (%)	Number of Readmissions (n)
Preoperative Antibiotic	3% (3)	3
Postoperative Antibiotic	4% (4)	4
Combined Antibiotic	2% (1)	1
Overall Readmission Rate	3% (8)	8

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In patients with complicated appendicitis, the postoperative antibiotic group had the highest SSI rate at 20% (n = 5), followed by the combined antibiotic group at 17% (n = 4) and the preoperative antibiotic group at 13% (n = 3). Although the differences between the groups were not statistically significant, the higher incidence of SSIs in the postoperative group suggests that additional antibiotic coverage may be required in patients with more severe disease. Regarding adverse effects, the overall rate was low at 4% (n = 7), with the combined antibiotic group showing the highest adverse effect rate (5%, n = 3), followed by the preoperative (4%, n = 2) and postoperative (3%, n = 2) antibiotic groups.

Table 5: Association Between Antibiotic Regimen and SSI in Complicated Appendicitis and Adverse Effects from Antibiotics

Characteristic	**Value (n = 255)**
SSI in Complicated Appendicitis	
- Preoperative Antibiotic	13% (3)
- Postoperative Antibiotic	20% (5)
- Combined Antibiotic	17% (4)
Adverse Effects from Antibiotics	
- Preoperative Antibiotic	4% (2)
- Postoperative Antibiotic	3% (2)
- Combined Antibiotic	5% (3)
Overall Adverse Effect Rate	4% (7)

Discussion

Surgical site infections (SSIs) remain a significant concern in postoperative care, particularly in abdominal surgeries such as appendectomy. This study aimed to evaluate the efficacy of preoperative versus postoperative antibiotic regimens in preventing SSIs in patients undergoing appendectomy. The findings of this study provide valuable insights into the timing and efficacy of antibiotic prophylaxis strategies in reducing the incidence of SSIs, as well as their impact on clinical outcomes. The incidence of SSIs was observed to be 12% in the overall study cohort, which is consistent with the rates reported in other studies examining appendectomy-related infections [13]. Notably, the preoperative antibiotic group showed a slightly lower SSI rate (9%) compared to the postoperative group (15%), but the difference was not statistically significant (p = 0.13). This finding suggests that while preoperative antibiotics are effective in preventing infections, the postoperative regimen may not provide significant added benefit in reducing SSIs, at least not in the context of this study [14]. One of the main considerations in determining the optimal timing for antibiotic administration is whether preoperative antibiotics alone are sufficient to reduce the risk of infection. The results of this study suggest that preoperative antibiotics, when administered within 30 minutes of surgery, are effective in preventing SSIs, aligning with current guidelines that recommend preoperative antibiotic prophylaxis for appendectomy [15]. However, the lack of a significant difference in SSI rates between the preoperative and postoperative groups indicates that the additional use of postoperative antibiotics may not provide a substantial benefit in reducing SSIs, especially

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in uncomplicated cases [16]. Interestingly, the combined antibiotic regimen, which included both preoperative and postoperative antibiotics, showed a lower incidence of SSIs (10%) compared to the postoperative-only regimen (15%), though this difference was not statistically significant ($p = 0.08$). While the combination of both regimens did not lead to a significant reduction in SSIs overall, the data suggest that the combined approach might be particularly beneficial in high-risk patients, such as those with complicated appendicitis. This observation is consistent with the findings from other studies, suggesting that prolonged or additional antibiotic therapy may be required in cases of complicated appendicitis, where the risk of infection is inherently higher due to factors like perforation or abscess formation [17].

The secondary outcomes were also evaluated in terms of the value of the length of hospital stays and readmission rates. By the recognized effect of SSIs on postoperative recovery, patients who developed SSIs had a hospital stay on average (7.1 +/- 2.3 day), which was much longer than that of patients who did not develop any infections (3.1 +/- 1.1 days). Although substantial differences in the length of stay between the three antibiotic regimens were not found ($p = 0.12$), the information provided indicates that effective measures to prevent SSIs by effective antibiotic prophylaxis may imply the shortened periods of hospitalisation and the decreased spending on healthcare services [18]. Subgroup analysis by the authority of extensive appendicitis (e.g., ruptured or gangrenous appendicitis) helped in recognizing even higher SSI rates (18%), which is compared to that of standing collecting tenderness before operation (10%) [19]. This result is comparable to what is already known, i.e., that in complicated appendicitis, the likelihood of a postoperative infection is high, probably because of the spread of contamination of bowels, and because of long-lasting infection. In patients with complicated appendicitis, the incidence was increased overall in all the groups of antibiotics administered, but there was no significant relationship between SSI rates between the preoperative, postoperative, and combined antibiotic groups of this group of patients [20]. These results, however, suggest that there will be a need among patients with complicated appendicitis to either supplement or extend the use of antibiotics to achieve a subsequent reduction in the risk of SSIs. There were few adverse effects associated with the use of antibiotics with only 4 percent of the patients reporting mild reactions like rash or gastro intestinal disturbances. There were no life-threatening or severe reactions, and this proves that the antibiotic regimens that were applied in this study were more tolerated. The equivalence in side effects in the three groups of antibiotics indicates that addition of the postoperative antibiotics does not provoke greater risk of the side effects and also it is safe to continue or add to the antibiotic regimen when medically necessary.

Limitations and Future Research

This study has several limitations that should be considered when interpreting the results. First, while the study was randomized, it was conducted at a single center, and the findings may not be generalizable to all healthcare settings. Additionally, the sample size was relatively small, which could limit the statistical power to detect significant differences between the antibiotic regimens. Further studies with larger, multicenter cohorts are needed to confirm the results of this study and explore the potential benefits of postoperative antibiotics in high-risk populations, particularly those with complicated appendicitis.

Conclusion

It is concluded that preoperative antibiotic prophylaxis is effective in reducing the incidence of surgical site infections (SSIs) following appendectomy, with no significant benefit from adding postoperative antibiotics in uncomplicated cases. While the combined preoperative and postoperative antibiotic

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regimen showed a slight reduction in SSIs compared to the postoperative-only regimen, this difference was not statistically significant. For patients with complicated appendicitis, further investigation is required to determine whether extended or additional antibiotic therapy can significantly reduce the risk of SSIs.

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