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[Research Article]

A Prospective Comparison of Ceftriaxone and Levofloxacin for Surgical Site Infection Prophylaxis in Elective General Surgeries

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Abstract:

Background: Surgical Site Infections (SSIs) are prevalent postoperative complications that can lead to increased morbidity, prolonged hospital stays, and elevated healthcare costs. Prophylactic antibiotic administration is a standard practice aimed at reducing the incidence of SSIs. This study compares the efficacy of ceftriaxone and levofloxacin as prophylactic antibiotics in patients undergoing elective general surgeries.

Methods: A prospective, comparative study was conducted involving 100 patients scheduled for elective general surgeries. Participants were randomized into two groups: Group A received a single preoperative dose of ceftriaxone (1g IV), and Group B received levofloxacin (750mg IV). Data collected included patient demographics, type of surgery, incidence and grading of SSIs (using the Southampton grading system), microbiological profiles of infections, duration of hospital stay, and total antibiotic dosage administered.

Results: The overall incidence of SSIs was 39%, with 22 cases in the ceftriaxone group and 17 in the levofloxacin group ($p = 0.78$). The most common procedures associated with SSIs were hernioplasty and cholecystectomy. Predominant pathogens isolated included *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. Patients in the levofloxacin group had a shorter mean hospital stay, with 48% discharged within three days, compared to 8% in the ceftriaxone group. Additionally, 76% of patients in the levofloxacin group required ≤4 mg of antibiotics, whereas 78% in the ceftriaxone group required 4–10 mg.
Conclusion: Both ceftriaxone and levofloxacin are effective as prophylactic antibiotics in elective general surgeries. However, levofloxacin demonstrated advantages in terms of shorter hospital stays and lower total antibiotic consumption. These findings suggest that levofloxacin may be a more cost-effective option for SSI prophylaxis in elective general surgical procedures.

Keywords: Surgical Site Infection, Prophylactic Antibiotics, Ceftriaxone, Levofloxacin, Antimicrobial Prophylaxis.

Introduction:

Surgical site infections (SSIs) are among the most prevalent healthcare-associated infections (HAIs), accounting for significant morbidity, prolonged hospital stays, and increased healthcare costs. The European Centre for Disease Prevention and Control (ECDC) reported over 10,000 SSIs across nine surgical categories in 2021–2022, with rates varying from 0.6% in laminectomies to 9.6% in open colon surgeries (Ecdc, 2021; Freitas et al., 2023)

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Antibiotic prophylaxis is a cornerstone in SSI prevention. Ceftriaxone, a third-generation cephalosporin, has demonstrated efficacy in reducing SSI incidence. A systematic review and meta-analysis found that ceftriaxone prophylaxis resulted in a 3.41% SSI rate compared to 6.9% in comparator groups, indicating a significant reduction (Somakumar et al., 2024).

Levofloxacin, a fluoroquinolone antibiotic, has also been evaluated for surgical prophylaxis. A systematic review and meta-analysis reported that preoperative oral fluoroquinolones, including levofloxacin, combined with intravenous antibiotics, significantly decreased total SSIs (risk ratio [RR] 0.43, 95% confidence interval [CI] 0.32–0.57) compared to intravenous antibiotics alone (Johnson et al., 2023).

Despite the proven efficacy of both antibiotics, direct comparisons between ceftriaxone and levofloxacin in elective general surgeries are limited. This study aims to compare the prophylactic efficacy of ceftriaxone and levofloxacin in preventing SSIs among patients undergoing elective general surgeries, with the goal of identifying a potentially more effective and safer alternative.

Methods:

This prospective analytical study was conducted over a six-month period in the Department of General Surgery at Ananta Institute of Medical Sciences and Research Center, Rajsamand, Rajasthan. A total of 100 male and female patients undergoing clean-contaminated and contaminated surgeries were included.

Eligible participants were adolescents and adults requiring surgical antibiotic prophylaxis. Patients with established infections, viral illnesses, contraindications to antibiotic use, or those who were pregnant were excluded from the study. Data were collected from selected patients undergoing surgery during the study period. Each patient received prophylactic antibiotics with the aim of evaluating alternative agents to ceftriaxone that may offer effective infection prevention with fewer adverse effects.

Post-operatively, patients were monitored for 30 days to identify any signs of infection. In cases where infection occurred, pus cultures were performed to isolate and identify the causative bacteria. Detailed patient information including ID numbers, registration data, laboratory findings, follow-up records, and treatment outcomes was systematically documented and analyzed to assess the efficacy of alternative prophylactic antibiotics.

Method of Data Analysis:

IBM SPSS Version 23 was used to analyze the data. Responses to the research questions and demographic data were analyzed using descriptive statistics (frequency and percentages), and the study hypotheses were tested at a 0.05 level of significance using inferential statistics (Pearson's Product Moment Correlation).

Result

Table 1 : Gender-wise distribution of patients

Gender of Participants	Ceftriaxone group(n)	Levofloxacin group(n)	Total(n)
Male	29	34	63
Female	21	16	37
Total	50	50	100

In the ceftriaxone group, 29 patients were male and 21 were female. The levofloxacin group included 34 male and 16 female patients.

Table 2 : Age wise distribution of patients

Age- group (Years)	Ceftriaxone group	Levofloxacin group	Total Number (%)
18 – 27	6(12%)	6(12%)	12
28 - 37	9(18%)	10(20%)	19
38 – 47	12(24%)	10(20%)	22
48 – 57	8(16%)	11(22%)	19
58 – 67	8(16%)	7(14%)	15
68-77	7(14%)	3 (6%)	10
78-87	0 (0%)	3(6%)	3
Total	50	50 (100%)	100

Patients were grouped into 10-year age intervals. The highest representation was from the 38–47 age group (22%), while the lowest was in the 78–87 group (3%).

Table3: Type of surgeries and prophylactic antibiotic prescribed

S. No.	Type of surgery	Ceftriaxone	Levoflofloxacin	Total
1	Appendectomy	7	4	11
2	Cholecystectomy	13	11	24
3	Colostomy	2	3	5
4	Hernioplasty	24	18	42
5	Haemrroidectomy	1	2	3
6	Epididynorchities	1	1	2
7	Lord stretching	0	1	1
8	Cystolithotomy	0	1	1
9	Fistulectomy	1	3	4
10	Ileostomy	0	4	4

Hernioplasty was the most commonly performed procedure (42 cases), followed by cholecystectomy (24 cases) and appendectomy (11 cases). Ceftriaxone was more frequently prescribed overall, particularly in hernioplasty and cholecystectomy cases. Levofloxacin was notably used in cases like ileostomy, cystolithotomy, and lord stretching, where ceftriaxone was not prescribed.

Table 4: Types of surgeries during which SSI developed

S. No.	Type of surgeries	Ceftriaxone	Levofoxacin
1	Appendectomy	4	2
2	Cholecystectomy	6	3
3	Fistulectomy	1	1
4	Hernioplasty	11	2
5	Ileostomy	0	4

SSIs were more commonly observed in patients who received ceftriaxone, particularly after hernioplasty (11 cases) and cholecystectomy (6 cases). In contrast, the highest incidence of SSIs with levofloxacin occurred in ileostomy cases (4 cases), where none were reported in the ceftriaxone group. This suggests a possible variation in antibiotic efficacy depending on the type of surgery.

Table 5: Type of microorganism identified at the surgical site in patients who develop SSI

S. No.	Type of surgery	Bacteria	ceftriaxone	levofloxacin
1	Appendectomy	Escherichia coli	4	2
2	Cholecystectomy	Klebsiella pneumonie	6	3
3	Fistulectomy	Escherichia coli	1	1
4	Hernioplasty	pseudomonas	11	2
5	Ileostomy	Escherichia coli	0	4

Among patients who developed SSIs, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas spp.* were the predominant isolates. *Pseudomonas spp.* was notably associated with hernioplasty in the ceftriaxone group (11 cases), indicating a potential resistance pattern or procedural risk. *Escherichia coli* was the most common pathogen overall, especially in appendectomy and ileostomy cases. Notably, all ileostomy-related infections

with *E. coli* occurred in the levofloxacin group, suggesting variability in bacterial susceptibility between antibiotic regimens.

Table 6: Development of SSI of patients

Development of SSI	Cetriaxone (n) **group**	**Levofloxacin (n) group**	**Total**	**Pvalue**
Yes	22	17	39	0.78
No	28	33	61	
Total	50	50	100	

The overall incidence of SSIs was 39 patients, with 22 in the ceftriaxone group and 17 in the levofloxacin group. Statistical analysis using the Chi-square test yielded a P-value of 0.78, indicating no significant difference in the development of SSIs between the two antibiotic regimens at a 95% confidence level. This suggests that, while both antibiotics are effective for prophylaxis, the incidence of post-operative infections did not significantly vary between groups.

7: Grade of SSI table of patients

Grades of SSI	**Ceftriaxone group**	**Levofloxacin group**	**Total**	**P-value**
Normal	28	35	63	
Ia	7	8	15	
Ib	3	1	4	
Ic	1	1	2	
IIb	0	2	2	**0.04**
IIIa	1	0	1	
IIIb	3	0	3	
IIIc	3	1	4	

Iva	1	2	3	
IVb	3	0	3	
IVc	0	0	0	
	50	50	100	

The grading of SSIs revealed that the majority of patients exhibited normal wound healing (63%). Notably, the ceftriaxone group had a higher incidence of severe infections (Grades III–IV) compared to the levofloxacin group, which had a higher number of mild infections (Grades Ia–II). The observed differences were statistically significant (P = 0.04), indicating that the choice of prophylactic antibiotic may influence the severity of post-operative infections. These findings suggest that levofloxacin may be associated with milder SSIs compared to ceftriaxone.

8: **Mean Hospital stay of patients**

Mean hospital stay	ceftriaxone group	Levofloxacin group	Total
≤ 3 days	4	24	28
3-6 days	42	23	65
≥ 6days	4	3	7

The majority of patients in both groups had a hospital stay of 3–6 days, with the ceftriaxone group having a slightly higher number of patients in this category. Notably, a higher number of patients in the levofloxacin group were discharged within 3 days compared to the ceftriaxone group. This difference may be attributed to factors such as the severity of the surgical procedure, the presence of comorbidities, or the efficacy of the antibiotic regimen in preventing post-operative complications. However, further statistical analysis is required to determine if these differences are statistically

9 : Total Antibiotic dose taken

Total Antibiotic dose taken	Ceftriaxone Group	Levofloxacin group	Total
≤ 4 mg	4	38	42
4-10 mg	39	12	51

≥ 10mg	7	0	7

The majority of patients in both groups received 4–10 mg of the prescribed antibiotic. A higher number of patients in the levofloxacin group received ≤ 4 mg, indicating a possible difference in dosing protocols or the duration of antibiotic therapy between the two groups. Additionally, a small number of patients in the ceftriaxone group received ≥ 10 mg, which may reflect variations in individual patient requirements or adjustments based on clinical judgment. These findings suggest that while the dosing regimens were generally aligned with standard practices, individual patient factors may have influenced the total antibiotic doses administered.

Discussion:

Surgical site infections (SSIs) continue to pose significant challenges in postoperative care, contributing to increased morbidity, prolonged hospital stays, and elevated healthcare costs (Dhole et al., 2023). Antibiotic prophylaxis remains a cornerstone strategy in mitigating the risk of SSIs, with the selection of appropriate agents being crucial to balance efficacy and the prevention of antimicrobial resistance.

Recent studies have explored the comparative effectiveness of various prophylactic antibiotics. A randomized clinical trial by Haghighi et al. (2024) assessed the prophylactic efficacy of intravenous cefazolin versus oral levofloxacin in patients undergoing transurethral resection of the prostate (TURP). The study found no significant difference in postoperative infection rates between the two groups, suggesting that oral levofloxacin, with its ease of administration and cost-effectiveness, could be a viable alternative to intravenous cefazolin in certain surgical contexts (Haghighi et al., 2024).

In another study, a systematic review and meta-analysis conducted by Somakumar et al. (2024) evaluated the clinical efficacy and safety of ceftriaxone in surgical prophylaxis. The analysis concluded that ceftriaxone is effective in preventing SSIs across various surgical procedures, with a favorable safety profile (Somakumar et al., 2024). These findings support the continued use of ceftriaxone as a prophylactic agent, particularly in settings where its broad-spectrum activity is advantageous.

Our study aimed to compare the safety and efficacy of ceftriaxone and levofloxacin as prophylactic antibiotics in elective general surgery patients. The results indicated that both antibiotics were similarly effective in preventing SSIs, with no significant differences in infection rates or severity between the two groups. These findings align with the aforementioned studies, reinforcing the potential interchangeability of these agents in surgical prophylaxis, depending on patient-specific factors and resource availability.

However, it is important to acknowledge the limitations of our study, including the relatively small sample size and the single-center design, which may affect the generalizability of the findings. Further large-scale, multicenter randomized controlled trials are warranted to validate these results and to establish more definitive guidelines for the selection of prophylactic antibiotics in various surgical settings.

Conclusion:

Both ceftriaxone and levofloxacin demonstrate comparable efficacy and safety profiles as prophylactic antibiotics in elective general surgery. The choice between these agents should be guided by considerations such as patient-specific factors, antibiotic resistance patterns, cost, and institutional protocols. Ongoing research and surveillance are essential to inform best practices and to optimize outcomes in surgical prophylaxis.

Limitations

Despite providing valuable insights into the comparative efficacy of ceftriaxone and levofloxacin in surgical site infection (SSI) prophylaxis, this study is subject to several limitations. First, the sample size of 100 patients,

while informative, may be insufficient to detect smaller but clinically significant differences between treatment groups. Second, the study was conducted at a single center, which may limit the generalizability of the findings to broader populations or different healthcare settings with varying microbial profiles and antibiotic resistance patterns. Third, randomization procedures and blinding methods were not explicitly described, raising the possibility of allocation or observer bias. Fourth, only short-term outcomes (within 30 days) were assessed, without evaluating long-term infection-related complications or antibiotic resistance development. Lastly, variation in surgical types and patient comorbidities were not fully stratified or controlled, which could influence infection risk and treatment outcomes. Future multicenter, randomized controlled trials with larger sample sizes and extended follow-up are needed to validate and expand upon these findings.

Conflict of interest:

The authors declare that there is no conflict of interest.

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