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Review Article

Comparative Efficacy of Cefoperazone and Clindamycin in the Management of Soft Tissue Infections: A Prospective Study

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ABSTRACT

Background: Soft tissue infections (STIs) constitute a significant cause of bacterial morbidity in India, accounting for 10–20% of all hospital admissions. Effective antibiotic selection remains critical for favourable clinical outcomes. **Objective:** To compare the clinical and inflammatory marker-based efficacy of cefoperazone (a third-generation cephalosporin) and clindamycin (a lincosamide antibiotic) in patients with soft tissue infections. **Methods:** A six-month prospective, open-label, comparative study was conducted in the Department of General Surgery at Durgabhai Deshmukh Hospital and Research Centre (DDHRC), Hyderabad, enrolling 60 patients (26 on cefoperazone; 34 on clindamycin) meeting predefined inclusion criteria. Efficacy was assessed via white blood cell (WBC) count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) measured over three consecutive days. **Results:** Clindamycin demonstrated a statistically superior reduction in WBC ($p < 0.001$ on Days 2 and 3) and CRP ($p < 0.001$ on all three days) compared with cefoperazone. ESR showed a non-significant downward trend favouring clindamycin. Clindamycin was also prescribed significantly more often in abscess cases ($p = 0.043$). **Conclusion:** Clindamycin exhibits superior anti-inflammatory and antibacterial efficacy over cefoperazone in the management of soft tissue infections, particularly in abscess cases and high-risk comorbid patients.

INTRODUCTION

Soft tissue infections (STIs) are among the most prevalent bacterial infections encountered in clinical practice, representing 10–20% of all

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hospital admissions in India.[1] They encompass a broad clinical spectrum — from superficial, uncomplicated presentations such as cellulitis and folliculitis to life-threatening necrotizing fasciitis — and are characterized by microbial invasion of the skin, subcutaneous tissue, fascia, and underlying muscle.[2]

The most frequently implicated pathogens are *Staphylococcus aureus* and *Streptococcus pyogenes*, with methicillin-resistant *S. aureus* (MRSA) emerging as a critical therapeutic challenge.[3] Polymicrobial infections, particularly aerobic-anaerobic combinations, are characteristic of necrotizing soft tissue infections (NSTIs), which carry mortality rates ranging from 23% to 46% without prompt surgical and antimicrobial intervention.[4]

The global incidence of skin and soft tissue infections (SSTIs) is estimated at 24.6 per 1,000 person-years, making SSTIs the third most common reason for emergency department attendance. Approximately 70–75% of cases are managed in an outpatient setting, though complex and necrotizing infections necessitate inpatient care with broad-spectrum intravenous antibiotics.[3]

CLASSIFICATION OF SOFT TISSUE INFECTIONS:

- Folliculitis – superficial infection confined to the hair follicle.
- Cellulitis – diffuse infection of the dermis and subcutaneous tissue, typically non-purulent.
- Erysipelas – superficial cellulitis with sharply demarcated, raised margins.
- Abscess – localized collection of pus requiring drainage in addition to antibiotic therapy.

- Necrotizing fasciitis – rapidly progressive, life-threatening infection of the fascia and subcutaneous tissue, associated with high mortality.

CEFOPERAZONE:

Cefoperazone is a third-generation semisynthetic cephalosporin that exerts bactericidal activity by irreversibly binding to penicillin-binding proteins (PBPs), thereby inhibiting bacterial cell wall synthesis. It demonstrates broad-spectrum efficacy against Gram-negative organisms, including *Pseudomonas aeruginosa*, and is particularly useful in biliary tract infections owing to its predominantly hepatobiliary excretion.[5]

CLINDAMYCIN:

Clindamycin, a lincosamide antibiotic, suppresses bacterial protein synthesis by binding to the 23S rRNA of the 50S ribosomal subunit, thereby preventing peptide chain elongation. Its efficacy against Gram-positive aerobes (*S. aureus*, *Streptococcus* spp.) and anaerobes, combined with a distinctive anti-toxin effect and superior tissue penetration, renders it particularly valuable in necrotizing and deep-seated infections.[6,7]

RATIONALE FOR THE STUDY:

Despite the extensive clinical use of both agents, comparative evidence specific to soft tissue infections — particularly using objective inflammatory markers as endpoints — remains limited in the Indian patient population. This prospective study was therefore designed to rigorously evaluate and compare the efficacy of cefoperazone and clindamycin, using WBC count, ESR, and CRP as surrogate markers of therapeutic response.

MATERIALS AND METHODS



AIM:

To compare the clinical and inflammatory marker-based efficacy of cefoperazone and clindamycin in the management of soft tissue infections.

OBJECTIVES:

- To assess and compare trends in WBC count, ESR, and CRP over three days of therapy in both treatment groups.
- To evaluate diagnosis-specific treatment response, including abscess, cellulitis, erysipelas, and necrotizing fasciitis.
- To monitor resolution of chief presenting complaints (fever, redness, pus discharge, pain, and tenderness).
- To identify patient and disease characteristics that may influence choice of empiric antibiotic therapy.

MATERIALS AND METHODOLOGY:

- **Study design and setting:** This was a six-month prospective, open-label, comparative study conducted in the Department of General Surgery, Durgabhai Deshmukh Hospital and Research Centre (DDHRC), a 300-bedded multi-specialty tertiary care hospital, Hyderabad. The study protocol was approved by the Institutional Ethics Committee (IEC) prior to patient enrolment, and written informed consent was obtained from all participants.
- **Patient population:** A total of 60 patients with soft tissue infections, aged 40–70 years, were enrolled and allocated to one of two treatment groups based on the treating physician's clinical judgement: Group I (n = 26) received cefoperazone and Group II (n = 34) received clindamycin.

- **Inclusion criteria:** Confirmed diagnosis of cellulitis, folliculitis, erysipelas, or necrotizing soft tissue infection, with elevated inflammatory markers (WBC, CRP, or ESR) at baseline.
- **Exclusion criteria:** Patients with deep vein thrombosis (DVT), those unwilling to comply with the study protocol, and those on concurrent immunosuppressive agents.
- **Drug regimens:** Cefoperazone was administered intravenously at 2–4 g/day in two divided doses every 12 hours, with dose escalation up to 8 g/day for severe infections. Clindamycin was administered intravenously at 600 mg every 8 hours for mild-to-moderate infections, and 900–1,200 mg every 8 hours for severe infections, as per standard institutional protocol.[8]
- **Outcome measures:** Primary efficacy outcomes were trends in WBC count, ESR, and CRP measured on Days 1, 2, and 3 of treatment. Secondary outcomes included resolution of chief complaints and diagnosis-specific treatment response. Demographic data and vitals were recorded using structured case report forms.
- **Statistical analysis:** Data were analyzed using SPSS software. Continuous variables are expressed as mean $\pm$ standard deviation (SD). Between-group comparisons were performed using the unpaired t-test or Mann–Whitney U test as appropriate, and categorical data were compared using the Chi-square or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

RESULT AND DISCUSSION:



A total of 60 patients with soft tissue infections were evaluated, comparing cefoperazone and clindamycin using demographic parameters, diagnosis distribution, and the inflammatory markers WBC, ESR, and CRP.

Table 1: Distribution Based on Age and Gender by Treatment Group

Parameter	Cefoperazone (n=26)	Clindamycin (n=34)	Total (n=60)	P value
Mean age $\pm$ SD (years)	53.65 $\pm$ 8.04	54.44 $\pm$ 9.54	—	0.736
Female n (%)	14 (53.8%)	15 (44.1%)	29 (48.3%)	0.455
Male n (%)	12 (46.2%)	19 (55.9%)	31 (51.7%)	—

(SD = Standard Deviation; no statistically significant difference in age or gender distribution between groups)

RESULT:

The mean age of patients in the cefoperazone and clindamycin groups was comparable (53.65 $\pm$ 8.04 years vs. 54.44 $\pm$ 9.54 years; p = 0.736). Gender distribution was similarly balanced between the two groups (48.3% female, 51.7% male; p = 0.455), confirming baseline demographic comparability and supporting the validity of

subsequent efficacy comparisons. The most prevalent comorbidities were diabetes mellitus, which was significantly more common in the clindamycin group (41.2% vs. 7.7%; p = 0.029), and hypertension (30.8% in the cefoperazone group vs. 17.6% in the clindamycin group). Immunosuppression was present in 38.5% of the cefoperazone group compared with 20.6% of the clindamycin group.

Table 2: Diagnosis Distribution by Treatment Group

Diagnosis	Cefoperazone n (%)	Clindamycin n (%)	Total n (%)	P value
Abscess	1 (3.8%)	10 (29.4%)	11 (18.3%)	0.043*
Cellulitis	13 (50.0%)	9 (26.5%)	22 (36.7%)	—
Erysipelas	3 (11.5%)	6 (17.6%)	9 (15.0%)	—
Necrotizing Fasciitis	9 (34.6%)	9 (26.5%)	18 (30.0%)	—

(*Statistically significant; p < 0.05)

RESULT:

Cellulitis was the most frequent diagnosis overall (36.7%), followed by necrotizing fasciitis (30.0%), abscess (18.3%), and erysipelas (15.0%). A statistically significant difference was observed in abscess cases, with clindamycin prescribed considerably more often (29.4%) than

cefoperazone (3.8%; p = 0.043), reflecting clinician preference for clindamycin's superior tissue penetration in deep-seated, purulent infections. No statistically significant inter-group difference was observed in overall presenting-symptom distribution (p = 0.384), indicating comparable baseline clinical severity between the two groups.

Table 3: Distribution Based on Mean WBC Count by Treatment Group

Day	Treatment	Mean (cells/ μ L)	Std. Deviation	P value
Day 1	Cefoperazone	13,312.38	4165.27	0.009
	Clindamycin	10,942.88	—	
Day 2	Cefoperazone	14,296.04	3522.19	<0.001
	Clindamycin	8,086.09	—	
Day 3	Cefoperazone	12,335.65	4527.53	<0.001
	Clindamycin	6,516.71	—	



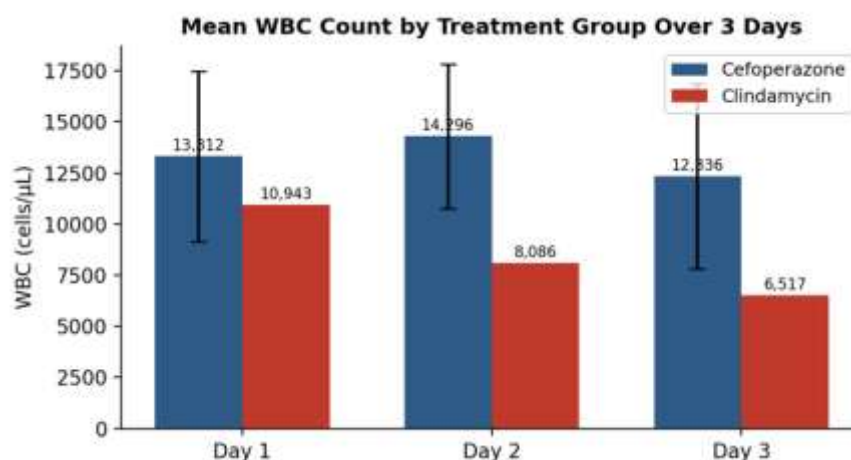


Figure 1: Bar graph depicting mean WBC count by treatment group over three days.

RESULT:

On Day 1, mean WBC was higher in the cefoperazone group (13,312 cells/μL) than in the clindamycin group (10,943 cells/μL; $p = 0.009$).

By Day 3, the clindamycin group showed a significantly greater reduction, to 6,517 cells/μL, versus 12,336 cells/μL in the cefoperazone group ($p < 0.001$), indicating markedly faster control of systemic inflammation with clindamycin therapy.

Table 4: Distribution Based on Mean ESR by Treatment Group

Day	Treatment	Mean (mm/hr)	Std. Deviation	P value
Day 1	Cefoperazone	34.54	12.30	0.093
	Clindamycin	29.32	—	
Day 2	Cefoperazone	30.54	12.74	0.659
	Clindamycin	32.06	—	
Day 3	Cefoperazone	31.12	10.47	0.233
	Clindamycin	28.18	—	

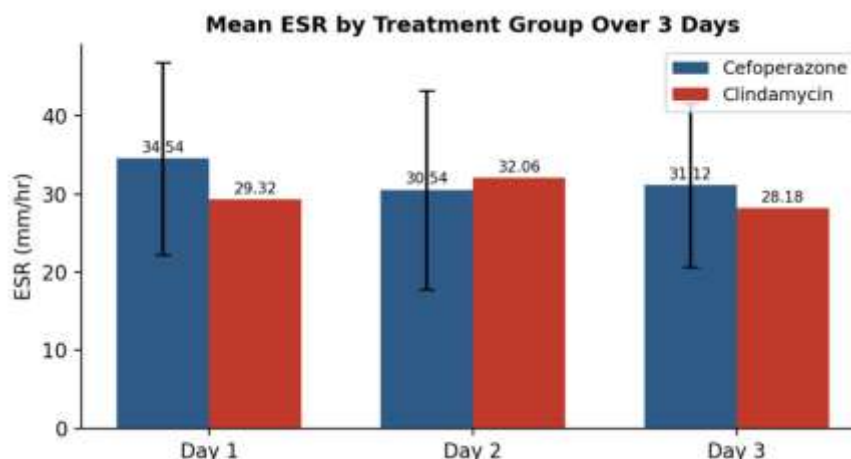


Figure 2: Bar graph depicting mean ESR by treatment group over three days.

RESULT:

ESR values showed a numerical decline in the clindamycin group across the three days; however, between-group differences did not reach statistical

significance ($p = 0.093$, 0.659 , and 0.233 on Days 1, 2, and 3, respectively). This is attributable to the inherently slower kinetics of ESR as an inflammatory marker, which responds more gradually than WBC or CRP within a short observation window.

Table 5: Distribution Based on Mean CRP by Treatment Group

Day	Treatment	Mean (mg/dL)	Std. Deviation	P value
Day 1	Cefoperazone	26.45	15.59	<0.001
	Clindamycin	19.84	—	
Day 2	Cefoperazone	32.17	11.98	<0.001
	Clindamycin	17.53	—	
Day 3	Cefoperazone	31.16	14.78	<0.001
	Clindamycin	13.29	—	

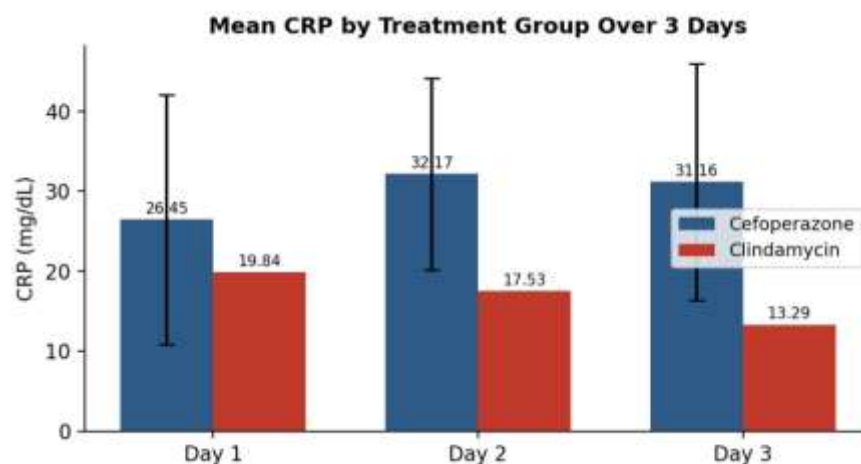


Figure 3: Bar graph depicting mean CRP by treatment group over three days.

RESULT:

CRP demonstrated the most striking inter-group difference among all markers assessed. On Day 1, mean CRP was 26.45 mg/dL in the cefoperazone group versus 19.84 mg/dL in the clindamycin group ($p < 0.001$). The divergence widened progressively, with Day 3 values of 31.16 mg/dL versus 13.29 mg/dL respectively ($p < 0.001$), confirming clindamycin's superior anti-inflammatory efficacy as measured by this sensitive acute-phase reactant.

DISCUSSION:

This prospective study represents a head-to-head comparison of two widely used antibiotics in soft tissue infection management — cefoperazone and clindamycin — using objective laboratory markers

as the primary efficacy endpoints. The well-matched demographic baseline (age and gender) strengthens the internal validity of the comparative analysis.

The superior performance of clindamycin in reducing WBC count and CRP over three days is consistent with its well-established pharmacological advantages in soft tissue infection. Clindamycin's mechanism of action — inhibition of the 50S ribosomal subunit — not only arrests bacterial protein synthesis but also suppresses production of bacterial exotoxins, including streptococcal pyrogenic exotoxins and staphylococcal toxins.[6] This anti-toxin effect is particularly relevant in necrotizing and abscess-forming infections, explaining why clindamycin



was the preferred agent for abscess cases in this cohort.

The markedly superior CRP reduction in the clindamycin group (Day 3: 13.29 vs. 31.16 mg/dL; $p < 0.001$) is a clinically meaningful finding, as CRP is a sensitive, real-time marker of systemic inflammatory response that responds rapidly to effective antibiotic therapy.[9] The progressively widening CRP gap between groups suggests that clindamycin's anti-inflammatory effect is not merely additive, but amplifies over time as toxin suppression accumulates.

Diabetes mellitus was significantly more prevalent in the clindamycin group (41.2% vs. 7.7%; $p = 0.029$) — a population that is inherently harder to treat owing to impaired immunity, microvascular compromise, and poor wound healing — which makes the superior efficacy outcomes observed with clindamycin even more noteworthy. This finding aligns with existing evidence supporting the use of clindamycin in immunocompromised and high-risk patient groups.

Cefoperazone, while demonstrating clinical utility — particularly in cellulitis (50% of its cohort) and in settings requiring Gram-negative or polymicrobial coverage — showed a paradoxical rise in mean WBC on Day 2 (14,296 cells/ μ L from a Day 1 baseline of 13,312 cells/ μ L). This transient worsening of the inflammatory index may reflect cefoperazone's bactericidal mechanism, which involves rapid bacterial lysis and consequent release of endotoxins triggering a transient inflammatory surge — a phenomenon well documented with beta-lactam antibiotics.[5]

The non-significant ESR trend observed in this study is attributable to the physiology of ESR as a marker: it responds more slowly to resolution of inflammation compared with CRP, often lagging by days to weeks, and is therefore less sensitive for

capturing short-term (3-day) antibiotic efficacy differences.

These findings are consistent with the broader literature. Swartz established the importance of tissue-penetrant antibiotics with anti-toxin effects in necrotizing infections.[10] May, and Ustin and Malangoni, similarly emphasized that broad-spectrum anaerobic coverage and toxin inhibition are critical determinants of outcome in complicated soft tissue infections.[11,12] The present data extend this evidence by quantifying inflammatory-response kinetics between the two agents in an Indian tertiary-care setting.

A limitation of this study is the relatively short three-day observation window for inflammatory markers, which precludes assessment of complete clinical resolution. The non-randomized allocation to treatment groups — based on physician preference — also represents a potential selection bias, as reflected in the unequal group sizes ($n = 26$ vs. $n = 34$). Future studies with randomized allocation, longer follow-up, and culture-sensitivity data would further strengthen the evidence base.

CONCLUSION

- Clindamycin was significantly more efficacious than cefoperazone in the management of soft tissue infections, with a greater and faster reduction in WBC count and CRP levels over three days of therapy.
- Its superior anti-inflammatory profile, together with notable efficacy in abscess cases and in diabetic patients, suggests that clindamycin should be considered a preferred empiric option for soft tissue infections, particularly when deep-seated infection, toxin-producing organisms, or high-risk comorbidities are present.



- Cefoperazone retains an important clinical role in polymicrobial and Gram-negative–predominant infections and in biliary tract-associated soft tissue pathology.
- Rational antibiotic selection, guided by infection type, pathogen profile, and patient comorbidities, remains the cornerstone of optimal soft tissue infection management.

Therefore, we conclude that clindamycin is a safe and effective empiric choice for soft tissue infections, offering measurable advantages in inflammatory-marker resolution over cefoperazone, particularly among high-risk and comorbid patients.

CONFLICT OF INTEREST:

The authors declare no conflict of interest.

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REFERENCES

1. Esposito S, Bassetti M, Concia E, et al. Diagnosis and management of skin and soft-tissue infections (SSTI). A literature review and consensus statement: an update. *J Chemother.* 2017;29(2):69–82.
2. Ramakrishnan K, Salinas RC, Agudelo-Higuita NI. Skin and soft tissue infections. *Am Fam Physician.* 2015;92(6):474–83.
3. Ki V, Rotstein C. Bacterial skin and soft tissue infections in adults: a review of their epidemiology, pathogenesis, diagnosis, treatment and site of care. *Can J Infect Dis Med Microbiol.* 2008;19(2):173–184.
4. V K, Hiremath BV, V AI. Necrotising soft tissue infection – risk factors for mortality. *J Clin Diagn Res.* 2013;7(8):1662–1665.
5. Paladino JA, et al. Pharmacodynamics and clinical applications of cefoperazone in the treatment of infections. *Antimicrob Agents Chemother.* 2015;59(9):5272–5280.
6. Gonzales R, et al. Pharmacokinetics and pharmacodynamics of clindamycin in humans. *Clin Pharmacokinet.* 2016;55(7):903–913.
7. Tacke CE, et al. Clindamycin: a review of its antimicrobial efficacy, pharmacokinetics, and clinical use. *Ther Clin Risk Manag.* 2016;12:507–517.
8. Stevens DL, et al. Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the IDSA. *Clin Infect Dis.* 2014;59(2):e10–e52.
9. Papp-Wallace KM, et al. Mechanisms of β -lactam resistance among Gram-negative bacteria and approaches to overcome them. *Clin Microbiol Rev.* 2011;24(3):760–791.
10. Swartz MN. Cellulitis. *N Engl J Med.* 2004;350(9):904–912.
11. May AK. Skin and soft tissue infections. *Surg Clin North Am.* 2009;89(2):403–420.
12. Ustin JS, Malangoni MA. Necrotizing soft-tissue infections. *Crit Care Med.* 2011;39(9):2156–2162.
13. Gunderson CG. Cellulitis: definition, etiology, and clinical features. *Am J Med.* 2011;124(12):1113–1122.
14. Mistry RD, et al. Skin and soft tissue infection treatment and prevention practices by pediatric emergency medicine providers. *Pediatr Emerg Care.* 2022.

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