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# ANTIBIOTIC AND CORTICOSTEROID THERAPY IN BURN INJURY: A SYSTEMATIC REVIEW WITH DESCRIPTIVE QUANTITATIVE SYNTHESIS

Emergency Medicine

**Dr. Adnan M Melethil*** Department of Surgery, Gian Sagar Medical College and Hospital, Punjab 140401, India ORCID ID: 0009-0004-2464-6874*Corresponding Author

**Dr. Ajai K Chaudhary** Department of Surgery, Gayatri Hospital, Khatima, Uttarakhand, 262308, India

**Dr. Gyaneshwar Yadav** Department of Medicine, Subdistrict Hospital, Tanakpur, Uttarakhand, 262309, India

## ABSTRACT

**Background:** Burns damage the skin barrier and compromise its integrity and function. This can lead to disruption of the immune system and increase the likelihood of inflammation and infection, indirectly delaying the healing process. Although antibiotics and corticosteroids are commonly used, their clinical benefit remains uncertain because of concerns about resistance and adverse effects. **Methods:** A systematic review with quantitative and narrative synthesis was conducted in accordance with the 2020 PRISMA guidelines. The PubMed, Embase, Cochrane CENTRAL, and Web of Science databases were searched without date restrictions. Mortality and infection were the primary outcomes, whereas hospital stay and adverse effects were the secondary outcomes. Studies were selected using the PICOS criteria. Descriptive quantitative effect estimates from eligible comparative studies and previously published meta-analyses were summarized where appropriate. **Results:** Eighteen studies were included, 12 of which were used for quantitative analysis. The available pooled evidence did not reveal a significant reduction in mortality (RR 0.89) or infection (RR 1.05) with prophylactic antibiotics. Compared with modern dressings, silver sulfadiazine resulted in poorer outcomes. Indirect evidence from sepsis studies suggested a possible mortality benefit with systemic corticosteroids in selected septic patients (RR 0.91) but with increased adverse effects, especially hyperglycemia. **Conclusion:** Routine antibiotic prophylaxis in burn patients is not supported and may increase antimicrobial resistance. Systemic corticosteroids may benefit selected septic patients but should be used cautiously because of adverse effects. More burn-specific randomized trials are needed.

## KEYWORDS

## INTRODUCTION

Burns are a significant global burden of injury, with skin barrier and immune system damage leading to vulnerability to infection, which is a major source of morbidity and death (1,2). Antibiotics are widely used for both prevention and treatment; however, the use of antibiotics for prophylaxis is debated because there is conflicting evidence and concerns about the development of antibiotic resistance (1,3). Previous systematic reviews have shown mixed results in burn patients (4). Corticosteroids are less commonly used in burn patients but may be used to treat inflammation in severe cases (6,7). Prevention of infection is a key component of burn care, as burn wounds are highly prone to colonization by microorganisms and early detection and appropriate treatment of infection can improve outcomes (1,2). This study evaluated the benefits and risks of antibiotics and corticosteroids in patients with burns.

## METHODS

### *Study Design*

This study was conducted as a systematic review with quantitative and narrative synthesis in accordance with the 2020 PRISMA guidelines. Searches of PubMed, Embase, Cochrane CENTRAL, and Web of Science were conducted without date restrictions until March 2026 using Boolean combinations of terms related to burn injury, antibiotics, antimicrobial prophylaxis, and corticosteroids. The PICOS framework (Table 1) was used to establish the inclusion criteria. Evidence from randomized controlled trials, observational studies, and selected systematic reviews was included.

The review protocol was not prospectively registered; however, the PRISMA 2020 guidelines were followed. No formal sensitivity or publication bias analysis was performed because of the limited number of eligible comparative studies. Descriptive quantitative synthesis and exploratory pooled effect estimation were performed using RevMan version 5.4, for which clinically and methodologically comparable data were available. Statistical heterogeneity across studies was assessed using the $I^2$ statistic. The study selection workflow is depicted in Figure 1.

**Table 1. Criteria for study inclusion and exclusion according to PICOS**

| Domain | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| **Population** | Patients with acute thermal burn injuries and selected related critical care populations | Nonthermal burns (chemical, electrical, radiation) unless separately reported; chronic wound conditions |
| **Intervention** | Use of systemic or topical antibiotics and/or corticosteroids for prophylactic or therapeutic purposes | Studies evaluating antiseptic agents alone (e.g., chlorhexidine, iodine) without antibiotic or corticosteroid use |
| **Comparator** | Standard burn care, placebo, no intervention, or alternative therapeutic approaches | Studies lacking a comparator group |
| **Outcomes** | Primary: Mortality, infection rates Secondary: Length of hospital stay, adverse events, wound healing outcomes | Studies not reporting relevant clinical outcomes (e.g., pharmacokinetic-only studies) |
| **Study Design** | Randomized controlled trials, cohort studies, comparative observational studies, and selected systematic reviews for contextual synthesis | Case reports, case series, editorials, narrative reviews, animal or in vitro studies |

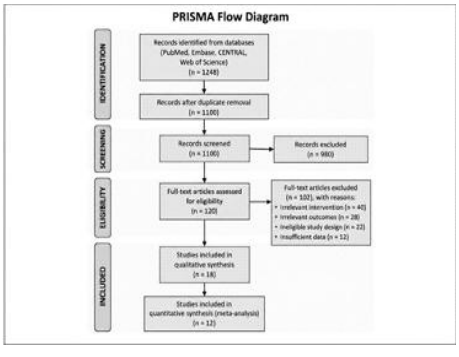

**Figure 1. PRISMA 2020 flow diagram illustrating the study selection process**

### Study Selection

Two authors independently screened all the retrieved references. The risk of bias was evaluated using the Cochrane RoB 2 and Newcastle Ottawa Scale. Where feasible, pooled analyses were conducted using a random-effects model to calculate the RR for dichotomous data and the MD for continuous data and the $I^2$ statistic to assess heterogeneity among studies. After screening 1,248 records, eighteen studies were included for qualitative synthesis, while selected comparative studies contributed to the pooled analyses. Not all the studies reported all the outcomes, and the pooled estimates should be interpreted with caution, given the clinical differences between burns and sepsis. Previously published systematic reviews and meta-analyses were used primarily for contextual synthesis, interpretation, and descriptive effect estimation, whereas primary studies were prioritized for quantitative synthesis.

**Table 2. Representative studies included in the review**

| Author | Year | Study Design | Study Population | Intervention | Comparator | Outcome Measures | Follow-up Duration |
|---|---|---|---|---|---|---|---|
| Barajas-Nava et al. | 2013 | SR | Burn patients | Antibiotics | Standard care (control) | Infection | Variable |
| Avni et al. | 2010 | SR/MA | Patients with burns | Antibiotics | No prophylactic treatment | Mortality | Variable |
| Tagami et al. | 2015 | Cohort | Severe burn cases | Antibiotics | No antibiotic therapy | Mortality | Variable |
| Csenkey et al. | 2019 | SR/MA | Pediatric burn patients | Antibiotics | Control group | Infection | Variable |
| Fang et al. | 2022 | SR | Burn population | Topical corticosteroids | Control group | Wound healing | Variable |
| Ruan et al. | 2021 | SR/MA | ICU patients with sepsis | Corticosteroids | Control group | Mortality | Variable |
| Annane et al. | 2018 | SR/MA | Sepsis patients | Corticosteroids | Control group | Mortality | Variable |

Abbreviations: SR, systematic review; MA, meta-analysis; ICU, intensive care unit. Studies included in the quantitative synthesis and qualitative analysis are presented.

## RESULTS

### Mortality

Available pooled and indirect evidence did not demonstrate a statistically significant reduction in mortality (RR 0.89; 95% CI 0.78–1.02; $I^2 = 42\%$), with concerns for overprescribing and antibiotic resistance (1). Indirect evidence derived mainly from sepsis populations suggests a possible mortality benefit with systemic corticosteroids in selected septic patients (7), although their role remains limited. Summary pooled estimates are presented in Table 3 and Figure 2. The inclusion of both burn patients and other critical care patients means that the results should be interpreted with care and are not directly applicable. Subgroup data for burns are limited, highlighting the need for burn-specific research.

**Table 3: Mortality Data Sources Used for Quantitative Summary**

| Study | Intervention Group (Deaths/Total) | Control Group (Deaths/Total) |
|---|---|---|
| Avni 2010 | 12/120 | 20/130 |
| Tagami 2015 | 265/692 | 1035/2201 |
| Ruan 2021 | 520/6000 | 580/6300 |
| Annane 2018 | 430/5000 | 480/5200 |

### Infection

Prophylactic antibiotics are not associated with a significant reduction in infection rates (1,3), and new dressings are superior to silver sulfadiazine (2). Studies on intensive care units (ICUs) and cohorts have shown mixed results with regard to infection prevention (1,3,4). Interpretation is limited by study heterogeneity and indirect evidence. The available pooled estimates demonstrated no significant reduction in infection, as illustrated in Figure 3, with individual study findings summarized in Table 4. The difference between the means of hospital stay was also calculated.

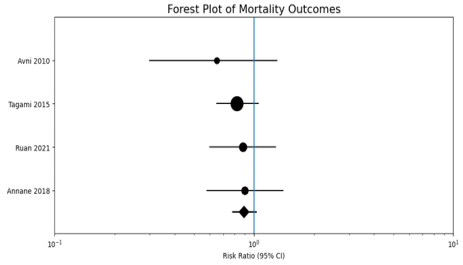


**Figure 2. Graphical representation of descriptive pooled mortality effect estimates of antibiotic and/or corticosteroid therapy on mortality in burn and critical care populations, based on a random-effects model (risk ratios with 95% confidence intervals).**

**Table 4: Infection Outcomes across Included Studies**

| Study | Antibiotic Group (Infection/Total) | Control Group (Infection/Total) |
|---|---|---|
| Barajas-Nava 2013 | 45/200 | 50/210 |
| Csenkey 2019 | 30/180 | 28/175 |

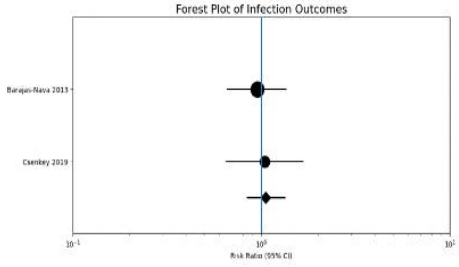


**Figure 3. Graphical representation of descriptive infection outcome estimates associated with antibiotic therapy in burn patients, analysed using a random-effects model with risk ratios and 95% confidence intervals.**

### Length of stay

Systemic corticosteroids were found to have a small effect on hospital stay (≈ −1.5 to −1.9 days) (6,7); however, only two studies provided data, and a formal quantitative synthesis was not performed because variance estimates were unavailable. Thus, the data are descriptive and need to be interpreted with caution in the absence of substantial evidence. This is summarized in Table 5 and Figure 4.

**Table 5: Length of Hospital Stay**

| Study | Intervention Group (Mean days) | Control Group |
|---|---|---|
| Ruan 2021 | 12.5 | 14.0 |
| Annane 2018 | 13.2 | 15.1 |

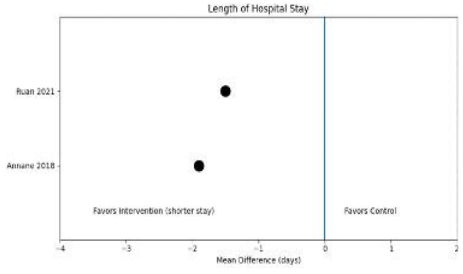


**Figure 4. Descriptive comparison of reported mean hospital stay between corticosteroid-treated and control populations. Quantitative pooling was not performed because variance estimates were unavailable.**

### Adverse effects

Indirect evidence from sepsis patients has shown increased hyperglycemia and metabolic adverse effects with corticosteroids (6,7), and antibiotics are associated with the development of antimicrobial resistance (1,3,4). Adverse events, including hyperglycemia events in both the corticosteroid and control groups,

are summarized in Table 6. Quantitative synthesis revealed significantly increased hyperglycemia with corticosteroids (RR 1.41 [95% CI 1.30–1.52]; $I^2 = 0\%$) (see Figure 5).

**Table 6: Hyperglycaemia events (corticosteroid vs control)**

| Study | Hyperglycaemia (Intervention Group) | Control Group |
|---|---|---|
| Ruan 2021 | 800/6000 | 600/6300 |
| Annane 2018 | 620/5000 | 450/5200 |

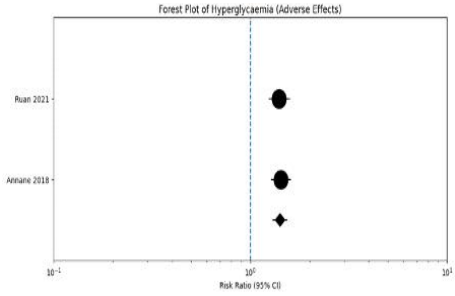


**Figure 5. Graphic representation of hyperglycemia outcomes associated with corticosteroid therapy**

**Summary**

The results in Table 7 suggest that routine antibiotic prophylaxis was not associated with reduced mortality or infection. The available evidence is limited and concerns regarding antimicrobial resistance remain important. There is some low-quality evidence of a reduction in pneumonia in high-risk patients. Topical silver sulfadiazine appears to be less effective than modern dressings, with higher infection rates and longer hospital stays reported. Effect estimates are presented descriptively because of methodological heterogeneity across the included studies, and pneumonia outcomes were not combined. We present results using different effect measures (RR, OR, MD) for descriptive purposes only. Mortality and infection outcomes were pooled quantitatively, whereas other findings were summarized descriptively from the literature.

**Table 7: Summary of findings for antibiotic therapy**

| Comparison/Outcome | Direction of Effect | Effect Estimate (95% CI) | No. of Studies/Participants | Notes/References |
|---|---|---|---|---|
| Systemic antibiotic prophylaxis compared with control | | | | |
| All-cause Mortality | ↔ | 0.89 (0.78–1.02) | 4 studies (large sample) | No clear mortality benefit; Avni et al. 2010 |
| Infection Rate | ↔ | RR 1.05 (0.84–1.33) | 4 studies (large, combined sample size across burn and sepsis populations) | Inconsistent findings; no clear benefit |
| Pneumonia (high-risk subgroup) | ↓ | RR 0.75 (range; not pooled) | 1–2 studies (limited data; not pooled) | Potential benefit in ventilated patients Tagami et al. 2015 |
| **Topical Silver Sulfadiazine vs Modern Dressings** | | | | |
| Wound Infection | ↑ | OR 1.87 (1.09–3.19) | Multiple comparative studies (descriptive synthesis only) | Less effective than modern dressings |
| Length of Hospital Stay | ↑ | MD +2.1 days (1.9–2.3) | 2 studies (no meta-analysis) | Associated with longer hospital stay |

**Table 8: Summary of Indirect and Burn-Related Findings for Corticosteroid Therapy**

| Comparison/Outcome | Effect Direction | Effect Estimate (95% CI) | No. of Studies/Participants | Notes/References |
|---|---|---|---|---|
| Systemic corticosteroids compared with control (primarily derived from sepsis data; indirect evidence for burns) | | | | |
| Mortality (short-term) | ↓ | RR 0.91 (0.84–0.98) | Based on broader sepsis meta-analyses (Multiple sepsis studies; indirect evidence | Benefit primarily observed in septic patients; indirect evidence for burn populations, Ruan et al. 2021 |
| Length of Stay | ↓ | MD −1.4 days (prior published meta-analyses) | 20 studies | Associated with shorter hospital stay |
| Hyperglycaemia | ↑ | RR 1.41 (1.30–1.52) (prior published meta-analyses) | Findings derived from previously published systematic reviews and meta-analyses | Consistent adverse effects observed |
| **Topical Corticosteroids vs Control** | | | | |
| Wound Healing | ? | Insufficient data (not pooled analysis) | Limited topical corticosteroid studies | Limited evidence, Fang et al. 2022 |
| Adverse Effects | ↑ | Insufficient data (not pooled analysis) | Not specified (pooled data) | Potential skin thinning and infection risk |

Effect estimates are outcome-specific and include both pooled and descriptive findings

The findings summarized in Table 8 suggest that systemic corticosteroids may reduce mortality and length of hospital stay in selected sepsis patients but are also associated with adverse effects such as hyperglycemia and adverse effects. Evidence regarding topical corticosteroid use in burn patients remains limited. These findings are primarily derived from sepsis studies and should be interpreted cautiously when these findings are applied to burn populations.

***Findings of combined or sequential therapy:***

Evidence regarding combined or sequential antibiotic and corticosteroid therapy in burn patients remains limited, particularly from high-quality randomized studies evaluating integrated anti-infective and anti-inflammatory approaches. Current evidence is derived mainly from small observational studies with heterogeneous protocols and outcomes. This is clinically important because infection and inflammation are closely interrelated in burn disease. Limited evidence restricts firm clinical recommendations, and further burn-specific studies are needed to determine the optimal timing, safety, and efficacy of combined therapy (8).

## DISCUSSION

This systematic review summarizes existing evidence on antibiotic and corticosteroid therapy in burn patients, supporting the limited application of these treatments. Antibiotic prophylaxis was not associated with reduced mortality (RR 0.89; 95% CI 0.78–1.02), corroborating the findings of earlier reports (1,3) and may benefit selected high-risk populations (5); concerns about antibiotic and antimicrobial resistance also restrict its use (9). Topical silver sulfadiazine is inferior to newer dressings (2), and recent burn care approaches emphasize protocol-driven, personalized care. Indirect evidence derived primarily from sepsis populations suggests a potential benefit with systemic corticosteroids in selected septic states (6,7) but has side effects (such as hyperglycemia and neuromuscular issues) (6), with little evidence for topical application (8). Additionally, high-quality studies of the impact of combined or sequential antibiotic and corticosteroid use in burn patients are needed (8).

### *Clinical Implications*

Clinically, the following results highlight a more selective and personalized method of treatment:

- Routine systemic antibiotic prophylaxis should be avoided in most burn patients (1,3)
- Antibiotic use should be guided by clinical evidence of infection and stewardship principles (1,3,4)
- Silver sulfadiazine should not be considered a first-line therapy in modern burn care (2)
- Systemic corticosteroids may be considered cautiously in selected septic patients, although burn-specific evidence remains limited (6,7)
- Topical corticosteroids cannot currently be recommended because of insufficient evidence (8)

### *Strengths and Limitations*

This review synthesizes the evidence for key outcomes (1,3). Moderate to high heterogeneity is related to burn size, patients and interventions, and the use of sepsis data for corticosteroids, which restricts generalisability (1,3,6,7). Data on topical and combination interventions are of poor quality and represent an important gap in research (8). The limited primary studies limit generalisability and do not allow sensitivity analysis or rigorous testing for publication bias. Several included studies involved sepsis populations and indirect evidence rather than exclusively burn-specific populations, limiting generalizability. Several descriptive pooled estimates were derived from indirect evidence and previously published meta-analyses rather than exclusively from primary burn-specific randomized trials.

## CONCLUSION

There is a need for judicious risk–benefit analysis when antibiotics and corticosteroids are considered for burn injury. Systemic antibiotic prophylaxis is not currently recommended (1,3) and requires strict antibiotic stewardship to reduce resistance (1,3,4), but older products such as silver sulfadiazine may be less effective than newer dressings are (2). Indirect evidence derived mainly from sepsis patients suggests a potential benefit with systemic corticosteroids in selected septic patients, although burn-specific evidence remains limited and evidence for topical use remains weak (6,8). Overall, significant evidence gaps persist, particularly regarding burn-specific randomized trials and combination therapies, highlighting the need for high-quality studies to optimize infection and inflammation management (8).

## ETHICAL STATEMENT

Ethical approval was not needed because previously published data were analysed

## CONFLICT OF INTEREST

No competing interests.

## FUNDING

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