

Role of Steroids in Septic and Cardiogenic Shock: A Comparative Prospective Observational Study in a Tertiary Care Centre

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Abstract:

Background: Shock remains a major cause of morbidity and mortality in critically ill patients. Septic shock and cardiogenic shock are the most common forms encountered in intensive care units. Corticosteroids have been increasingly used as adjunctive therapy in shock management because of their anti-inflammatory, vasopressor-sensitizing, and hemodynamic stabilizing effects. However, their clinical benefits may differ between septic and cardiogenic shock.

Aim: To evaluate and compare the effects of corticosteroid therapy on clinical outcomes in patients with septic shock and cardiogenic shock.

Methods: A prospective observational study was conducted at a tertiary care center from January 2023 to December 2023. A total of 120 patients diagnosed with shock were enrolled, including 70 patients with septic shock and 50 patients with cardiogenic shock. Clinical characteristics, vasopressor requirements, duration of ICU stay, shock reversal time, mortality, and adverse effects were recorded and analyzed.

Results: Shock reversal occurred significantly earlier in septic shock patients receiving steroids compared with cardiogenic shock patients (58.4 ± 18.2 vs 81.7 ± 24.5 hours; $p < 0.001$). Vasopressor requirements decreased significantly in septic shock patients. ICU stay was shorter among steroid-responsive septic shock patients ($p = 0.002$). Mortality was lower in septic shock patients receiving steroids (25.7%) compared with cardiogenic shock patients (38.0%), although the difference was not statistically significant ($p = 0.11$).

Conclusion: Steroid therapy appears to be more beneficial in septic shock than cardiogenic shock, particularly in accelerating shock reversal and reducing vasopressor dependence. Further randomized studies are required to establish definitive recommendations.

Keywords: Septic Shock, Cardiogenic Shock, Corticosteroids, Hydrocortisone, Vasopressors, Critical Care.

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Introduction

Inadequate tissue perfusion causes cellular hypoxia, metabolic dysfunction, and multiorgan failure in shock, a potentially fatal clinical condition. Shock continues to be a leading cause of death globally, despite advancements in critical care medicine. Among the different types of shock, cardiogenic and septic shock are linked to poor clinical outcomes and account for a sizable percentage of intensive care unit admissions. A dysregulated host response to infection causes severe vasodilation, endothelial dysfunction, capillary leakage, and circulatory collapse, all of which contribute to septic shock. On the other hand, despite sufficient intravascular volume, cardiogenic shock is characterised by insufficient cardiac output as a result of significant myocardial dysfunction,

leading to tissue hypoperfusion. Although hypotension and organ dysfunction are evident in both disorders, their underlying pathophysiological pathways are very different [1].

In critically ill patients experiencing shock, corticosteroids have become a crucial supplementary treatment. The idea of critical illness-related corticosteroid insufficiency, in which endogenous cortisol production falls short of physiological needs, serves as the basis for the justification for steroid therapy in septic shock. Corticosteroids improve endothelial function, reduce excessive inflammatory reactions, increase vascular responsiveness to catecholamines, and speed up the reversal of shock. Low-dose

hydrocortisone may lessen the need for vasopressors and speed up shock reversal in septic shock, according to several randomised trials. The effect on mortality is still debatable, though. According to current international standards, patients with septic shock who are still hypotensive after receiving sufficient fluid resuscitation and vasopressor support should get corticosteroid therapy [2].

Less is known about corticosteroids' involvement in cardiogenic shock. Since inflammatory activation has been identified as a significant factor in cardiogenic shock, corticosteroids may offer therapeutic advantages. However, there are still worries about possible negative consequences such as immunosuppression, arrhythmias, hyperglycemia, and delayed cardiac repair. There are few studies that compare the steroid response of cardiogenic and septic shock, especially in tertiary care settings in India. Clinicians may be able to optimise treatment plans and improve results by having a better understanding of the varied effects of corticosteroids in these diseases [3].

In order to examine the effects of corticosteroids on hemodynamic recovery, vasopressor needs, ICU stay, and mortality, the current study was conducted to assess their involvement in septic and cardiogenic shock.

Materials and Methods

Study Design: Prospective observational study.

Study Setting: Division of Critical Care Medicine, Department of Anaesthesiology, Tertiary Care Hospital.

Study Duration: January 2023 to December 2023.

Sample Size: 120 patients.

Study Population

- **Septic Shock:** 70 patients
- **Cardiogenic Shock:** 50 patients

Inclusion Criteria

- Age ≥ 18 years.
- Diagnosis of septic shock according to Sepsis-3 criteria.

- Diagnosis of cardiogenic shock based on clinical, echocardiographic, and hemodynamic parameters.
- Patients receiving corticosteroid therapy.

Exclusion Criteria

- Chronic steroid therapy.
- Adrenal insufficiency.
- Pregnancy.
- Malignancy.
- End-stage liver disease.

Data Collection

- Demographic profile.
- Etiology of shock.
- APACHE II score.
- Vasopressor requirement.
- Shock reversal time.
- ICU stay.
- Hospital mortality.
- Adverse events.

Corticosteroid Therapy Protocol: All patients included in the study received corticosteroid therapy. In accordance with the Surviving Sepsis Campaign Guidelines 2021, patients in the septic shock group received intravenous hydrocortisone 50 mg every 6 hours (200 mg/day) in addition to standard shock management. For the purpose of comparison, patients in the cardiogenic shock group also received intravenous hydrocortisone 50 mg every 6 hours during the study period. Corticosteroid therapy was continued according to the treating physician's clinical judgment and institutional protocol.

Statistical Analysis

Data were analyzed using SPSS version 26.

- Student's t-test.
- Chi-square test.
- Logistic regression.
- $p < 0.05$ considered significant.

Results

Baseline demographic and severity characteristics were comparable between the two groups.

Table 1: Baseline Characteristics

Variable	Septic Shock (n=70)	Cardiogenic Shock (n=50)	p-value
Age (years)	58.4 $\pm$ 13.7	61.2 $\pm$ 12.4	0.24
Male (%)	62.9	66.0	0.72
APACHE II Score	23.4 $\pm$ 4.8	24.1 $\pm$ 5.1	0.46
Mean Arterial Pressure (mmHg)	58.7 $\pm$ 6.3	60.1 $\pm$ 7.1	0.29

Patients with septic shock experienced significantly faster hemodynamic recovery and reduced vasopressor dependence following steroid therapy.

Table 2: Hemodynamic Outcomes

Outcome	Septic Shock	Cardiogenic Shock	p-value
Shock Reversal Time (hours)	58.4 ± 18.2	81.7 ± 24.5	<0.001
Vasopressor Duration (hours)	72.5 ± 20.8	96.3 ± 28.7	<0.001
MAP Improvement (%)	28.4 ± 8.1	17.5 ± 6.3	<0.001

ICU stay was significantly shorter among septic shock patients. Mortality was lower in septic shock but did not achieve statistical significance.

Table 3: Clinical Outcomes

Outcome	Septic Shock	Cardiogenic Shock	p-value
ICU Stay (days)	8.4 ± 3.1	11.2 ± 4.6	0.002
Mechanical Ventilation (%)	48.6	58.0	0.31
Mortality (%)	25.7	38.0	0.11

Steroid-related adverse events were observed more frequently in the cardiogenic shock group than in the septic shock group. Hyperglycemia was the most common complication and occurred significantly more often among cardiogenic shock patients (32.0% vs. 20.0%; $p=0.04$). New-onset arrhythmias were also significantly more frequent in the cardiogenic shock group (16.0% vs. 4.3%;

$p=0.03$). Secondary infections and electrolyte disturbances were numerically higher among cardiogenic shock patients, although these differences did not reach statistical significance. Overall, corticosteroid therapy demonstrated an acceptable safety profile in both groups, but adverse effects were more common in patients with cardiogenic shock.

Table 4: Steroid-Related Adverse Effects

Adverse Effect	Septic Shock (%)	Cardiogenic Shock (%)	p-value
Hyperglycemia	20.0	32.0	0.04
Secondary Infection	8.6	14.0	0.32
Electrolyte Disturbance	10.0	20.0	0.08
New-Onset Arrhythmia	4.3	16.0	0.03
Delirium/Agitation	5.7	12.0	0.21

Discussion

The current prospective observational study investigated the effects of corticosteroid therapy on hemodynamic recovery and patient outcomes in patients with septic and cardiogenic shock. According to the results, corticosteroids are more clinically beneficial in septic shock than in cardiogenic shock. The groups' baseline demographics, disease severity, and hemodynamic parameters were similar, making it possible to compare results in a meaningful way [4]. The most notable discovery was that patients with septic shock had a noticeably shorter shock reversal time. By increasing adrenergic receptors and lowering inflammatory mediator activity, corticosteroids are known to enhance vascular reactivity to both endogenous and exogenous catecholamines. The earlier restoration of hemodynamic stability seen in septic shock patients is probably due to these mechanisms [5].

Patients in septic shock received vasopressor treatment for a much shorter period of time. This result is in line with other research showing that hydrocortisone helps patients with refractory septic shock stop receiving vasopressor therapy earlier. Because prolonged vasopressor medication is

linked to peripheral ischemia, arrhythmias, and higher healthcare expenditures, reducing vasopressor exposure is therapeutically significant. Patients in septic shock also showed a considerably higher improvement in mean arterial pressure. Corticosteroids have a greater hemodynamic effect in septic shock than in cardiogenic shock, where pump failure is still the main pathogenic mechanism. This could be explained by the significant vasodilatory component of septic shock [6].

Additionally, the study showed that patients with septic shock had far shorter ICU stays. Reduced organ dysfunction, quicker recovery, and fewer critical care needs could all result from earlier hemodynamic stabilisation. The septic shock group had a decreased fatality rate, although this difference was not statistically significant. This conclusion is consistent with a number of big clinical trials that have shown improved shock reversal without a discernible mortality advantage [7]. It's yet unclear how corticosteroids affect cardiogenic shock. Cardiogenic shock is characterised by inflammatory activation, although myocardial dysfunction, not systemic vasodilation, is the main abnormality. As a result, corticosteroids may have less noticeable physiological effects.

This theory is supported by the extended vasopressor duration and delayed shock reversal seen in patients with cardiogenic shock[8].

Steroid-related adverse effects were observed more frequently in the cardiogenic shock group than in the septic shock group. Hyperglycemia was the most common complication and occurred significantly more often among cardiogenic shock patients. In addition, arrhythmias and electrolyte disturbances were more frequently observed in cardiogenic shock. This finding may be explained by the underlying myocardial dysfunction and electrical instability present in cardiogenic shock, which may increase susceptibility to corticosteroid-induced metabolic and cardiovascular adverse effects. Although these complications were generally manageable and did not necessitate discontinuation of therapy, they highlight the need for careful monitoring when corticosteroids are administered in patients with cardiogenic shock. In contrast, the benefits of corticosteroid therapy appeared to outweigh the risks in septic shock, where significant improvements in hemodynamic recovery were achieved with relatively fewer adverse events [9].

Notwithstanding these drawbacks, the study offers significant clinical evidence that corticosteroid therapy is superior than cardiogenic shock in septic shock, especially in terms of hemodynamic recovery and decreased vasopressor reliance. To determine the ideal use of corticosteroids in various shock states, more multicenter randomised studies are needed.

Conclusion

The current study shows that corticosteroid therapy significantly improves mean arterial pressure, shortens ICU stays, speeds up shock reversal, and lowers the need for vasopressors in patients with septic shock. Compared to patients experiencing cardiogenic shock, these effects were far more pronounced. Steroid-treated septic shock patients had a numerically decreased fatality rate, but this difference was not statistically significant. The results imply that rather than directly lowering mortality, corticosteroids' positive benefits are mostly associated with better hemodynamic stabilisation. Because myocardial pump failure is still the primary pathogenic mechanism in cardiogenic shock, the response to corticosteroid therapy was less noticeable.

When proper monitoring is used, the majority of steroid-related side effects were modest and controllable, suggesting an acceptable safety profile. The most frequent consequence was hyperglycemia. Overall, the study is in favour of

using corticosteroids as an additional treatment for certain septic shock patients who are still hemodynamically unstable after receiving conventional care. More research is needed on their regular use in cardiogenic shock. To determine patient populations most likely to benefit from corticosteroid medication and to create definite treatment recommendations, larger multicenter randomised controlled trials are required. Steroid-related complications, particularly hyperglycemia and arrhythmias, were more frequently observed in the cardiogenic shock group, emphasizing the importance of close monitoring when corticosteroids are used in this population."

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