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Original Research Article

Clinical Effect of Norepinephrine Combined with Esmolol Treatment in Patients with Septic Shock and Its Impact on Prognosis: A Retrospective Study

Sameechi M.[1], Manjunath Irappa Pattanshetti[2], Chirag M. Gowda[3]

[1]Junior Resident, Department of General Medicine, RajaRajeswari Medical College and Hospital, Bengaluru, India

[2]Junior Resident, Department of General Medicine, Rajarajeswari Medical College and Hospital, Bengaluru, India

[3]Junior Resident, Department of General Medicine, Rajarajeswari medical college and hospital, Bengaluru, India

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Corresponding Author: Sameechi M.

Conflict of interest: Nil

Abstract:

Background: Septic shock is linked to elevated mortality and is defined by significant circulatory and metabolic dysfunctions. Norepinephrine is the primary vasopressor; however, sustained tachycardia may exacerbate results. Esmolol, a short-acting β1-adrenergic antagonist, has been suggested to enhance hemodynamic and prognosis.

Objective: To assess the therapeutic efficacy of norepinephrine in conjunction with esmolol in patients experiencing septic shock and its influence on in-hospital outcomes.

Methods: This retrospective analysis encompassed 100 individuals diagnosed with septic shock over a two-year period. Patients were categorized into two groups: Group A (n=50) was administered norepinephrine only, while Group B (n=50) got a combination of norepinephrine and esmolol. Hemodynamic parameters, lactate clearance, vasopressor requirements, duration of ICU stay, and in-hospital mortality were analysed for comparison.

Results: The combination group showed significantly improved mean arterial pressure (MAP) at 24 hours (75 ± 8 mmHg vs 62 ± 10 mmHg, $p<0.01$), greater lactate clearance at 48 hours (52% vs 35%, $p<0.001$), and lower in-hospital mortality (22% vs 38%, $p=0.04$). Multivariate analysis demonstrated that combination therapy was independently associated with reduced mortality (Adjusted OR 0.42; 95% CI 0.18–0.95).

Conclusion: To evaluate the therapeutic effectiveness of norepinephrine combined with esmolol in patients suffering from septic shock and its impact on in-hospital outcomes.

Keywords: Septic shock, Norepinephrine, Esmolol, Mortality, Hemodynamic.

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Introduction

Septic shock continues to be a primary cause of death in critically ill patients. It is characterized by sustained hypotension necessitating vasopressor use and high serum lactate levels despite sufficient fluid resuscitation [1]. Norepinephrine is the preferred vasopressor owing to its strong α-adrenergic properties. Septic shock often presents with prolonged tachycardia, elevating myocardial oxygen demand and perhaps exacerbating cardiac dysfunction [2].

Recent research indicates that β1-selective antagonists like esmolol may boost ventricular-arterial coupling, decrease heart rate, and improve cardiac efficiency without jeopardizing perfusion [3]. Nonetheless, statistics from Indian tertiary care institutions are few. This study assesses the clinical effects of the combination of esmolol and norepinephrine in patients with septic shock [4].

Materials and Methods

Study Design: Retrospective observational study.

Study Setting: Rajarajeswari medical college and hospital, Bengaluru.

Study Duration: 1 years.

Sample Size: 100 patients with septic shock:

- **Group A:** Norepinephrine alone (n=50).
- **Group B:** Norepinephrine + Esmolol (n=50).

Inclusion Criteria

- Age ≥18 years.
- Diagnosis of septic shock (Sepsis-3 criteria).

- Required norepinephrine support.

Exclusion Criteria

- Pre-existing severe cardiac dysfunction.
- Bradyarrhythmias.
- Advanced chronic kidney disease.
- Pregnancy.

Data Collected

- Demographics.
- Heart rate (HR).
- Mean arterial pressure (MAP).
- Serum lactate levels
- Vasopressor dose
- Length of ICU stay
- In-hospital mortality

Statistical Analysis: Continuous variables were presented as mean ± SD and analyzed using an independent t-test. Categorical variables were represented as frequency and percentage and examined with the chi-square test. Multivariate logistic regression was employed to identify independent determinants of mortality. A p-value of less than 0.05 was deemed statistically significant.

Results

Table 1: Baseline Characteristics

Variable	Group A (NE)	Group B (NE+Esmolol)	p-value
Mean age (years)	58 ± 12	52± 11	0.45
Male (%)	60%	62%	0.82
Baseline HR (bpm)	112 ± 15	128 ± 17	0.05
Baseline MAP (mmHg)	48± 8	61 ± 7	0.01

Table 2: Hemodynamic and Clinical Outcomes

Parameter	NE Alone	NE + Esmolol	p-value
MAP at 24 hrs (mmHg)	62 ± 10	75 ± 8	<0.01*
HR at 24 hrs (bpm)	114 ± 12	88 ± 10	<0.001*
Lactate clearance (%)	35%	52%	<0.001*
ICU stay (days)	9.3 ± 3.2	7.6 ± 2.8	0.02*
In-hospital mortality	38%	22%	0.04*

*Significant

Discussion

This retrospective investigation indicates that incorporating esmolol into norepinephrine treatment for patients with septic shock markedly enhances hemodynamic parameters and decreases in-hospital mortality. The combination therapy resulted in improved heart rate regulation and elevated mean arterial pressure without jeopardizing systemic perfusion [5]. The higher lactate clearance in the combo group indicates superior tissue oxygenation and improved microcirculatory function. The documented decrease in mortality (38% vs 22%) is clinically significant and aligns with prior randomized trials indicating the cardioprotective advantages of β1-blockade in septic shock. The possible mechanisms contributing to these advantages may encompass less cardiac oxygen demand, increased diastolic filling duration, improved ventricular–arterial coupling, and reduction of the inflammatory response [6].

Limitations

- Retrospective design
- Single-centre study
- Moderate sample size
- No long-term follow-up
- Randomized trials are essential to corroborate these findings.

Conclusion

The incorporation of esmolol with norepinephrine in patients experiencing septic shock markedly improved hemodynamic stability, improves lactate clearance, decreases ICU duration, and reduces in hospital mortality.

Combination therapy may serve as an advantageous approach for certain septic shock patients with prolonged tachycardia. Timely heart rate management in conjunction with vasopressor therapy may enhance outcomes in septic shock.

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