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RESEARCH ARTICLE

Utilization Patterns and Outcome Impact of Inotrope–vasopressin Combinations Across Different Shock Phenotypes (Septic, Cardiogenic, Hypovolemic) in a Resource-limited Tertiary Care Setting: A Six-month Prospective Observational Analysis

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ABSTRACT

Background: Shock represents a life-threatening state of circulatory failure characterized by inadequate tissue perfusion and impaired oxygen delivery. Vasoactive agents including inotropes and vasopressors remain central to hemodynamic stabilization. Although norepinephrine is widely recommended as first-line therapy, vasopressin is frequently added in refractory hypotension. Evidence regarding real-world utilization patterns and outcome impact across different shock phenotypes in resource-limited tertiary care settings remains limited.

Objective: To evaluate prescribing patterns and clinical outcomes associated with inotropes and vasopressin therapy in septic, cardiogenic, and hypovolemic shock patients admitted to an intensive care unit.

Methods: A prospective observational study was conducted over six months in the medicine intensive care unit of a tertiary care teaching hospital. All adult patients diagnosed with shock and receiving vasopressor/inotrope therapy were included. Demographic characteristics, type of shock, vasoactive drug utilization, combination therapy, and clinical outcomes (mortality and survival) were recorded and analyzed descriptively.

Results: A total of 106 patients were included. Septic shock was the most common phenotype (65%), followed by cardiogenic (22%) and hypovolemic shock (13%).Norepinephrine monotherapy was the most frequently used agent (n=64), followed by vasopressin alone (n=26) and norepinephrine-vasopressin combination therapy (n=16).

Conclusion: Norepinephrine remains the most effective first-line vasopressor across shock phenotypes. Vasopressin appears beneficial as an adjunct in refractory septic shock but not as monotherapy in cardiogenic shock. Early escalation to combination therapy may improve outcomes in selected critically ill patients. Further multicenter randomized trials are required.

Keywords: Shock; Vasopressors; Inotropes; Vasopressin; Norepinephrine; Septic shock; Cardiogenic shock; Critical care; Hemodynamic stabilization

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Introduction

Shock is a life-threatening clinical syndrome characterized by circulatory failure resulting in inadequate cellular oxygen utilization and impaired tissue perfusion.[1] Without prompt recognition and intervention, shock progresses to multiorgan dysfunction and death. Despite advances in intensive care medicine, shock remains one of the leading causes of mortality among critically ill patients worldwide. [2-4]Shock may be broadly categorized into four major types: hypovolemic, cardiogenic, distributive, and obstructive shock. Among these, septic shock (a form of distributive shock) and cardiogenic shock constitute the majority of intensive care unit admissions. Hypovolemic shock also contributes significantly in trauma and acute blood loss settings. Each shock phenotype differs in pathophysiology, hemodynamic profile, and therapeutic approach.[3]The cornerstone of shock management

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involves rapid restoration of perfusion through fluid resuscitation and vasoactive pharmacotherapy. Vasopressors increase systemic vascular resistance and arterial pressure, whereas inotropes improve cardiac output by enhancing myocardial contractility. Appropriate selection and timely administration of these agents are essential to prevent organ dysfunction.Norepinephrine is currently recommended as the first-line vasopressor for septic and most undifferentiated shock states due to its strong α-adrenergic vasoconstrictive effect and relatively favorable safety profile. Dopamine, epinephrine, and phenylephrine have specific indications but are associated with higher risk of arrhythmias or adverse outcomes in certain patient populations. [2,4,6].Vasopressin is an endogenous antidiuretic hormone that acts on V1 receptors to produce potent vasoconstriction independent of adrenergic receptors.[5] During prolonged septic shock, relative vasopressin deficiency occurs, contributing to refractory hypotension. Consequently, vasopressin is commonly used as an adjunct vasopressor when catecholamines alone fail to achieve adequate mean arterial pressure.[7-9].Although numerous randomized controlled trials have evaluated vasopressor therapy, most originate from high-resource settings. Data describing real-world prescribing patterns and clinical outcomes in resource-limited tertiary hospitals remain sparse. Moreover, the comparative effect of combination therapy across different shock phenotypes is insufficiently explored.[10-13].Understanding local prescribing practices and their outcomes is essential for optimizing rational drug utilization, minimizing complications, and improving survival in critically ill patients. Observational studies from routine clinical practice can provide valuable insight into therapeutic effectiveness beyond controlled trial environments.[14-16] Therefore, this prospective observational study was undertaken to evaluate the utilization pattern and outcome impact of inotrope–vasopressin therapy in patients presenting with septic, cardiogenic, and hypovolemic shock in a tertiary care hospital[17]

Materials and Methods

Study Design and Setting

A prospective, observational study was conducted over a period of six months in the Medicine Intensive Care Unit (MICU) of a tertiary care teaching hospital. The institution serves as a referral center for surrounding rural and semi-urban populations and represents a resource-limited critical care setting with restricted advanced hemodynamic monitoring facilities.The study was designed to evaluate real-world prescribing practices and clinical outcomes associated with vasopressor and inotrope therapy among patients presenting with different shock phenotypes.The study protocol was reviewed and approved by the Institutional Ethics Committee. Patient confidentiality was maintained throughout the study. As this was an observational study without intervention, treatment decisions were made entirely by the treating physicians according to standard hospital protocols and international critical care guidelines.[2]

Study Population

Inclusion Criteria

Patients were included if they fulfilled all of the following:

- Age ≥ 18 years
- Admission to ICU with clinical diagnosis of shock.
- Requirement of vasopressor and/or inotrope therapy.
- Presence of persistent hypotension after initial fluid resuscitation.

Exclusion Criteria

Patients were excluded if they had:

- Age < 18 years
- Pregnancy
- Obstructive shock (pulmonary embolism, cardiac tamponade, tension pneumothorax)
- ICU stay < 6 hours
- Incomplete medical records
- Patients discharged against medical advice before outcome assessment

Data Collection

Data were collected prospectively from patient medical records, ICU monitoring charts, and physician prescriptions using a structured case record form.

Baseline Variables

- Age
- Gender
- Comorbidities
- Type of shock
- Source of infection (if septic)
- Vital parameters at admission

Treatment Variables

- Type of vasopressor used
- Type of inotrope used
- Combination therapy

- Duration of therapy
- Escalation or de-escalation patterns

The vasoactive agents evaluated included:

- Norepinephrine
- Vasopressin
- Norepinephrine + Vasopressin combination
- Survival at ICU discharge

Secondary Outcomes

- Mortality rate
- Drug utilization pattern
- Comparative survival across shock phenotypes
- Effectiveness of monotherapy vs combination therapy

Sample Size

All eligible patients admitted during the study period were included. A total of 106 patients fulfilled inclusion criteria and were analyzed.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using descriptive statistical methods.

- Continuous variables were expressed as mean ± standard deviation
- Categorical variables were expressed as frequency and percentage
- Outcomes were compared across treatment groups descriptively

Due to observational design and limited sample size, inferential statistical testing was not applied; instead, clinical trends and outcome associations were interpreted [18-22].

Results

Study Population

During the six-month study period, a total of 106 patients admitted to the intensive care unit with clinical shock and requiring vasoactive therapy met the inclusion criteria and were analyzed.

Age Distribution

The majority of patients belonged to the middle-aged and elderly population. The highest frequency of shock was observed in patients aged between 51–70 years, indicating increased vulnerability of older adults to circulatory failure.

Gender Distribution

Among the enrolled patients:

- **Male:** 64 patients (60.4%)
- **Female:** 42 patients (39.6%)

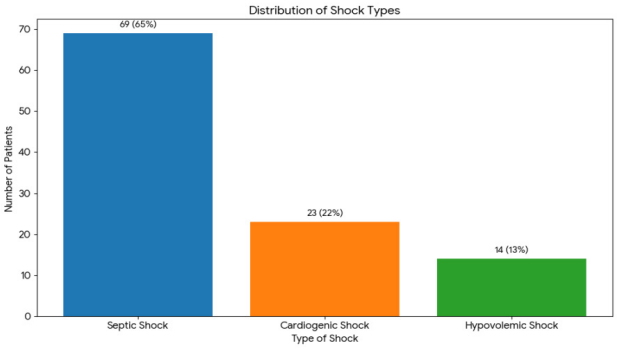

Fig. 1: Distribution of Shock Types

Table 1: Septic shock was the most common cause of ICU admission requiring vasopressor therapy

Type of shock	*Number of patients*	*Percentage*
Septic Shock	69	65%
Cardiogenic Shock	23	22%
Hypovolemic Shock	14	13%
Total	106	100%

A male predominance was observed across all shock categories.

Distribution of Shock Phenotypes

Of the 106 patients studied:

Vasopressor and Inotrope Utilization Pattern

Three therapeutic strategies were observed:

Clinical Outcomes Comparison Across Shock Phenotypes

The multi-panel bar chart visualizes the number of survivors and deaths for each treatment group (Norepinephrine, Vasopressin, and Combination therapy) categorized by shock type. Survival percentages are highlighted for each therapy.

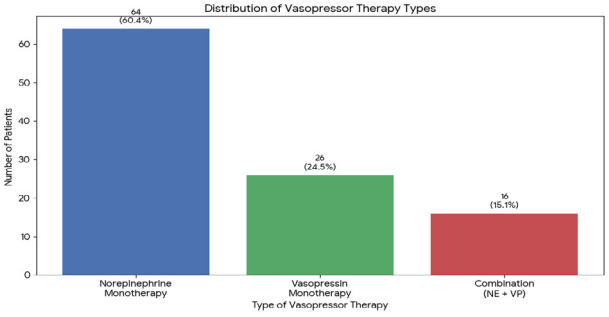

Fig. 2: Distribution of Vasopressor Therapy Types

Table 2: Norepinephrine was the most frequently prescribed first-line vasopressor

Therapy type	*Number of patients*	*Percentage (of 106)*
Norepinephrine Monotherapy	64	60.4%
Vasopressin Monotherapy	26	24.5%
Combination (NE + VP)	16	15.1%

Comparative Interpretation

- Norepinephrine remained the most effective first-line vasopressor across all shock phenotypes.
- Combination therapy demonstrated maximum benefit in septic shock.
- Vasopressin monotherapy showed poor outcomes in cardiogenic shock.
- Hypovolemic shock patients had the highest survival overall.
- Mortality was highest in cardiogenic shock receiving vasopressin alone.

Discussion

Shock remains a leading cause of mortality in critically ill patients, particularly in low- and middle-income countries where delayed presentation, limited monitoring infrastructure, and restricted access to advanced supportive modalities influence clinical outcomes.[23-24] The present prospective observational study evaluated the utilization patterns and outcome impact of inotrope–vasopressin therapy across septic, cardiogenic, and hypovolemic shock phenotypes in a resource-limited tertiary care setting.A total of 106 patients were analyzed, with septic shock accounting for the majority of cases (65%), followed by cardiogenic (22%) and hypovolemic shock (13%). This distribution aligns with global ICU epidemiology where septic shock represents the most common cause of circulatory failure. The predominance of septic shock in this study likely reflects delayed healthcare access, high infection burden, and late referrals frequently observed in developing healthcare systems.[25-27]

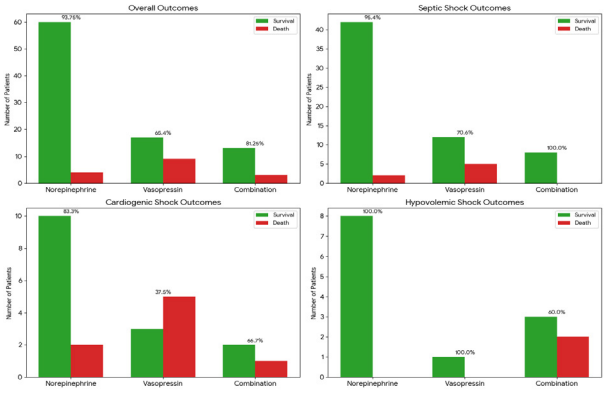

Fig 3: Clinical Outcomes Comparison Across Shock Phenotypes

Implications for Resource-Limited Settings

In many developing regions, invasive hemodynamic monitoring, lactate clearance tracking, and advanced circulatory support devices are unavailable. Clinicians therefore rely heavily on clinical judgment and basic monitoring parameters.

This study provides practical evidence that:

- Norepinephrine should remain the universal first-line vasopressor
- Vasopressin should be reserved for adjunct use in septic shock
- Vasopressin monotherapy should be avoided in cardiogenic shock
- Early combination therapy may improve survival in refractory distributive shock

These conclusions are particularly valuable in settings where protocol-driven care is difficult to implement due to resource constraints.

Strengths of the Study

- Prospective real-world ICU data
- Inclusion of multiple shock phenotypes
- Evaluation of combination therapy patterns
- Applicability to low-resource healthcare systems
- Clinically relevant outcome measure (survival)

Table 3: Various therapies and survival rate

Therapy	*Overall survival*	*Septic survival*	*Cardiogenic survival*	*Hypovolemic survival*
Norepinephrine	93.75%	95.4%	83.3%	100%
Vasopressin	65.4%	70.6%	37.5%	100%
Combination	81.25%	100%	66.7%	60%

Limitations

Several limitations should be acknowledged:

- Single-center study
- Small sample size in subgroup analyses
- No randomization
- Lack of severity scoring (SOFA/APACHE II)
- No lactate clearance analysis
- Absence of dose-response evaluation

Therefore, causal relationships cannot be established, and findings should be interpreted as observational associations.

Future Directions

Future research should focus on:

- Multicenter randomized controlled trials
- Early vs delayed vasopressin initiation
- Dose-dependent outcome analysis
- Hemodynamic phenotype-guided therapy
- Cost-effectiveness in low-resource ICUs

Such studies would help develop context-specific guidelines applicable to developing healthcare systems[28-30].

Conclusion

This prospective observational study evaluated the utilization pattern and clinical outcome impact of norepinephrine, vasopressin, and combination therapy across septic, cardiogenic, and hypovolemic shock in a resource-limited tertiary care intensive care unit. Norepinephrine emerged as the most effective first-line vasopressor across all shock phenotypes, demonstrating the highest survival rate. Vasopressin monotherapy showed inferior outcomes, particularly in cardiogenic shock where increased vascular resistance without augmentation of cardiac output likely contributed to higher mortality. However, vasopressin proved beneficial when used as an adjunct to norepinephrine in septic shock, where combination therapy achieved the best survival outcomes.

These findings suggest that vasopressor therapy should be tailored according to shock phenotype rather than applied uniformly. In distributive shock, early addition of vasopressin to norepinephrine may improve hemodynamic stability and survival. Conversely, vasopressin should be avoided as primary therapy in cardiogenic shock.

In resource-limited ICUs lacking advanced monitoring, a practical treatment strategy can be proposed:

- Norepinephrine as universal first-line agent
- Early adjunct vasopressin in refractory septic shock
- Avoid vasopressin monotherapy in cardiogenic shock
- Prompt fluid resuscitation with minimal vasopressor exposure in hypovolemic shock

Although limited by observational design and single-center data, this study provides real-world evidence applicable to developing healthcare systems. Larger multicenter randomized trials are required to confirm phenotype-guided vasopressor therapy protocols and improve global critical care outcomes.

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