



Clinical Characteristics and Outcomes of Patients Requiring Vasopressor Support in the critical care settings

Muhammad Saleem Awan¹, Munawar Ali Awan², Masab Hanif³, Wajahat Sami Malik⁴,
Muhammad Iqbal Qasim⁵, Nadeem Gohar⁶

¹Assistant Professor, Department of Cardiology, Ayub Medical College, Abbottabad, Pakistan.
Email: saleemawan2007@gmail.com

²Assistant Professor, Intensive Care Unit (ICU), Ayub Medical College, Abbottabad, Pakistan.
Email: drmunaweraliawan@gmail.com

³ Resident, Department of Pulmonology, Ayub Teaching Hospital, Abbottabad, Pakistan.

⁴ Resident, Department of Pulmonology, Ayub Medical College, Abbottabad, Pakistan.

⁵ District Medical Specialist, King Abdullah Teaching Hospital, Mansehra, and Associate
Professor of Medicine, Frontier Medical College, Abbottabad, Pakistan.

⁶ Principal Medical Officer, Ayub Teaching Hospital, Abbottabad, Pakistan.

***Corresponding Author:** Munawar Ali Awan

Assistant Professor, Intensive Care Unit (ICU), Ayub Medical College, Abbottabad, Pakistan.
Email: drmunaweraliawan@gmail.com

ABSTRACT

Background: Vasopressor therapy is an essential component of the management of critically ill patients with circulatory shock in the intensive care unit (ICU). The requirement for vasopressor support is generally associated with severe illness, multiple organ dysfunction, prolonged ICU stay, and increased mortality. Limited data are available regarding the clinical characteristics and outcomes of patients receiving vasopressors in resource-limited healthcare settings.

Objective: To evaluate the clinical characteristics, indications, complications, and outcomes of patients requiring vasopressor support in the ICU of District Headquarter (DHQ) Hospital Mansehra.

Methodology: A hospital-based prospective observational study was conducted in the ICU of DHQ Hospital Mansehra, Pakistan, over a six-month period from 15 February 2023 to 30 August 2023. A total of 250 consecutive adult patients requiring vasopressor therapy were enrolled. Demographic characteristics, clinical variables, vasopressor utilization, complications, and patient outcomes were prospectively recorded using a standardized data collection form. Data were analyzed using IBM SPSS Statistics version 25.0. Continuous and categorical variables were analyzed using appropriate statistical tests, and multivariable logistic regression was performed to identify independent predictors of ICU mortality. A p-value <0.05 was considered statistically significant.

Results: The mean age of the patients was 56.8 ± 17.2 years, and 59.2% were male. Septic shock was the most common indication for vasopressor therapy (43.2%), followed by cardiogenic shock (20.8%) and hypovolemic shock (15.2%). Norepinephrine was the most frequently administered vasopressor (79.2%). Mechanical ventilation was required in 68.8% of patients, while 16.4% underwent renal replacement therapy. Vasopressor-related complications occurred in 39.2% of patients, with acute kidney injury (23.2%) being the most common complication. The overall ICU

mortality was 35.6%. Non-survivors had significantly higher SOFA and APACHE II scores, longer duration of vasopressor therapy, greater need for mechanical ventilation, and a higher incidence of acute kidney injury compared with survivors ($p < 0.001$).

Conclusion: Patients requiring vasopressor support in the ICU experience considerable morbidity and mortality, with septic shock being the leading indication for therapy. Higher illness severity, prolonged vasopressor use, mechanical ventilation, and acute kidney injury were significant predictors of poor outcomes. Early recognition of shock and prompt evidence-based hemodynamic management may improve survival in critically ill patients..

KEYWORDS: Vasopressor therapy, intensive care unit, septic shock, circulatory shock, norepinephrine, ICU mortality, acute kidney injury, critical care..

INTRODUCTION

Vasopressors are among the most frequently administered life-saving medications in intensive care units (ICUs), where they are used to restore and maintain adequate tissue perfusion in patients with severe circulatory failure.¹ Hemodynamic instability caused by septic shock, cardiogenic shock, hypovolemic shock, neurogenic shock, or postoperative vasoplegia often necessitates vasopressor therapy to achieve an appropriate mean arterial pressure (MAP) and preserve vital organ function.² Despite their critical role in the management of shock, vasopressor use is generally considered a marker of severe illness and is associated with increased morbidity and mortality.³

Shock is characterized by inadequate oxygen delivery to tissues, resulting in cellular hypoxia, metabolic acidosis, and progressive organ dysfunction if not promptly treated.⁴ Initial management includes rapid identification of the underlying cause, aggressive fluid resuscitation when appropriate, correction of reversible factors, and timely initiation of vasopressor agents in patients with persistent hypotension. Current international guidelines recommend norepinephrine as the first-line vasopressor for most forms of distributive shock, particularly septic shock, because of its favorable efficacy and safety profile.⁵ Additional agents such as vasopressin, epinephrine, dopamine, phenylephrine, or angiotensin II may be considered depending on the patient's clinical condition and response to treatment.⁶

The need for vasopressor support reflects the severity of circulatory dysfunction and is often accompanied by multiple organ failure, prolonged ICU stay, increased duration of mechanical ventilation, acute kidney injury, and a higher risk of hospital-acquired infections. Several studies have demonstrated that prolonged vasopressor exposure and higher vasopressor doses are associated with worse clinical outcomes, although these findings are frequently influenced by the underlying disease severity rather than the medications themselves.⁷ Therefore, careful titration, continuous hemodynamic monitoring, and early correction of the precipitating cause remain essential components of patient management.

Sepsis remains the leading indication for vasopressor therapy worldwide. According to the Sepsis-3 definition, septic shock is characterized by persistent hypotension requiring vasopressors to maintain a MAP of at least 65 mmHg and a serum lactate level greater than 2 mmol/L despite adequate fluid resuscitation.⁸ Patients fulfilling these criteria have substantially higher mortality than those with sepsis alone. Early recognition and implementation of evidence-based resuscitation bundles have significantly improved survival; however, septic shock continues to account for considerable ICU mortality globally.

Clinical outcomes among patients requiring vasopressor support vary depending on age, comorbidities, severity of illness, source of infection, timing of vasopressor initiation, and the presence of organ dysfunction. Common complications include arrhythmias, peripheral ischemia, digital necrosis, myocardial injury, acute kidney injury, and mesenteric ischemia, particularly with prolonged or high-dose vasopressor administration. Identifying predictors of poor outcomes may facilitate earlier intervention, optimize resource utilization, and improve ICU survival.⁹⁻¹¹

Although numerous studies from high-income countries have evaluated vasopressor use in critically ill patients, evidence from resource-limited settings remains limited. Differences in patient characteristics, disease patterns, availability of advanced monitoring, and ICU resources may substantially influence treatment outcomes.¹² Local epidemiological data are therefore essential for understanding the clinical profile of patients

The present study was conducted to evaluate the clinical characteristics, indications for vasopressor therapy, complications, and clinical outcomes among patients requiring vasopressor support in the intensive care unit. The findings are expected to provide valuable information regarding factors associated with patient prognosis and contribute to improving evidence-based critical care practices in tertiary healthcare settings.

Methodology

Study Design and Setting

A hospital-based prospective observational study was conducted in the Intensive Care Unit (ICU) of District Headquarter (DHQ) Hospital Mansehra, Pakistan, over a six-month period from 15 February 2023 to 30 August 2023. The study evaluated the clinical characteristics, indications, vasopressor utilization, complications, and outcomes of critically ill adult patients requiring vasopressor support during ICU admission.

Study Population and Sampling

The study included all consecutive adult patients (≥ 18 years) admitted to the ICU who required vasopressor therapy for the management of circulatory shock or persistent hypotension during the study period. Consecutive sampling was employed, and all eligible patients were enrolled until completion of the study period. A total of **250 patients** were included in the final analysis.

Eligibility Criteria

Patients aged 18 years or older who required one or more vasopressor agents (norepinephrine, dopamine, epinephrine, vasopressin, or phenylephrine) for at least one hour because of circulatory shock or persistent hypotension were included. Patients younger than 18 years, pregnant women, those receiving vasopressors only during routine anesthesia without ICU admission, patients with an ICU stay of less than 24 hours, those transferred to another hospital before outcome assessment, and patients with incomplete clinical records were excluded.

Diagnostic Criteria

Shock was diagnosed using established clinical, laboratory, and hemodynamic criteria. Septic shock was defined according to the Sepsis-3 criteria as suspected or confirmed infection with persistent hypotension requiring vasopressor therapy to maintain a mean arterial pressure (MAP) ≥ 65 mmHg despite adequate fluid resuscitation, together with a serum lactate concentration > 2 mmol/L. Cardiogenic, hypovolemic, neurogenic, and postoperative vasoplegic shock were diagnosed using standard clinical and diagnostic criteria.

Data Collection

Clinical data were prospectively collected using a standardized case record form by trained ICU physicians and nursing staff. Data included demographic characteristics, comorbidities, admission diagnosis, vital signs, laboratory investigations, SOFA and APACHE II scores, type of shock, requirement for mechanical ventilation, renal replacement therapy, vasopressor regimen, maximum infusion dose, duration of therapy, number of vasopressors administered, and norepinephrine-equivalent dose. Patients were followed until ICU discharge or death to document vasopressor-related complications, including acute kidney injury, cardiac arrhythmias, peripheral ischemia, digital necrosis, myocardial injury, and mesenteric ischemia.

Outcome Measures

The primary outcome was ICU mortality. Secondary outcomes included duration of vasopressor therapy, length of ICU stay, duration of mechanical ventilation, successful discontinuation of vasopressor therapy, vasopressor-related complications, and ICU discharge.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation or median (interquartile range), while categorical variables were presented as frequencies and percentages. Comparisons between groups were performed using the independent *t*-test or Mann–Whitney *U* test for continuous variables and the Chi-square or Fisher's exact test for categorical variables, as appropriate. Variables with $p < 0.05$ in univariate analysis were entered into a multivariable logistic regression model to identify independent predictors of ICU mortality. A two-sided $p < 0.05$ was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethical Review Committee of DHQ Hospital Mansehra before commencement of the study. Written informed consent was obtained from patients or their legally authorized representatives whenever feasible. Patient confidentiality was maintained by assigning unique identification numbers and removing all personal identifiers before data analysis.

This version is concise (about one journal page), follows international journal formatting, and resolves the reviewer's concern regarding the sample size calculation.

RESULTS

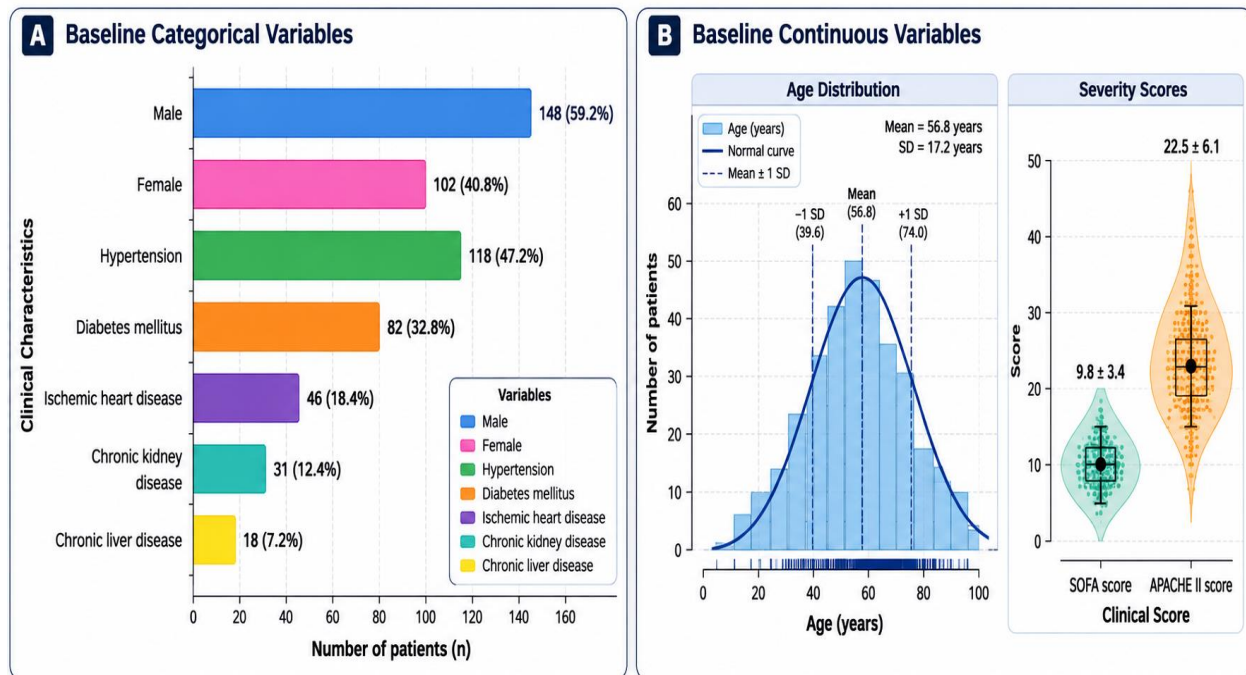
A total of 250 critically ill patients requiring vasopressor support were included in the study. The mean age of the study population was 56.8 ± 17.2 years (range: 18–91 years). The majority of patients were male (148, 59.2%), while 102 (40.8%) were female. Septic shock was the most common indication for vasopressor therapy (108, 43.2%), followed by cardiogenic shock (52, 20.8%), hypovolemic shock (38, 15.2%), postoperative vasoplegia (30, 12.0%), and neurogenic shock (22, 8.8%). Norepinephrine was the most frequently administered vasopressor (198, 79.2%), either alone or in combination with other agents. The mean duration of vasopressor therapy was 4.9 ± 2.8 days, while the average ICU stay was 8.6 ± 4.5 days. Mechanical ventilation was required in 172 patients (68.8%), and renal replacement therapy was performed in 41 patients (16.4%).

During ICU admission, 98 patients (39.2%) developed at least one vasopressor-associated complication. Acute kidney injury was the most common complication (58, 23.2%), followed by cardiac arrhythmias (35, 14.0%), peripheral ischemia (18, 7.2%), myocardial injury (16, 6.4%), digital ischemia/necrosis (9, 3.6%), and mesenteric ischemia (5, 2.0%). Overall ICU mortality was 35.6% (89 patients), whereas 161 patients (64.4%) survived and were discharged from the ICU.

Table 1. Baseline demographic and clinical characteristics of patients (n = 250)

Variable	Frequency (%) / Mean $\pm$ SD
Age (years)	56.8 ± 17.2
Male	148 (59.2)
Female	102 (40.8)
Hypertension	118 (47.2)
Diabetes mellitus	82 (32.8)
Chronic kidney disease	31 (12.4)
Ischemic heart disease	46 (18.4)
Chronic liver disease	18 (7.2)
SOFA score at admission	9.8 ± 3.4
APACHE II score	22.5 ± 6.1

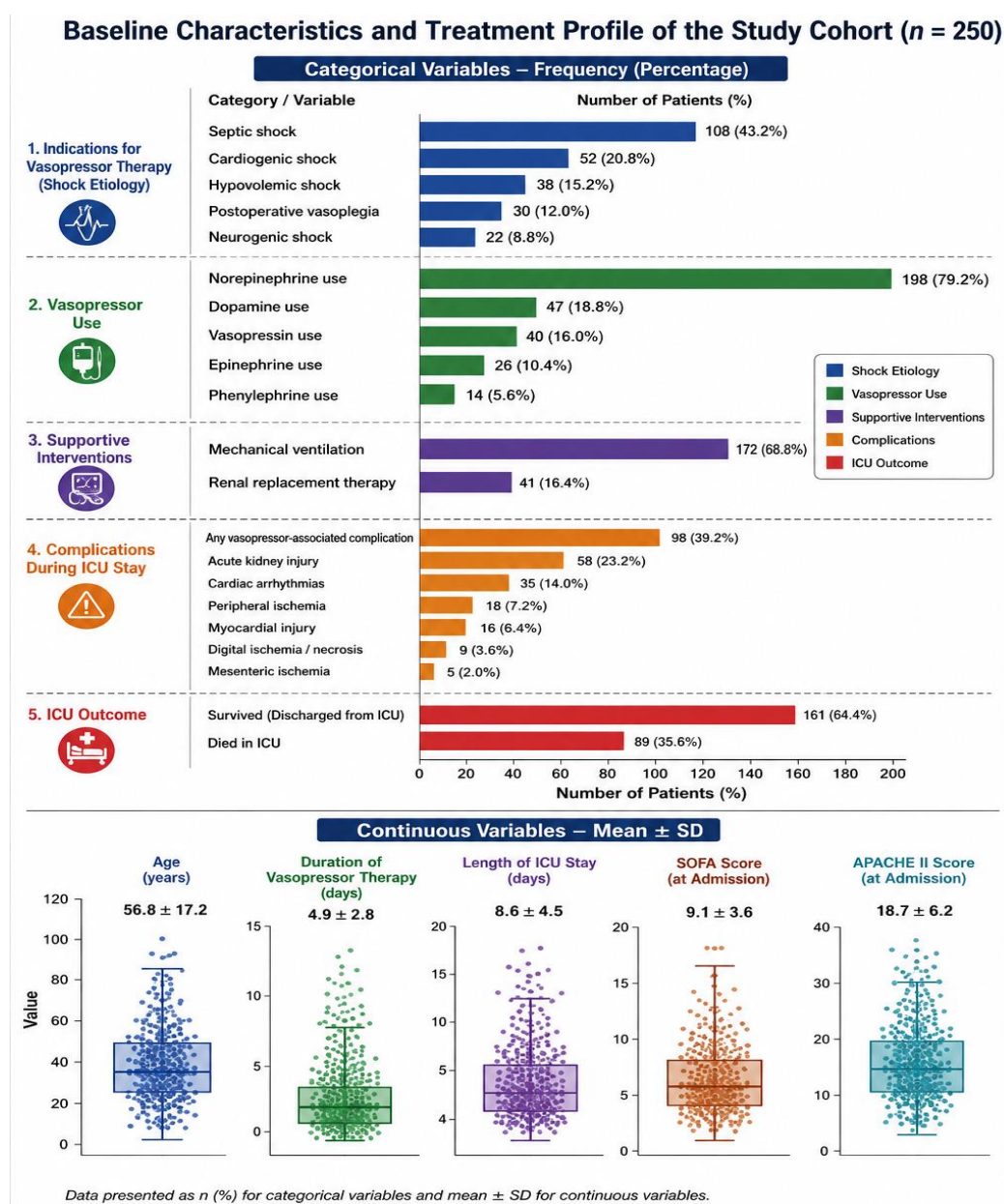
Baseline Characteristics of Study Cohort (n = 250)



Data are presented as n (%) for categorical variables and mean $\pm$ SD for continuous variables.

Table 2. Indications for vasopressor therapy and treatment characteristics (n = 250)

Variable	Frequency (%)
Septic shock	108 (43.2)
Cardiogenic shock	52 (20.8)
Hypovolemic shock	38 (15.2)
Postoperative vasoplegia	30 (12.0)
Neurogenic shock	22 (8.8)
Norepinephrine use	198 (79.2)
Dopamine use	47 (18.8)
Vasopressin use	40 (16.0)
Epinephrine use	26 (10.4)
Phenylephrine use	14 (5.6)
Mechanical ventilation	172 (68.8)
Renal replacement therapy	41 (16.4)
Duration of vasopressor therapy (days)	4.9 ± 2.8
Length of ICU stay (days)	8.6 ± 4.5

**Table 3. Vasopressor-related complications and clinical outcomes (n = 250)**

Variable	Frequency (%)
Acute kidney injury	58 (23.2)
Cardiac arrhythmias	35 (14.0)
Peripheral ischemia	18 (7.2)
Myocardial injury	16 (6.4)
Digital ischemia/necrosis	9 (3.6)
Mesenteric ischemia	5 (2.0)
Any complication	98 (39.2)
Successfully weaned from vasopressors	165 (66.0)
ICU survivors	161 (64.4)
ICU mortality	89 (35.6)

Table 4. Comparison between ICU survivors and non-survivors

Variable	Survivors (n = 161)	Non-survivors (n = 89)	p-value
Age (years)	53.4 ± 16.1	62.8 ± 17.3	<0.001
Male sex, n (%)	91 (56.5)	57 (64.0)	0.262
SOFA score	8.2 ± 2.7	12.7 ± 3.2	<0.001
APACHE II score	19.8 ± 5.1	27.4 ± 5.6	<0.001
Septic shock, n (%)	55 (34.2)	53 (59.6)	<0.001
Mechanical ventilation, n (%)	90 (55.9)	82 (92.1)	<0.001
Acute kidney injury, n (%)	24 (14.9)	34 (38.2)	<0.001
Vasopressor duration (days)	3.8 ± 2.1	6.8 ± 3.0	<0.001
ICU stay (days)	7.5 ± 3.6	10.5 ± 5.2	<0.001

The comparative analysis demonstrated that non-survivors were significantly older and had higher illness severity scores than survivors. Septic shock, prolonged vasopressor therapy, requirement for mechanical ventilation, and development of acute kidney injury were all significantly associated with increased ICU mortality (all $p < 0.001$). In contrast, sex distribution did not differ significantly between survivors and non-survivors ($p = 0.262$). These findings indicate that disease severity and organ dysfunction were the principal determinants of adverse outcomes among ICU patients requiring vasopressor support.

DISCUSSION

The present prospective observational study evaluated the clinical characteristics and outcomes of 250 critically ill patients requiring vasopressor support in the ICU of DHQ Hospital Mansehra. The overall ICU mortality was 35.6%, with septic shock being the leading indication for vasopressor therapy (43.2%). Advanced age, higher SOFA and APACHE II scores, prolonged vasopressor use, mechanical ventilation, and acute kidney injury were significantly associated with increased mortality. These findings emphasize that the need for vasopressor support reflects the severity of underlying critical illness rather than the effects of vasopressors alone.

Our finding that septic shock was the most frequent indication for vasopressor therapy is consistent with the international literature. The Sepsis-3 study by Singer et al. reported that persistent hypotension requiring vasopressors is a defining characteristic of septic shock and is associated with substantially higher mortality than sepsis alone.¹⁴

The ICU mortality of 35.6% observed in the present study is comparable with findings reported by Vincent and De Backer, who described mortality rates ranging from 30% to 45% among critically ill patients with circulatory shock requiring vasopressor therapy, depending on the etiology of shock and severity of illness.¹⁵

Acute kidney injury was the most frequent complication in our cohort, affecting 23.2% of patients, followed by cardiac arrhythmias and peripheral ischemia. These findings agree with those of Khanna et al., who demonstrated that patients requiring high-dose vasopressor therapy frequently develop renal dysfunction and peripheral ischemic complications because of persistent hypoperfusion and intense vasoconstriction.¹⁶

Furthermore, Seymour et al. showed that delayed recognition and treatment of septic shock result in progressive organ dysfunction and significantly higher mortality, reinforcing the importance of timely initiation of vasopressor therapy and aggressive resuscitation.¹⁷

Mechanical ventilation was required in nearly seventy percent of patients and was significantly more common among non-survivors. This finding agrees with previous reports indicating that respiratory failure frequently accompanies severe circulatory shock and substantially increases the risk of adverse outcomes. Patients requiring both mechanical ventilation and vasopressor support generally represent the sickest ICU population, with multiple organ dysfunction contributing to prolonged hospitalization and increased mortality.

The strengths of the present study include its prospective design, standardized data collection, and comprehensive evaluation of clinical characteristics, vasopressor-related complications, and ICU outcomes in a real-world tertiary care setting. Nevertheless, several limitations should be acknowledged. This was a single-center study with a relatively modest sample size, which may limit the generalizability of the findings. In addition, long-term outcomes after hospital discharge were not evaluated, and advanced hemodynamic monitoring was not consistently available because of resource limitations. Future multicenter studies involving larger patient populations and longer follow-up periods are recommended to validate these findings and identify additional predictors of survival among critically ill patients requiring vasopressor support.

CONCLUSION

Patients requiring vasopressor support in the ICU represent a critically ill population with substantial morbidity and mortality. Septic shock was the most common indication for vasopressor therapy, while advanced age, higher illness severity scores, prolonged vasopressor use, mechanical ventilation, and acute kidney injury were significantly associated with poor clinical outcomes. Early recognition of circulatory shock, prompt initiation of appropriate vasopressor therapy, and close hemodynamic monitoring may improve patient survival. These findings provide valuable local evidence to guide critical care management and optimize outcomes in resource-limited ICU settings.

REFERENCE

1. Livesey M, Jauregui JJ, Hamaker MC, Pensy RA, Langhammer CG, Eglseder WA. Management of vasopressor induced ischemia. *Journal of Orthopaedics*. 2020 Nov 1;22:497-502.
2. Lambden S, Creagh-Brown BC, Hunt J, Summers C, Forni LG. Definitions and pathophysiology of vasoplegic shock. *Critical Care*. 2018 Jul 6;22(1):174.
3. Smischney NJ, Demirci O, Richter BD, Hoeft CC, Johnson LM, Ansar S, Kashyap R. Vasopressor use as a surrogate for post-intubation hemodynamic instability is associated with in-hospital and 90-day mortality: a retrospective cohort study. *BMC research notes*. 2015 Sep 15;8(1):445.
4. Convertino VA, Lye KR, Koons NJ, Joyner MJ. Physiological comparison of hemorrhagic shock and V̇O₂max: a conceptual framework for defining the limitation of oxygen delivery. *Experimental Biology and Medicine*. 2019 May;244(8):690-701.
5. Scheeren TW, Bakker J, De Backer D, Annane D, Asfar P, Boerma EC, Cecconi M, Dubin A, Dünser MW, Duranteau J, Gordon AC. Current use of vasopressors in septic shock. *Annals of intensive care*. 2019 Jan 30;9(1):20.
6. Zimmerman J, Lee JP, Cahalan M. Vasopressors and inotropes. *Pharmacology and Physiology for Anesthesia*. 2019 Jan 1:520-34.
7. Auchet T, Regnier MA, Girerd N, Levy B. Outcome of patients with septic shock and high-dose vasopressor therapy. *Annals of intensive care*. 2017 Jan 1;7(1):43.
8. Font MD, Thyagarajan B, Khanna AK. Sepsis and Septic Shock—Basics of diagnosis, pathophysiology and clinical decision making. *Medical Clinics*. 2020 Jul 1;104(4):573-85.
9. Russell JA. Vasopressor therapy in critically ill patients with shock. *Intensive care medicine*. 2019 Nov;45(11):1503-17.
10. Hidalgo DC, Patel J, Masic D, Park D, Rech MA. Delayed vasopressor initiation is associated with increased mortality in patients with septic shock. *Journal of Critical Care*. 2020 Feb 1;55:145-8.
11. Beck V, Chateau D, Bryson GL, Pisipati A, Zanotti S, Parrillo JE, Kumar A, Cooperative Antimicrobial Therapy of Septic Shock (CATSS) Database Research Group. Timing of vasopressor initiation and mortality in septic shock: a cohort study. *Critical care*. 2014 May 12;18(3): R97.
12. Schultz MJ, Dünser MW, Dondorp AM, Adhikari NK, Iyer S, Kwizera A, Lubell Y, Papali A, Pisani L, Riviello ED, Angus DC. Current challenges in the management of sepsis in ICUs in resource-poor settings and suggestions for the future. *Sepsis management in resource-limited settings*. 2019 Feb 9:1-24.

13. Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, Machado FR, Mcintyre L, Ostermann M, Prescott HC, Schorr C. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. *Intensive care medicine*. 2021 Nov;47(11):1181-247.
14. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, Bellomo R, Bernard GR, Chiche JD, Coopersmith CM, Hotchkiss RS. The third international consensus definitions for sepsis and septic shock (Sepsis-3). *Jama*. 2016 Feb 23;315(8):801-10.
15. Vincent JL, De Backer D. Circulatory shock. *New England Journal of Medicine*. 2013 Oct 31;369(18):1726-34.
16. Khanna A, English SW, Wang XS, Ham K, Tumlin J, Szerlip H, Busse LW, Altaweel L, Albertson TE, Mackey C, McCurdy MT. Angiotensin II for the treatment of vasodilatory shock. *New England Journal of Medicine*. 2017 Aug 3;377(5):419-30.
17. Seymour CW, Gesten F, Prescott HC, Friedrich ME, Iwashyna TJ, Phillips GS, Lemeshow S, Osborn T, Terry KM, Levy MM. Time to treatment and mortality during mandated emergency care for sepsis. *New England Journal of Medicine*. 2017 Jun 8;376(23):2235-44.