



RESEARCH ARTICLE

Comparative Study of Using Norepinephrine Infusion versus Dopamine in Hemodynamically Unstable Patients at Surgical Intensive Care Unit

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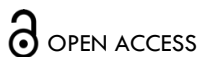
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OPEN ACCESS

PUBLISHED

31 July 2025

CITATION

Naeem, M., Khaskheli, MS., et al., 2025. Comparative Study of Using Norepinephrine Infusion versus Dopamine in Hemodynamically Unstable Patients at Surgical Intensive Care Unit. Medical Research Archives, [online] 13(7). <https://doi.org/10.18103/mra.v13i7.6720>

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DOI

<https://doi.org/10.18103/mra.v13i7.6720>

ISSN

2375-1924

ABSTRACT

Objective: This study evaluated the efficacy and safety of norepinephrine infusion versus dopamine in managing hemodynamically unstable patients in the surgical intensive care unit.

Methodology: This retrospective cohort study was conducted on patients admitted during 2021 and 2022. It was conducted at Peoples Medical College Hospital, Shaheed Benazirabad, Pakistan. The study included patients with hemodynamic instability, hypotension, and impaired tissue perfusion. The standardized protocol guided the administration of norepinephrine and dopamine, with doses adjusted according to hemodynamic goals and patient response.

Results: Patient records of 399 met the study criteria after reviewing the records. Among non-operative cases, 12.28% (n=49) patients received norepinephrine, while 46.37% (n=185) received dopamine. In post-operative cases, 6.27% (n=25) patients were administered norepinephrine compared to 35.08% (n=140) who received dopamine. In norepinephrine patients, 14.01% (n=16) were on self-ventilation, and 3.26% (n=13) required mechanical ventilation post-operatively, whereas, in the dopamine group, 8.77% (n=35) patients were on self-ventilation and 26.31% (n=105) on mechanical ventilation. Non-operative norepinephrine patients showed 7.02% (n=28) self-ventilation and 4.26% (n=17) mechanical ventilation, while dopamine patients showed 23.81% (n=95) self-ventilation and 22.56% (n=90) mechanical ventilation. Antibiotic use was higher in the dopamine group (76.19%, n=304) compared to the norepinephrine group (17.29%, n=69). Mortality was lower with norepinephrine (64.89%, n=48) than with dopamine (75.1%, n=244).

Conclusion: These results suggest that norepinephrine may be more effective and safer than dopamine, supporting its use as a first-line vasopressor.

Keywords: Norepinephrine, dopamine, vasopressor therapy, mortality, mechanical ventilation, antimicrobials.

Introduction

Hemodynamically unstable patients experience refractory, organ dysfunction, hypotension, and increased mortality rates. So, it is essential to select an appropriate vasopressor therapy to manage their condition. The death rate in patients with septic shock is 60-85% despite advances in basic care¹⁻³. Even though training boundaries exist, the ideal initial vasopressor for a patient in septic shock remains controversial⁴⁻⁶. Various studies involving patients with vasodilatory septic shock suggest that the organization of fixed-dose vasopressin might be a viable salvage therapy with conventional catecholamines if the reaction to the agents is inadequate^{7,8}.

Septic shock is related to dangerous hypotension that doesn't answer enough to fluid revival. Organ perfusion becomes compromised, prompting multi-organ dysfunction. Vasopressors are essential in reestablishing circulatory strain and keeping up with imperative organ capability⁹. There are two widely used agents: norepinephrine and dopamine. It has been found that these vasopressors are used in the context of septic shock and other critical conditions. However, the optimal choice between these agents remains a topic of debate. Norepinephrine is a potent agonist consisting of alpha-1 and beta-1 receptors^{10,11}. It is frequently used in septic shock. It enhances systemic vascular resistance and blood pressure and increases tissue perfusion. However, norepinephrine's effects on oxygen consumption and metabolic factors permit further study¹². Dopamine, another extensively used agent, acts on numerous receptors, including alpha-1, beta-1, and dopamine. Its hemodynamic effects are dose-dependent, with low doses primarily stimulating dopamine receptors and higher doses affecting alpha-1 and beta-1 receptors. However, concerns exist regarding tachyarrhythmias and adverse effects¹³. This retrospective study compared the efficacy and safety of norepinephrine infusion and dopamine in managing hemodynamically unstable patients in the surgical intensive care unit (SICU).

Methodology

This retrospective cohort study was conducted on hemodynamically unstable patients admitted to the SICU at Peoples Medical College Hospital, Shaheed Benazirabad, Pakistan. The study's ethical approval was received from the Institutional Bioethics Committee of the University of Sindh, Jamshoro, Pakistan (Reference No. ORIC/SU#122). Because this was a retrospective study, informed consent was not required. Data confidentiality was maintained throughout the study, and data was used only for research purposes.

The study included patients with hemodynamic instability, hypotension, and impaired tissue perfusion admitted to PMCH's SICU. At the same time, subjects with contraindications to norepinephrine or dopamine, severe hypertension, severe cardiac arrhythmias, or those enrolled in other concurrent clinical trials were excluded from this study. A non-probability purposive sampling technique was used for the collection of patients admitted to SICU during 2021 and 2022. A predesigned study instrument was used to collect data from patient medical records. Variables in the questionnaire included the use of vasoactive therapy (norepinephrine or dopamine), patient status (non-operative and post-operative), antibiotics prescribed, ventilator support, type of discharge, and medical outcome (dead or alive). The standardized protocol guided the administration of norepinephrine and dopamine, with doses adjusted according to hemodynamic goals and patient response. This incorporates clinical qualities, hemodynamic parameters, blood pressure, and cardiac output. The primary outcomes included mortality rate, while secondary outcomes included ventilator support and antibiotics used. The collected data was tabulated in Microsoft Excel, coded, and exported to IBM SPSS Version 24. The categorical variables were presented as frequencies and percentages.

Results

The study results are presented in the form of tables and figures and discussed below

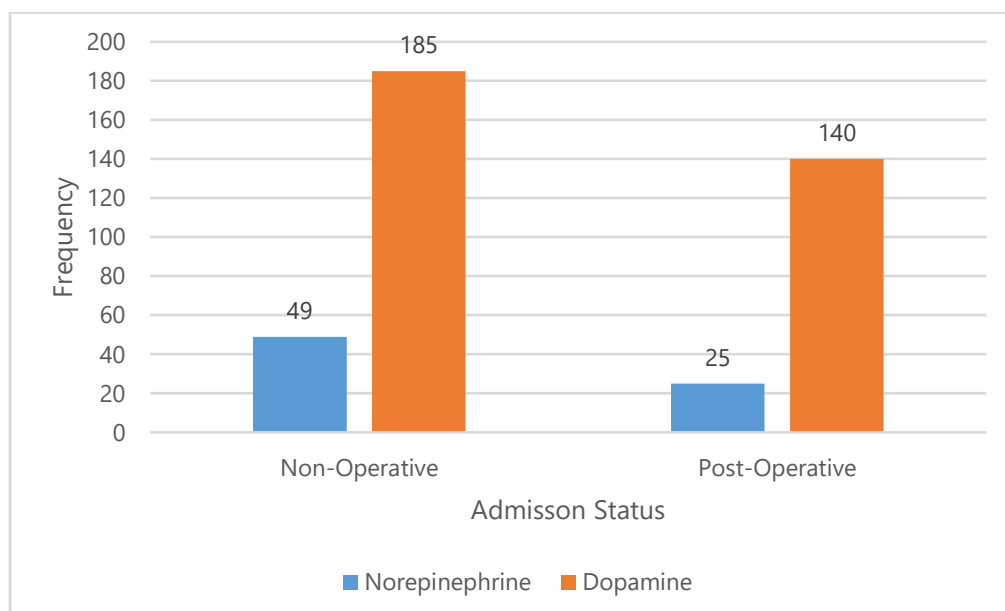


Figure 1: Graph showing frequencies of Operative & Non-Operative Cases with vasoactive therapy

The distribution of patients according to their admission status (operative or non-operative) and the type of vasoactive therapy administered (norepinephrine or dopamine) is shown in Figure 1. Among non-operative cases, 12.28% (n=49) patients received norepinephrine,

while 46.37% (n=185) received dopamine. In post-operative cases, 6.27% (n=25) of patients were administered norepinephrine compared to 35.08 % (n=140) who received dopamine.

Table 1: Self-Ventilation & Mechanical Cases with Vasoactive Therapies

Vasoactive therapy	Type of Admission	Type of Ventilation	Frequency	Percentage
Norepinephrine	Post-operative	Self	16	4.01
		Mechanical	13	3.26
	Non Operative	Self	28	7.02
		Mechanical	17	4.26
Dopamine	Post-operative	Self	35	8.77
		Mechanical	105	26.31
	Non Operative	Self	95	23.81
		Mechanical	90	22.56

Table 1 shows the frequencies and percentages of self-ventilation to mechanical ventilation cases among patients receiving norepinephrine and dopamine therapies in the SICU. For patients receiving norepinephrine, post-operative cases required self-ventilation in 14.01% (n=16) cases, while 3.26% (n=13) required mechanical ventilation. In non-operative norepinephrine-administered cases, 7.02% (n=28) required self-

ventilation and 4.26% (n=17) mechanical ventilation, totaling 74 cases. In contrast, for patients administered dopamine, among post-operative cases, 8.77% (n=35) of patients required self-ventilation compared to 26.31% (n=105) requiring mechanical ventilation. While in non-operative dopamine administer cases, 23.81% (n=95) required self-ventilation, while 22.57% (n=90) necessitated mechanical ventilation, totaling 325 cases.

Table 2: Antimicrobial agents used with vasoactive therapies

Antimicrobial use	Norepinephrine		Dopamine	
	Frequency	Percentage	Frequency	Percentage
No	5	1.25	21	5.27
Yes	69	17.29	304	76.19
Ceftriaxone:	42	10.53	227	74.7
Piperacillin + Tazobactam	12	3.01	41	10.28
Amoxicillin	01	0.25	10	2.51
Metronidazole (Flagyl)	07	1.75	09	2.26
Meropenem	08	2.01	08	2.01
Augmentin	01	0.25	03	0.75
Moxifloxacin	02	0.50	02	20.50
Cefixime	01	0.25	01	0.25
Cefuroxime	0	0	01	0.25
Penicillin	0	0	01	0.25
Vancomycin	0	0	01	0.25
Cefoperazone	01	0.25	0	00

Table 2 shows the need for antimicrobial therapy among the patients receiving norepinephrine and dopamine therapies; for patients receiving norepinephrine, 17.29%(n=69) were administered antibiotics, while 5 (1.25%) did not required antibiotic. Among the antibiotics used in the norepinephrine group, Ceftriaxone was the most prevalent (42 cases), followed by Piperacillin +

Tazobactam (12 cases). In the dopamine group, 304 patients (76.19%) were administered antibiotics, while 21 (5.27%) did not require antimicrobial therapy. Among the administered antibiotics, Ceftriaxone was again the most commonly prescribed (227 cases), followed by Piperacillin + Tazobactam (41 cases).

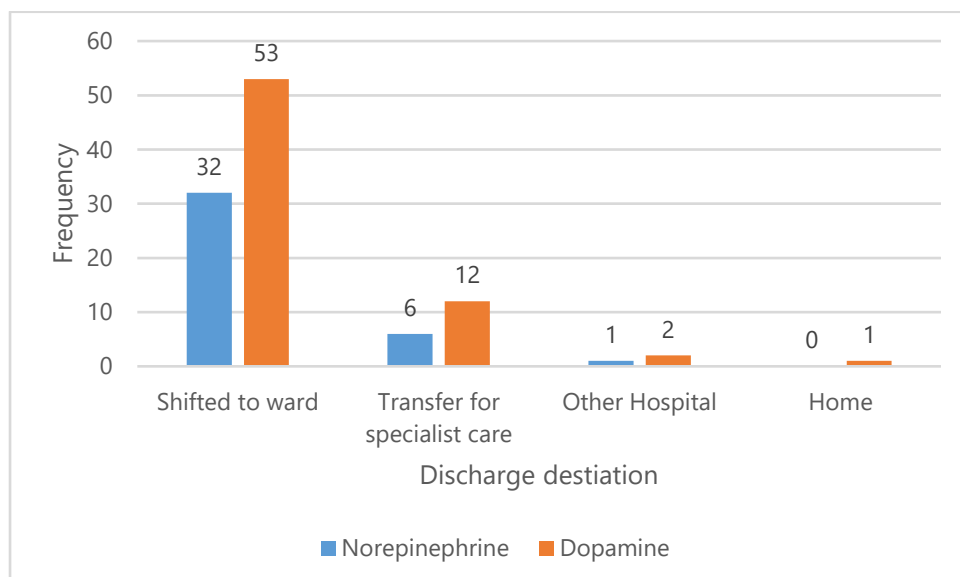


Figure 2: Discharge destination of live patients receiving norepinephrine or dopamine

Figure 2 shows the discharge destinations of 107 patients who were discharged alive from the SICU. Among patients who were administered norepinephrine,

8.02% (n=32) were shifted to the ward among. Conversely, 13.28% (n=53) were moved to the ward for patients receiving dopamine.

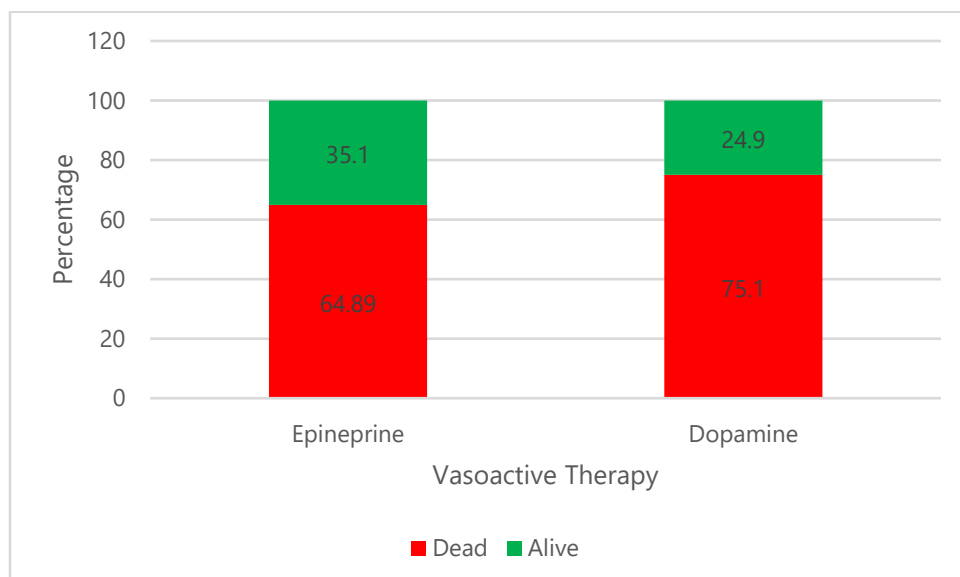


Figure 3: Outcome Distribution Based on Vasoactive Therapy

Figure 3 shows the primary outcomes based on dopamine and norepinephrine administration. Among patients administered norepinephrine, the majority (64.89%, n=48) were discharged as deceased, followed by

35.1% (n=26) discharged alive. Among patients administered dopamine, 75.1% (n=244) were discharged as deceased, followed by 24.9% (n=81) discharged alive.

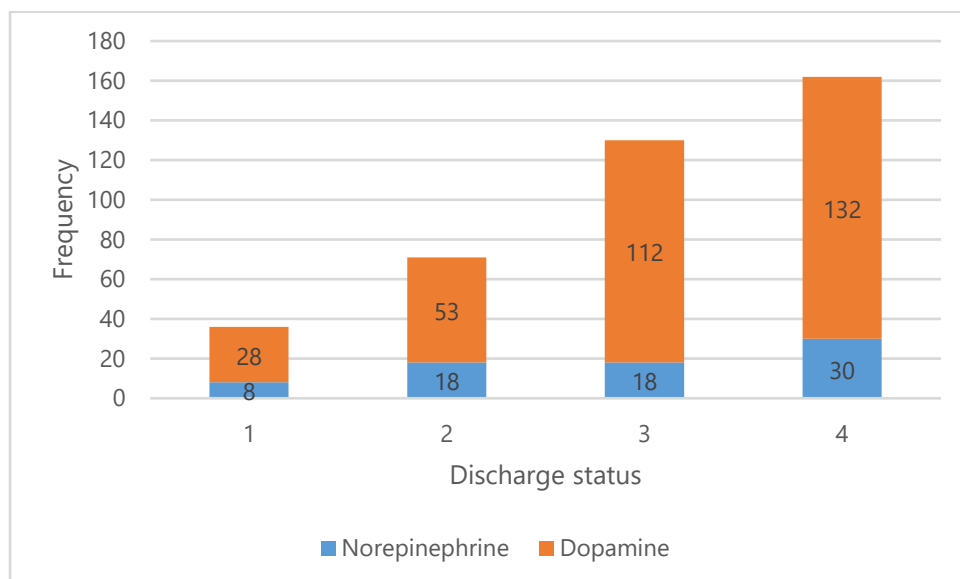


Figure 4: Discharge status of patients categorized by their surgical status

The discharge status of patients categorized by their surgical status (post-operative or non-operative) with the vasoactive therapy received (norepinephrine or dopamine). For patients receiving norepinephrine, among post-operative cases, 10.81% (n=8 cases) were discharged alive while 24.32% (n=18) were deceased, and among non-operative cases, 24.32% (n=18) were discharged alive while 40.54% (n=30) were deceased, totaling 74 cases. For patients administered dopamine, among post-operative cases, 8.61% (n=28) were discharged alive while 34.46% (n=112) were deceased, and among non-operative cases, 16.30% (n=53) were discharged alive while 40.16% (n=132) were deceased, totaling 325 cases.

Discussion

As such, the current study's results help to inform our understanding of the relevance of vasoactive therapies in the identified hemodynamically unstable patients within the SICU. Analysis of norepinephrine and dopamine has exhibited differences concerning patient mortality, ventilator support, and antibiotic prescriptions.

In the current study, norepinephrine exhibited better outcomes than dopamine. While the application of dopamine at some time was considered noble considering its positive effects on renal perfusion, recent studies demonstrated that it is dangerous as it increases the incidence of arrhythmic events and mortality in some patient populations¹⁴. The outcomes of the present study are in line with these concerns and recommend that norepinephrine may be safer; this is in line with the evolving clinical practice guideline that proposes the use of norepinephrine as a first-line vasopressor in septic shock patients¹⁵.

A higher proportion of non-operated cases on dopamine than surgically operated cases indicates that dopamine therapy is more likely to be used in patients who are not operated. For this reason, dopamine is perceived as the first-line agent in treating hypotension and shock. Nonetheless, the reported higher mortality rates in patients in the dopamine group, especially in the non-operative subgroup, suggest that norepinephrine may be

more effective than dopamine in the treatment of hemodynamic instability. These results conform to the evidence suggesting that dopamine may have unfavorable effects in cases of specific kinds of patients¹⁶.

Regarding the ventilation tactics, the results suggest that patients who received dopamine more often relied on mechanical ventilation for one reason or another. This could indicate a worse severity of the clinical condition at the onset of the disease or the cautiousness of the clinicians in the exclusive use of respiratory support. Deciding when to use self-ventilation or to turn to mechanical ventilation depends on several factors, including the patient's respiratory index, oxygenation, and prognosis.¹⁹ It is also possible that the prevalence of mechanical ventilation among dopamine-receiving patients could be in line with increased disease severity, which warrants such an intervention. This finding is in concordance with the literature because as the severity of shock increases, patients are more prone to develop complications that warrant interventions like jet ventilation. This work showed the value of promptly assessing a patient's respiratory manipulation requirement to boost efficiency¹⁷.

Markers of antimicrobial usage varied significantly by the group; patients receiving dopamine had substantially greater antimicrobial utilization, potentially reflecting a higher prevalence of infection or more liberal policies of antimicrobial prophylaxis in patients undergoing noradrenergic blockade. The selection of antimicrobials – Ceftriaxone and Piperacillin + Tazobactam- is based on the guidelines for empirical antibiotic therapy used to treat infections that occur most frequently in intensive care unit (ICU) patients¹⁸. A high frequency of antimicrobial treatment aggregate dispensing, especially in the dopamine cluster, asserts specific questions about antimicrobial stewardship. In essence, with antibiotics, the likelihood of developing resistance causes a higher threat in the ICU environment¹⁹. This study emphasizes the importance of prudent use of antimicrobials, which should be recommended and used based on culture results and/or clinical indication.

The mortality in the patients in the dopaminergic group indirectly highlights the fact that the use of vasoactive agents in patients should be done carefully, considering their effect on the patient's overall survival. However, the study does not prove a cause-and-effect relationship but points towards comparing more specific characteristics when choosing vasoactive therapy. These highlighted concerns, most notably the high mortality rate among the patients on discharge and particularly receiving dopamine, should warrant the interconnection as a constant reminder of the severity of the conditions managed in the ICU. Of course, it is essential to note the possibility of selection bias: by definition, index patients with a 1-year mortality of 57% are sicker and, thus, presumably more likely to have received dopamine without actually being so because of it, therefore confounding the observed effect²⁰. Future studies need to try and isolate these factors to establish the exact role that the choice of vasoactive therapy plays in patient morbidity and mortality.

These results help elucidate whether managing patients with hemodynamic instability using direct or indirect vasoactive agents is more efficient. This points to the need to apply randomized controlled trials to better understand the effectiveness of the two drugs. Further, the

conclusions emphasize the need to consider the individual patient's characteristics and prognosis when managing ICU patients; this means that the treatment should be as individual as possible since the response to the therapy varies from one patient to another.

Conclusion:

In conclusion, the study unveils an understanding of the crosslinks between vasoactive therapies, patient management, and overall clinical results. These results suggest that norepinephrine may be more effective and safer than dopamine, supporting its use as a first-line vasopressor. This study underscores the importance of individualized patient management and careful consideration of vasoactive agent choice to improve outcomes in hemodynamically unstable patients.

Acknowledgment

We are thankful to the hospital management and staff for cooperating and facilitation the carrying out this research work.

Conflict of Interest

There no conflict of interest among the authors

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