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Original Research Article

A prospective and observational study on rationale use of noradrenalin and vasopressin in critically ill patients

Kreeti Sapkota^{1*}, Abhishek Kumar Sinha¹, Sonaxi Agrahari¹,
Shibi Mary Thomas², Balakeshwa Ramaiah³

¹Department of Pharmacy, Karnataka College of Pharmacy, Bengaluru, Karnataka, India

²Karnataka College of Pharmacy, Bengaluru, Karnataka, India

³Department of Pharmacy Practice, Karnataka College of Pharmacy, Bengaluru, Karnataka, India

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*Correspondence:

Dr. Kreeti Sapkota,

Email: kreetisapkota41@gmail.com

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ABSTRACT

Background: Shock, particularly septic shock, is a critical medical condition characterized by inadequate blood flow, leading to multi-organ failure and high mortality rates. Traditional treatment includes fluid resuscitation and antibiotic therapy, but advancements in understanding and management are needed. This study aims to evaluate the rationale use of noradrenalin and vasopressin in patients with shock, specifically focusing on their effects on blood pressure.

Methods: Conducted as a prospective observational study at a tertiary care hospital, the study involved 50 critically ill patients diagnosed with septic, cardiogenic or hypovolemic shock. Patients were treated with either noradrenalin, vasopressin or both and data were collected from ICU, HICU and CCU admissions. Inclusive criteria included critically ill patients with shock on noradrenalin or vasopressin. Exclusion criteria included pregnant or breastfeeding women and dialysis patients.

Results: Among the patients, septic shock was the most common type (68%). Age distribution showed a majority (24%) aged 61-70 years, while a minority (2%) was 11-20 years old. Significant contributors to septic shock were lower respiratory tract infections (23.4%) and urosepsis (19.4%). The study noted fluctuations in systolic and diastolic blood pressures in response to the medications.

Conclusions: The study result demonstrated that the change in the blood pressure were significant. Changes in the diastolic pressure when used vasopressin along with norepinephrine was more prominent. Drug interactions didn't cause any adverse effects in the course of treatment as there is no significant fluctuation in the K levels. Not much difference was seen in blood cells count, ABG but significant decrease in serum lactate, CRP and troponin were seen.

Keywords: Blood pressure, Critical care, Lower respiratory tract infections, Noradrenalin, Septic shock, Urosepsis

INTRODUCTION

Shock is a critical medical condition characterized by inadequate blood flow, resulting in insufficient oxygen and nutrient delivery to cells and organs, which can rapidly lead to multi-organ failure and death if not promptly treated.¹ The urgency and severity of shock are underscored by its high mortality rate, with approximately

one in five affected individuals succumbing to the condition.² Septic shock, a severe complication of bacterial infection and bacteremia, is particularly deadly, with a mortality rate of 50-75%, accounting for nearly half of the deaths associated with severe infections. Conventional treatment strategies for septic shock include fluid resuscitation and antibiotic therapy.³ Recognizing the global health impact of sepsis, which affects millions of

people each year, the World Health Assembly and WHO have prioritized the improvement of sepsis prevention, diagnosis and management since 2017.⁴ This study aims to highlight the critical need for advancements in the treatment and understanding of septic shock, given its prevalence and significant contribution to intensive care unit admissions and mortality rates worldwide.

To evaluate the rationale use of noradrenalin and vasopressin in patients with shock. To evaluate the effect on the blood pressure

METHODS

Study type

The study was designed as a prospective observational study to evaluate the rationale use of noradrenalin and vasopressin in patients with shock at Tertiary Care Hospital.

Study duration

The study was from January to October 2023.

Study population

The study population included patients who had been diagnosed with either septic, cardiogenic or hypovolemic shock and were admitted to intensive care units. A total of 50 patients were enrolled from the ICU, HICU and CCU.

Inclusive criteria

Critically ill patients with cardiac, septic and hypovolemic shock on either noradrenalin or vasopressin or both.

Exclusion criteria

Pregnant and breastfeeding women. Dialysis patient.

Source of data

Patient information chart, medication charts, medical notes RESULTS Rational use of noradrenalin and vasopressin in critically ill patients. MRD, Lab investigation.

Data collection

A prospective observational study was conducted in intensive care units. The patients who met the inclusion criteria were enrolled for the study. Baseline information such as demographic details like age, sex, weight, date of admission, starting date of drug and date of discontinuation of drugs were obtained.

Drug related data, dose, route of administration, duration and other laboratory data were collected and documented in a suitable designed data collection form. The follow-up

was also documented up to discontinuation of drugs. The standard references like MICROMEDEX and LEXICOMP software available in the department and standard text books like Textbook of Pharmacotherapy by Joseph T. Dipiro, Textbook of Pharmacotherapy by Herfindal, applied therapeutics by Koda Kimble were used. Data was evaluated by using suitable statistical tool.

Ethical considerations

Informed consent

Participants were provided with detailed information about the study and were required to give written consent.

Confidentiality

Data were anonymized and stored securely to protect participants' privacy.

RESULTS

Socio-demographic details

Among the 50 patients included in the study, 58% were male and 42% were female. The age distribution was as follows, 2% were aged 11-20 years, 8% were 21-30 years, 10% were 31-40 years, 18% were 41-50 years, 16% were 51-60 years, 24% were 61-70 years, 16% were 71-80 years and 6% were 81-90 years (Table 1).

Diagnostic and causative factors

Out of 50 patients, the majority (68%) were diagnosed with septic shock, while smaller percentages were identified with septic cardiogenic shock (14%), septic hypovolemic shock (12%), cardiogenic shock (4%) and hypovolemic shock (2%). The primary causes of these conditions were diverse, with lower respiratory tract infection (LRTI) being the most prevalent at 23.4%, followed by urosepsis at 19.14%. Other notable causes included urinary tract infections (UTI), complications post-surgery, age-related factors and various infections such as catheter line infections and peritonitis. This data underscores the predominance of infections as the leading contributors to critical illnesses among the patients studied (Table 2).

Drug administration and duration patterns

Out of 50 patients, 80% received only norepinephrine, 4% received only vasopressin and 16% received both drugs. For those treated with norepinephrine, the duration of treatment varied, with the majority receiving it for two days (31.25%) and three days (35.42%). Smaller percentages of patients received norepinephrine for one, four, five and six days. Regarding vasopressin, most patients received it for two days (30%), while others received it for one, three, four and five days (Table3).

Effect seen on blood pressure

The study analysed the effects of noradrenalin and vasopressin on blood pressure among patients. For those on noradrenalin, the initial systolic blood pressure (BP) was 104.16 ± 21.63 mmHg, with fluctuations observed over six days, peaking at 110 ± 3.53 mmHg on day six and dropping to 99.7 ± 13.5 mmHg on day five.

Diastolic BP started at 63.20 ± 11.86 mmHg, showing minor variations over the same period, ending at 67.5 ± 3.53 mmHg. Patients receiving vasopressin began with an initial systolic BP of 104.16 ± 21.63 mmHg, which

increased to 118.5 ± 12.97 mmHg by day three, then decreased to 110 ± 0 mmHg by day five. Their diastolic BP rose from 63.20 ± 11.86 mmHg initially to 70 ± 0 mmHg by day five, indicating a steady increase (Table 4).

Outcome of the patient after therapy

Out of 50 patients, 62% improved and were discharged, 24% experienced mortality due to other serious illnesses during the course of treatment, 12% were discharged against medical advice without completing their treatment and 2% were hemodynamically stable and discharged upon request (Table 5).

Table 1: Socio-demographic characteristics.

Demographic	Category	Number of patients	%
Gender	Male	29	58
	Female	21	42
Age range (in years)	11-20	1	2
	21-30	4	8
	31-40	5	10
	41-50	9	18
	51-60	8	16
	61-70	12	24
	71-80	8	16
	81-90	3	6

Table 2: Diagnostic and causative factors.

Category	Subcategory	Number of patients	%
Diagnostic distribution	Septic	34	68
	Cardiogenic	2	4
	Hypovolemic	1	2
	Septic hypovolemic	6	12
	Septic cardiogenic	7	14
Cause of condition	LRTI	11	23.40
	Urosepsis	9	19.14
	UTI	5	10.63
	Age	4	8.51
	Post surgery	4	8.51
	Catheter line infection	2	4.25
	DCLD	2	4.25
	Leg ulcer	2	4.25
	Peritonitis	2	4.25
	Diabetic foot	2	4.25
	Cellulitis	1	2.10
	Gangrenous cholecystitis	1	2.10
	Poisoning	1	2.10
	Post cardiac arrest	1	2.10

Table 3: Drug administration and duration patterns.

Category	Details	Number of patients	%
Drug Distribution	Only norepinephrine	40	80
	Only vasopressin	2	4
	Both	8	16

Continued.

Category	Details	Number of patients	%
Duration of norepinephrine use (days)	One	3	6.25
	Two	15	31.25
	Three	17	35.42
	Four	6	12.50
	Five	5	10.42
	Six	2	4.10
Duration of vasopressin use (days)	One	2	20
	Two	3	30
	Three	2	20
	Four	2	20
	Five	1	10

Table 4: Effect seen in blood pressure.

Parameter	Initial BP (mmHg)	Day 1 BP (mmHg)	Day 2 BP (mmHg)	Day 3 BP (mmHg)	Day 4 BP (mmHg)	Day 5 BP (mmHg)	Day 6 BP (mmHg)
Noradrenalin							
Systolic	104.16±21.63	108.6±12.55	109.3±9.29	108.3±9.08	108±8	99.7±13.5	110±3.53
Diastolic	63.20±11.86	62.3±7.76	64.7±7.59	63.38±38.39	63.93±4.55	64.42±5.71	67.5±3.53
Vasopressin							
Systolic	104.16±21.63	111±11.76	112±9.73	118.5±12.97	117±19.07	110±0	-
Diastolic	63.20±11.86	64.61±6.16	60.43±9.65	62.75±16.52	69.33±1.15	70±0	-

Table 5: Outcome of the patient after therapy.

Outcome	Number of patient	%
Discharged	31	62
Death	12	24
Discharged against medical advice	6	12
Discharged at request	1	2

DISCUSSION

This study, conducted on critically ill patients diagnosed with shock treated with noradrenaline and vasopressin, assessed changes in blood pressure, lab parameters and drug interactions. Among the 50 patients enrolled, the age distribution ranged from 11 to 90 years, with the majority (24%) aged between 61 and 70 years and a minority (2%) aged between 11 and 20 years. In a similar study by Gabriel Wardi et al, in California, the age of patients ranged from 18 to 85 years, with 62.7% of hospital admissions for septic shock being patients aged 65 and above, while those aged 18-44 showed the lowest incidence of admission with septic shock.⁵

In another study by Lemor, Alejandro et al, on 300 patients with cardiogenic shock and myocardial infarction, 79.3% were under 75 years old and 20.7% were 75 years and older, with a male majority of 58%.⁶ Sakr et al, found that, among 3,902 patients with septic shock in the ICU, 63.5% were male, highlighting a higher prevalence of severe sepsis in men than in women.⁷ In this study, septic shock was most dominant (68%), followed by septic cardiogenic shock, septic hypovolemic shock, cardiogenic shock and hypovolemic shock at 14%, 12%, 4% and 2% respectively.

Dahmash et al, reported a 54.2% incidence of septic shock in their study of 36 patients, with 45 episodes of septic shock from 83 episodes of bacteremia.⁸ In the current study, the most common infection causes were LRTI (23.4%), urosepsis (19.4%) and UTI (10.63%). Hospital-acquired infections, like catheter line infections, were seen in 4.25% of patients and 2.1% of patients were diagnosed with cardiogenic shock post-cardiac arrest. Mayr et al, observed that respiratory tract infections were the most common infection site leading to sepsis and septic shock.⁹

Similarly, Jozwiak et al, corroborated these findings, emphasizing the significant role of such infections in the development of severe sepsis and septic shock. This study highlights critical insights into the treatment of critically ill patients with shock, specifically those treated with noradrenaline and vasopressin. By assessing changes in blood pressure, lab parameters and drug interactions, the research underscores the prevalence of septic shock, which dominated the patient cohort at 68%.

The study also mirrors global findings, such as those by Wardi et al and Sakr et al, regarding age and gender distributions, respectively, indicating a higher incidence of septic shock in older adults and a greater prevalence in

men. The identification of common infection sources, particularly lower respiratory tract infections and urosepsis, aligns with previous studies by Florian et al, and Jozwiak et al, reinforcing the significance of respiratory infections in sepsis development. Future research should focus on tailored therapeutic strategies, the impact of early intervention and preventive measures for hospital-acquired infections, aiming to improve patient outcomes and reduce mortality rates in this vulnerable population.

This study faced several limitations, it was conducted at a single center, limiting its generalizability, the study period was short, restricting data collection, there was no funding support, the sample size was small (50 patients), reducing the generalizability of findings, some patients were discharged or died while still on medication, hindering the assessment of drug effects and the presence of other complications made it difficult to evaluate the impact of the drugs on lab parameters accurately.

CONCLUSION

This study provides valuable insights into the management of critically ill patients with shock treated with noradrenaline and vasopressin. Notably, 68% of patients experienced septic shock, affirming its prevalence in critical care settings. Age distribution analysis revealed that the majority of patients were aged between 61 and 70 years, while gender analysis indicated a higher prevalence of severe sepsis in men.

Infection sources, particularly lower respiratory tract infections (23.4%) and urosepsis (19.4%), were identified as significant contributors to septic shock. Despite its limitations, including the single-center design, limited study period and small sample size, the research highlights the need for tailored therapeutic strategies, early intervention and preventive measures for hospital-acquired infections. Future studies should aim to address these limitations to improve patient outcomes and reduce mortality rates in this vulnerable population.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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