

Predictive Value of Vasoactive-Inotropic Score (VIS) in All-Cause Paediatric Intensive Care Unit Admissions: A Cross-Sectional Study

Sweta Panchal¹, Dhruvkumar D Shah², Ankita Agrawal³, Krutika Rahul Tandon^{4*}

¹Ex-PG, Department of Pediatrics, Pramukh Swami Medical College, Bhaikaka University, Karamsad, Gujarat, India

²Assistant Professor, Department of Medicine, Dr. N. D Desai Faculty of Medical Science and Research, Dharamsinh Desai University, Nadiad, Gujarat, India

³Ex-Assistant Professor, Department of Pediatrics, Pramukh Swami Medical College, Bhaikaka University, Karamsad, Gujarat, India

⁴Professor & Former HOD, Department of Pediatrics, Pramukh Swami Medical College, Bhaikaka University, Karamsad, Gujarat, India

***Address for Correspondence:** Dr. Krutika Rahul Tandon, Professor & Former HOD, Department of Pediatrics, Pramukh Swami Medical College, Bhaikaka University, Karamsad-388325, Gujarat, India

E-mail: krutikart@bhaikakauniv.edu.in & **ORCID ID:** <https://orcid.org/0000-0001-6572-9917>

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ABSTRACT

Background: The VIS (Vasoactive-Inotropic Score) is an established prognostic marker in paediatric sepsis and adult cardiac surgery. However, its predictive utility in all-cause PICU (Paediatric Intensive Care Unit) admissions remains untested. This study aimed to evaluate the association between VIS and clinical outcomes in a PICU population.

Methods: We conducted a cross-sectional study from January to December 2023 in a tertiary-care PICU. All admitted children were included, irrespective of diagnosis or need for vasoactive support. Data were collected retrospectively from hospital records. We grouped patients based on the need for vasoactive agents. VIS was calculated for those receiving inotropes and categorized into three groups: 1–30, 31–60, and >60. Clinical outcomes and management variables were analyzed accordingly.

Results: Among 350 patients, 213 (60.9%) were male, whereas 214 (61.1%) were under five years. Vasoactive support was required in 59 (16.9%) patients. Need for vasoactive agents was significantly associated with higher PRISM III scores, increased mortality, invasive device use, encephalopathy, multi-organ involvement, mechanical ventilation, RT feeding, blood transfusions, and CPR ($p = 0.001$). However, no significant association was observed between VIS score categories and these clinical variables.

Conclusion: Major PICU admissions consist of under-5 children with male predominance and less than one-sixth needed vasoactive support of any kind. PRISM III score, outcome, invasive device utilization, encephalopathy, major organ involvement, mechanical ventilatory support, RT feeding, blood component requirement, and CPR were significantly associated with the need for vasoactive support but none of them were significantly associated with VIS score severity.

Key-words: Antibiotics, Inotropes, Mortality, PRISM score, Sepsis, Vasoactive agents, VISmax scores

INTRODUCTION

Critically ill children require constant monitoring, timely interventions, and specialized care to ensure optimal outcomes. Research indicates that in critically sick children, survival outcomes and lesser or no morbidity

are the result of the availability of trained personnel, appropriate treatment methods, and well-equipped PICU (Pediatric Intensive Care Units). All things considered, critical care in Pediatrics is important because it may help children with life-threatening illnesses recover faster and provide more effective care. ^[1,2] Vasoactive drug support is one of the important modalities to support circulatory function in ICUs. These drugs work by either constricting or dilating blood arteries, modifying heart rate, or increasing cardiac contractility. ^[3,4] Delayed initiation of vasoactive support in patients who require it is associated with prolonged recovery, increased PICU

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stay, and worsened outcomes. Over the last three decades, various studies, scoring system or models have been proven to predict mortality among critically sick pediatric patients.^[5-9] VISmax (Vasoactive-inotropic score maximum) is one of the scores which had a greater discriminating capability in postoperative cardiac patients than previous ICU (Intensive care unit) evaluation tools. In addition, it was also said that the length of ICU stays increased with increasing VISmax scores. VISmax independently predicted poor outcomes following cardiac surgery in an adult population, including short- and intermediate-term morbidity and mortality.^[10] The VIS (Vasoactive-Inotropic Score) in pediatric sepsis important parameter to predict mortality.^[11] However, it was not studied for reasons other than sepsis in Pediatrics. So, this study was conducted to determine the predictability of VIS for all cause admissions in PICU and not just in sepsis.

MATERIALS AND METHODS

Research design- This cross-sectional study was conducted in the PICU of the department of Pediatrics of Pramukhswami Medical College & Shree Krishna Hospital, Karamsad, Gujrat, India from January to December 2023.

Methodology- Data were collected from hospital records and details like age, sex, diagnosis, need for vasoactive agents, PRISM (Pediatric Risk of Mortality) III scores, invasive device use, presence of encephalopathy, multi-organ involvement, need of mechanical ventilation, feeding status, need of blood transfusions, any event like cardiac arrest, outcome and length of stay in PICU and hospital etc were recorded and entered into Microsoft excel, patients were divided into two grouped based on the requirement for vasoactive agents whereas VIS was calculated for those receiving vasoactive-inotropes and categorized into three groups: 1–30, 31–60, and >60.

Inclusion criteria

- All children admitted to the Pediatric Intensive Care Unit (PICU) during the study period from January to December 2023.
- Children aged 1 month to 18 years at the time of PICU admission.

Exclusion criteria

- Patients with a PICU stay of less than 1 hour.
- Patients outside the age range of 1 month to 18 years

Statistical Analysis- Descriptive statistics, including Mean (SD) and Frequency (%), were used to summarize the baseline profile of study participants and clinical outcomes. The Chi-square/Fisher's exact test was performed to determine the relationship between categorical variables, including morbidity and associated factors. Fisher's exact test was used to compare categorical variables. A p-value <0.05 was considered statistically significant. Statistical analysis was performed using STATA (Statistical software for Data Science) version 14.2.

Ethical approval- This study was approved by the Institutional Ethical Committee (IEC/BU/130/Faculty/8/157/2021 dated 15th November 2022). The ethical committee granted a waiver of consent, as the study primarily involved data collection from medical records. The confidentiality and privacy of all participants were maintained at every level.

RESULTS

In the present study, out of a total of 350 patients, males were 213 (60.86%) and females were 137 (39.14%), with a 3:2 proportion. The Median (Q1, Q3) age of all enrolled patients was 5 years (10 months, 10 years). The Median (Q1, Q3) of PRISM III score of all enrolled patients was 14 (11, 18). The patients required vaso-active support were 59(16.9%). All baseline variables in both the groups are shown in Table 1 that there was statistically no significant difference between the groups as long as gender, age group category and need of tracheostomy were considered. ($p= 0.253, 0.651$ & 0.433 respectively). However, for the remaining parameters like PRISM III score, use of central line, use of arterial line, presence of encephalopathy etc. show statistically significant difference ($p= 0.001, 0.001, 0.029$ & 0.008 respectively). Tables 2 & 3 are showing distribution of organ involvement and relevant management modalities used among the patients who needed vasoactive support vs those not needed vasoactive support with their p-values.

**Table 1:** Baseline characteristics of patients on Vasoactive Vs No Vasoactive support

		Total n=350 (%)	Vasoactive support n=59 (16.9%)	No Vasoactive support n=291 (83.1%)	p-value*
Gender	Male	213 (60.9)	32 (9.1)	181 (51.7)	0.253
	Female	137 (39.1)	27 (7.7)	110 (31.4)	
Age groups (in years)	< 1	107 (30.6)	16 (4.6)	91 (26)	0.651
	1-5	107 (30.6)	22 (6.3)	85 (24.3)	
	>5-10	50 (14.3)	7(2)	43 (12.3)	
	>10-18	86 (24.6)	14(4)	72 (20.6)	
PRISM III Score	<5- Mild risk	10(2.9)	0(0)	10(2.96)	0.001
	6-20-Moderate risk	261(74.6)	29(8.3)	232(66.3)	
	>20- high risk	79(22.6)	30(8.6)	49(14)	
Outcome	Death	20(5.7)	20(5.7)	0(0)	0.001
	DAMA/ Transferred	63(18)	19(5.4)	44(12.6)	
	Discharges	267(76.3)	20(5.7)	244(70.6)	
Invasive Devices	Central line	35(10)	27(7.7)	8(2.3)	0.001
	Arterial line	6(1.8)	3(0.9)	3(0.9)	0.029
	Tracheostomy	3(0.9)	0(0)	3(0.9)	0.433
Encephalopathy		25(07.41)	09(02.66)	16(04.74)	0.008

* Chi-square test or Fisher exact test

As per this Table 2, respiratory system, central nervous system and haematological systems require relatively less vasoactive support as compared to involvement of circulatory and cardiac system involvement ($p=0.001$). Table 3 suggests that requirement of mechanical ventilator, blood component therapy and the event of cardiac arrest were more in group of patients who needed vasoactive support. (all p -value of 0.001). Rest of

the parameters like need of oxygen therapy, non-invasive ventilation, dialysis, corticosteroids or intravenous immunoglobulins showed no statistical difference. Feeding including Ryle's tube feeding establishment was more successful in group of the patients who do not needed vasoactive support. ($p=0.001$)

Table 2: Major organ involvement in patients on Vasoactive Vs No Vasoactive support

	Total n=350 (%)	Vasoactive support n=59 (16.9%)	No Vasoactive support n=291 (83.1%)	p-value*
Respiratory system	183(52.3)	39(11.1)	144(41.1)	0.001
Central nervous system	149(42.6)	34(9.7)	115(32.9)	
Hematological system	128(36.6)	21(6)	107(30.6)	
Others	72(20.6)	45(12.9)	27(7.7)	
Circulatory system	66(18.9)	19(5.4)	47(13.4)	
Cardiac system	63(18)	29(8.3)	34(9.7)	
Renal/alimentary system	39(11.1)	5(1.4)	34(9.7)	

* Chi-square test or Fisher exact test

Table 3: Requirement of various management modalities in patients on Vasoactive Vs No Vasoactive support

	Total n=350 (%)	Vasoactive support n=59 (16.9%)	No Vasoactive support n=291 (83.1%)	p-value*
Mechanical ventilator	158(45.1)	51(14.6)	107(30.6)	0.001
Non-invasive ventilation	5(1.42)	3(0.9)	2(0.6)	0.682
High-flow nasal cannula	8(2.3)	1(0.3)	7(2)	0.739
Oxygen therapy	179(51.1)	4(1.1)	175(50)	0.059
Blood Component	55(15.7)	28(8)	027(7.7)	0.001
Ryle Tube feeding	120(34.8)	38(10.9)	82(23.9)	0.001
Dialysis	5(1.4)	0(0)	5(1.4)	0.598
Cardiopulmonary resuscitation	25(7.1)	24(6.9)	1(0.3)	0.001
Corticosteroid	50(14.3)	12(3.4)	38(10.9)	0.145
Intravenous immunoglobulin	6(1.7)	1(0.3)	5(1.4)	0.990

* Chi-square test or Fisher exact test

Fig. 1 shows the distribution of VIS scores among all 350 patients. There were nearly 291 (83.1%) patients whose VIS score was zero whereas around 18 (5%) patients had VIS score of 60 or more. Table 4 showing comparison of those 6 variables (PRISM III score, outcome, central or arterial line insertion, presence of encephalopathy, mechanical ventilator needs, blood component need,

Ryle tube feeding establishment, event of cardiac arrest) which were found significant for need of vasoactive support were analysed further as per severity of VIS scores. Table 4 shows that there was no statistical difference to any parameters as far as VIS score severity is concerned.

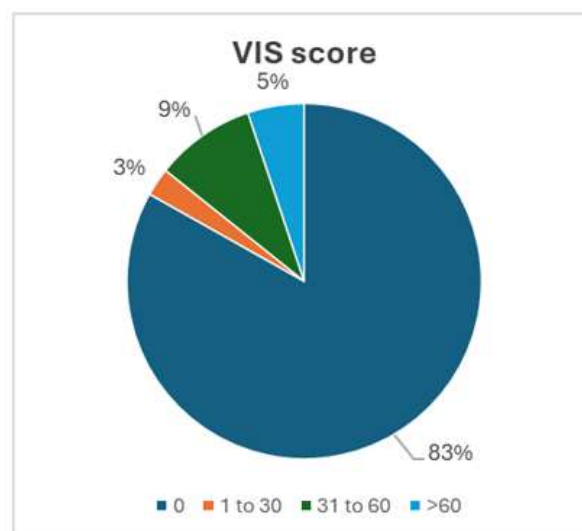
**Fig. 1:** VIS score distribution among all patients (n=350)

Table 4: Relationship of VIS score severity with other factors (PRISM III score, Outcome, Invasive device utilization, encephalopathy & management modalities)

Category	Subcategory(n)	Vasoactive-inotropic scores (n=59)			p-value*
		1-30 n=9	31-60 n=32	>60 n=18	
PRISM III score	<5 (0)	00	00	00	0.470
	6-20 (29)	05	18	06	
	>20 (30)	04	14	12	
Outcome	Discharge (20)	06	08	06	0.142
	Death (20)	00	14	06	
	DAMA/ Transferred (19)	03	10	06	
Invasive devices utilization	Central line (26)	01	14	11	0.086
	Arterial line (03)	00	01	02	0.710
Encephalopathy	GCS ≤7 (09)	01	04	04	0.99
	GCS>7 (50)	08	28	14	
Management modalities	Mechanical ventilator (42)	05	30	17	0.05
	RT feeding (38)	03	20	15	0.119
	Blood component (28)	03	15	10	0.765
	CPR (24)	01	13	10	0.157

* Chi-square test or Fisher exact test

DISCUSSION

Pediatric critical care has evolved into a distinct specialty over the past two-three decades in India, driven by key developments in four major areas: improved understanding of disease processes, advances in postoperative care, technological innovations, and enhanced strategies for pediatric sedation and pain management. Among these, early initiation of vasoactive support—particularly through central venous access—remains a crucial factor influencing outcomes in children with hemodynamic instability.

Demographic patterns in the present study revealed a higher proportion of male admissions (60.86%) compared with females (39.14%), though this difference did not correlate significantly with the need for vasoactive support. Few of the previous studies tried to report various factors affecting the morbidity and mortality in PICUs. [12-14] The predominance of male admissions may reflect increased vulnerability to severe diseases or socio-cultural factors influencing healthcare-seeking behaviour in favour of male children. Nearly half of all admissions involved children under five years of

age, highlighting the susceptibility of younger age groups to critical illnesses.

The PRISM III score continues to be one of the most widely used tools for predicting mortality in the PICU. Initially developed by Pollack et al. in 1988 and later revised in 1996 with the addition of three variables, PRISM III incorporates several physiologic parameters, with minimum systolic blood pressure, abnormal pupillary reflexes, and stupor/coma being particularly strong predictors of mortality.^[15,16] Consistent with previous literature, the present study demonstrates that higher PRISM III scores are associated with increased mortality, reinforcing its value as an indicator of initial illness severity. In resource-limited settings like India—where access to advanced critical care facilities may be constrained—the PRISM III score can serve as an effective triage tool to identify children who require urgent and intensive care. Timely recognition and intervention are paramount, as delays can increase the progression to multiorgan dysfunction, adversely affecting outcomes. Routine use of PRISM III in such settings may therefore contribute significantly to reducing childhood morbidity and mortality. The current



study finding also indicate that patients requiring vasoactive support had significantly higher PRISM III scores and a greater likelihood of death or discharge against medical advice (DAMA).

Respiratory and central nervous system (CNS) pathologies were the leading causes of admissions. As in results, respiratory system, central nervous system and haematological systems required relatively less vasoactive support as compared to involvement of circulatory and cardiac system involvement ($P=0.001$). However, there was no statistically significant relationship between the severity of Vasoactive-Inotrope Score (VIS) and patient outcomes, PRISM scores, need for NIV or mechanical ventilation, use of blood products, invasive lines, enteral feeding via Ryle's tube, encephalopathy, or event of cardiac arrest. These results suggest that VISmax may not be a reliable prognostic marker for all-cause PICU admissions in our population. This contrasts with previous studies in pediatric cardiac surgery and sepsis, where VIS has been validated as a measure of hemodynamic support and associated with outcomes.^[9,17] The discrepancy may be attributable to differences in disease profiles, timing of VIS measurement, or heterogeneity of PICU populations. Overall, the study highlights several factors that are closely linked to vasoactive drug use in PICU patients, emphasizing the complexity of managing critically ill children and the importance of tailored treatment approaches. But it not necessarily dependent of scores especially when all-cause PICU admissions taken into consideration.

LIMITATIONS

This is single-cantered with limited numbers of patients on vasoactive support. So, disease-wise or organ-system wise analysis can contribute further if larger number of patients in each group of VIS scoring.

CONCLUSIONS

Major PICU admissions consist of under-5 children with male predominance and less than one-sixth needed vasoactive support of any kind. PRISM III score, outcome, usage of central line and/or arterial line, encephalopathy, involvement of cardiac and/or circulatory system, mechanical ventilatory support, failure to establish RT feeding, blood component requirement, and cardiac arrest were significantly

associated with the need for vasoactive support but none of them were significantly associated with VIS score severity. Gender, age group, oxygen therapy, non-invasive ventilation, tracheostomy, requirement of corticosteroid or need of intravenous immunoglobulin was not associated significantly with need of vasoactive support. In future, the study can be conducted with more sample size to precisely about utility of VISmax. It can also be conducted to multi-center with different representee PICUs all over the country rather than single center. Also, studies should be focusing more on exclusive circulatory and/or cardiac system involvement to know the actual utility of VISmax.

CONTRIBUTION OF AUTHORS

Research concept- Krutika Rahul Tandon, Sweta Panchal

Research design- Krutika Rahul Tandon, Sweta Panchal

Supervision- Krutika Rahul Tandon, Ankita Agrawal

Materials- Sweta Panchal, Ankita Agrawal

Data collection- Sweta Panchal, Krutika Rahul Tandon, Ankita Agrawal

Data analysis and interpretation- Sweta Panchal, Krutika Rahul Tandon, Dhruvkumar D Shah, Ankita Agrawal

Writing article- Sweta Panchal, Krutika Rahul Tandon, Dhruvkumar D Shah, Ankita Agrawal

Critical review- Sweta Panchal, Krutika Rahul Tandon, Dhruvkumar D Shah, Ankita Agrawal

Article editing- Sweta Panchal, Krutika Rahul Tandon, Dhruvkumar D Shah, Ankita Agrawal

Final approval- Sweta Panchal, Krutika Rahul Tandon, Dhruvkumar D Shah, Ankita Agrawal

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