ORIGINAL ARTICLE

ASSOCIATION OF VASOACTIVE-INOTROPIC SCORE WITH POSTOPERATIVE OUTCOMES IN CHILDREN WITH CONGENITAL HEART DISEASES UNDERGOING CARDIAC SURGERY

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Objectives: This cross-sectional study aimed to evaluate the association between the vasoactive-inotropic score (VIS) and post-operative morbidity and mortality in pediatric patients undergoing cardiac surgery for congenital heart diseases (CHDs).

Methodology: A cross-sectional study was conducted at the Pediatric Cardiac Intensive Care Unit (PCICU) of the National Institute of Cardiovascular Diseases, Karachi, Pakistan, between October 2021 and March 2022. A total of 101 children up to 18 years of age admitted to the PCICU were included in the analysis. Demographic characteristics and peri-operative variables were recorded, and VIS scores were collected to assess their association with post-surgery outcomes. A score of ≥15 was considered high, while a score <15 was considered low.

Results: Among the 101 children included in the study, 49 (48.5%) were male and 52 (51.5%) were female, with a mean age of 7.45±2.81 years. Fifteen (14.9%) patients had a high VIS score during their ICU stay, while 86 patients had a low VIS score. Low cardiac output was the most common post-operative morbidity observed in 9 (8.9%) children, followed by hepatic dysfunction and acute kidney injury, each reported in 8 (7.9%) children. Significant associations were found between high VIS and hepatic dysfunction ($p<0.001$), acute kidney injury ($p<0.001$), low cardiac output ($p<0.001$), neurological dysfunction ($p=0.016$), and mortality ($p<0.001$).

Conclusion: High VIS scores were significantly associated with poor short-term morbidity and mortality in children undergoing corrective surgery for CHDs. The VIS system can aid in predicting disease progression, severity, and outcomes in pediatric cardiac surgical patients.

Keywords: vasopressor-inotropic score; pediatric cardiac care unit; cardiac surgery; congenital heart diseases

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INTRODUCTION

Congenital heart diseases (CHD) are prevalent worldwide, with a reported incidence of 15/1000 births and over 60,000 affected newborns annually. However, this figure likely underestimates the true prevalence due to undiagnosed cases, particularly in regions with limited access to specialized medical care.[1,2] Despite advancements in medical interventions, many children with CHD require surgical interventions to address their condition.[3] Nevertheless, these procedures, especially those involving open-heart surgery with cardiopulmonary bypass, carry significant risks of postoperative mortality and morbidity.[4,5]

One common complication seen in children undergoing CHD surgery is low cardiac output syndrome, necessitating postoperative administration of inotropic support.[6-8] The Wernovsky scoring system and its variations have been utilized to quantify the pharmacologic cardiovascular support required in the postoperative period.[9-12] However, the specific role of the vasoactive inotropic score (VIS) in predicting postoperative outcomes in the context of CHD surgeries remains relatively unexplored, particularly

in regions like Pakistan, where access to specialized pediatric cardiac care may be limited.

Against this backdrop, the present study seeks to fill this gap by examining the association between VIS and postoperative morbidity and mortality in pediatric patients undergoing cardiac surgery for congenital heart diseases in Karachi, Pakistan. By elucidating the relationship between VIS and postoperative outcomes, this study aims to provide valuable insights that may inform clinical decision-making and improve patient care in this vulnerable population.

METHODOLOGY

Study Design: This cross-sectional study aimed to investigate the outcomes of pediatric patients admitted to the Pediatric Cardiac Intensive Care Unit (PCICU), spanning from October 2021 to March 2022.

Setting: The study was conducted at the Pediatric Cardiac Intensive Care Unit (PCICU) of the National Institute of Cardiovascular Diseases, Karachi.

Participants: Children up to 18 years of age, of either gender, admitted to the PCICU during the specified period, were included in the study. Children requiring urgent surgery were excluded from the analysis.

Variables: The primary variables of interest included demographic characteristics, peri-operative parameters, and the Vasoactive-Inotropic Score (VIS). The VIS was dichotomized into high (≥15) and low (<15) categories following the approach used by Gaies et al.[13]

Data Sources/Measurement: Prospective data were collected after obtaining informed and written consent from the parents or legal guardians of the participants. Data collection involved the use of a non-probability purposive sampling technique. Relevant demographic and peri-operative parameters were recorded, including surgical procedures such as primary repair of Tetralogy of Fallot, correction procedures for the transposition of the great vessels, valvular repairs, and repair of septal defects.

Bias: Bias was minimized by implementing rigorous measures, including standardizing data collection procedures and ensuring consistency in variable measurement techniques.

Study Size: The study encompassed pediatric patients who were admitted to the Pediatric Cardiac Intensive Care Unit (PCICU) at the National Institute of Cardiovascular Diseases in Karachi within the designated timeframe of October 2021 to March 2022. In total, 101 patients were included in the analysis.

Quantitative Variables: Quantitative data were analyzed using IBM-SPSS version 26.0. Descriptive statistics, including frequency and percentages for qualitative data, and mean and standard deviation for quantitative data, were employed to summarize the characteristics of the study population and peri-operative parameters.

Statistical Methods: Comparisons of outcome variables with respect to VIS scores were conducted using the chi-square test for categorical variables and the independent sample t-test for continuous variables. A significance level of $p < 0.05$ was considered statistically significant.

RESULTS

Participants: The study comprised a cohort of 101 pediatric patients admitted to the Pediatric Cardiac Intensive Care Unit (PCICU) at the National Institute of Cardiovascular Diseases in Karachi between October 2021 and March 2022. Among these, 49 (48.5%) were male, and 52 (51.5%) were female, with a mean age of 7.45 ± 2.81 years, ranging from 7 months to 18 years.

Descriptive Data: The mean cardiopulmonary bypass time (CPBT) was 74.35 ± 23.45 minutes, while the mean cross-clamp time (CCT) was 44.05 ± 16.24 minutes. On average, patients spent 3.8 ± 1.6 days in the ICU. Baseline demographic characteristics, including gender distribution, age categories, and residence (urban or rural), are summarized in Table 1.

Table 1: Baseline demographic characteristics

Characteristics	Frequency (%)
Total (N)	**101**
Gender	
Male	49 (48.5%)
Female	52 (51.5%)
Age (years)	
<5	52 (51.5%)
6-18	49 (48.5%)
Residence	
Urban	40 (39.6%)
Rural	61 (60.4%)

Outcome Data: Hourly measurements of the Vasoactive Inotropic Score (VIS) were recorded, with 15 (14.9%) patients exhibiting a high VIS score during their ICU stay, while 86 patients had a low VIS score. Post-operative morbidity and mortality were assessed,

with low cardiac output being the most frequent morbidity observed in 9 (8.9%) children, followed by hepatic dysfunction and acute kidney injury in 8 (7.9%) children each.

Main Results: Significant associations were found between high VIS scores and various post-surgery outcomes. Patients with high VIS scores had a significantly longer mean CPBT compared to those with low VIS scores (112.4 ± 56.8 minutes vs. 67.55 ± 28.4 minutes, $p < 0.001$). Hepatic dysfunction, acute kidney injury, low cardiac output, neurological dysfunction, and mortality were all significantly associated with high VIS scores ($p < 0.001$ for hepatic dysfunction, acute kidney injury, low cardiac output, and mortality; $p = 0.016$ for neurological dysfunction). These findings are detailed in Table 2 and illustrated in Figure 1.

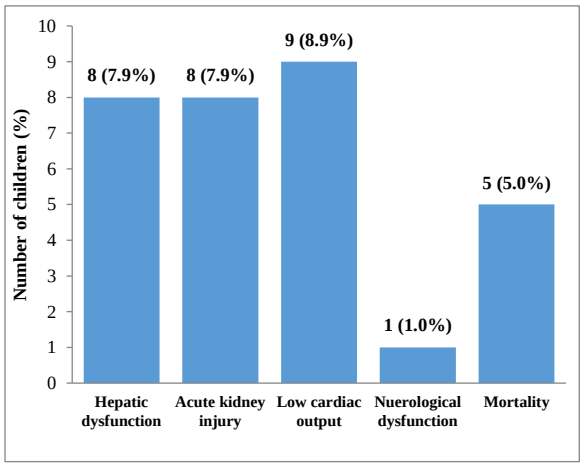

Figure 1: Frequency of post-operative morbidity and mortality (n=101)

Table 2: Association of Post-surgery Outcomes with Respect to VIS Score

Post-surgery outcomes	Vasoactive Inotropic Score		P-value
	Low	High	
Total (N)	**86**	**15**	
Hepatic dysfunction	2 (2.3%)	6 (40.0%)	<0.001
Acute kidney injury	1 (1.2%)	7 (46.7%)	<0.001
Low cardiac output	2 (2.3%)	7 (46.7%)	<0.001
Neurological dysfunction	-	1 (6.7%)	0.016
Mortality	-	5 (33.3%)	<0.001

DISCUSSION

In our study, we observed that low cardiac output was the most common post-operative finding. Corrective surgery for CHDs often results in low cardiac output, as evidenced by 8.9% of our patients experiencing this after surgery.[9,10] To address the adverse effects of low cardiac output, patients are typically initiated on inotropic and vasopressor support, often intra-operatively. Timely identification of low cardiac output in these patients is crucial for providing informed decisions to parents/caregivers regarding disease severity assessment and management options.[14]

Our study also revealed a significant association between high Vasoactive-Inotropic Score (VIS) and post-operative morbidity and mortality. Baysal PK et al highlighted VIS as the most important scoring system for predicting post-operative complications.[15] Na et al demonstrated a correlation between high VIS within the initial 48 hours and in-hospital mortality, while Davidson et al concluded that a higher VIS score at 48 hours post-operatively was a superior predictor of short-term poor outcomes compared to scores calculated at other time points.[16] Moreover, another study emphasized the predictive value of VIS calculated at 24 hours post-surgery.[17] In our study, we determined the maximum VIS score within the first 48 hours and found a robust association with adverse post-operative outcomes, including morbidity and mortality.

It's important to note that high VIS reflects poor physiological cardiac function in the post-operative period and should not be interpreted as causally linked to poor outcomes; rather, it serves as a tool for assessing illness severity and predicting the likelihood of poor outcomes in patients requiring higher support.[13] Therefore, VIS can aid in decision-making regarding therapeutic interventions and provide valuable information for counseling parents/caregivers during the postoperative period.

LIMITATION

However, our study has some limitations, including its single-center sample collection and potential variations in management due to involvement of different surgeons, despite following international protocols. Additionally, the sample size was limited to 101 cases, serving as a preliminary exploration for future studies. Further research is warranted to investigate the optimal scoring system for predicting outcomes of congenital heart surgeries in children.

CONCLUSION

In conclusion, our study highlights a significant association between high VIS and adverse short-term outcomes, including morbidity and mortality, in pediatric patients undergoing corrective surgery for

CHDs. The VIS system emerges as a valuable tool for predicting disease progression, assessing severity, and anticipating outcomes in this vulnerable patient population. By quantifying the pharmacologic cardiovascular support required postoperatively, VIS enables clinicians to identify patients at higher risk of complications and tailor their management accordingly.

AUTHORS' CONTRIBUTION

RAK and ZA: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. RAK, ZA, MUR, SBZ, AH, MMB, ASS, and SKB: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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