ORIGINAL ARTICLE

DIAGNOSTIC UTILITY OF MEAN PLATELET VOLUME IN PATIENTS OF EARLY NEONATAL SEPSIS

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ABSTRACT

Objective: To determine the diagnostic utility of mean platelet volume in patients presenting with early neonatal sepsis.

Materials and methods: This validation study was conducted in the Department of the Pediatrics ward, Khyber Teaching Hospital, Peshawar. After seeking parental consent, a brief history of Neonatal Sepsis and co-morbidities was obtained. The patient's clinical record was reviewed for the presence of any of the conditions indicated in the exclusion criteria for this study. A questionnaire about the patient's demographics, disease duration, and treatment records was compiled. Samples were taken and examined of such newborns with consent from the patient's guardians (n=322). 4 ml venous blood was collected from each subject. 2 ml was used for blood culture, and 2 ml was used for Mean Platelet Volume estimation each at hours 0, 24, and 48. Data was collected and analyzed using the SPPS 24.

Results: A total of 322 newborns (154 males, 168 females) were enrolled. The Sepsis group as diagnosed by blood culture, had 201 cases while the control group had 121 participants. There was a significant difference (p-value less than 0.05) between the two groups for Mean Platelet Volume. The values for sensitivity, specificity, and negative and positive predictive values as compared to blood culture as the gold standard were 77.58, 55.31, 50.00, and 81.08 percent, respectively.

Conclusion: The mean platelet volume has high diagnostic utility in patients with neonatal sepsis.

Keywords: Mean platelet volume, neonatal sepsis, newborns.

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INTRODUCTION

Sepsis is a systemic disorder induced by a pathological response to infection[1]. Sepsis is now realized as an out-of-control, severe infectious response or a complex infection-related illness [2,3,4]. Bacteria are the most common pathogens for causing sepsis[5]. On the other hand, viral respiratory infections in sepsis are mainly symptomless[6,7]. Intravenous antibiotics are recommended to treat sepsis within 1 hour of diagnosis[8].

Sepsis causes a significant burden on the health care system as it is associated with deaths in children worldwide. It is reported that 22 instances of pediatric sepsis cases are observed per 100,000 newborns per year all over the world [9,10]. Sepsis affects around 4% of all hospitalized children under the age of 18 and 8% of pediatric ICU patients in developed countries [11,12]. The mortality rate for neonatal sepsis ranges from 4% to 50% [12-14]. Neonatal sepsis has a high rate of morbidity and mortality. It occurs between 1 and 5 times per 1000 live births worldwide [15]. In the United States, the rate of sepsis in neonates is between 0.2 and 1 for each 1,000 live births[16]. Early sepsis costs roughly 0.77/1000 live births. The rate for neonates above 34 weeks of gestation drops to about 0.5/1000 live births[17].

Neonatal sepsis can take the form of newborn meningitis, septicemia, or a mix of the two. If sepsis occurs in the first six days of life, it is called Early onset, and that occurring from 7 days onwards is called late-onset [18]. Early-onset neonatal sepsis primarily begins within 72 hours of birth [19]. It can progress to multiple organ failures. In newborn sepsis, the signs and symptoms are often non-specific. As a result, the differential diagnosis is criti-

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cal[20]. Some of the clinical findings are apnea, hepato-splenomegaly, cyanosis, abdominal distention, peripheral circulatory disturbance, tachypnea, diarrhea, vomiting, bradycardia/tachycardia, difficulty sucking, and hypotension [20-23].

Blood, urine, and cerebrospinal fluid cultures are the diagnostic tests for sepsis. The growth of pathogenic bacteria in body fluids is the gold standard [24]. The absence of growth does not rule out the diagnosis[23]. Additionally, the sensitivity of diagnostic tests is affected by the limited blood volume available in neonates. According to research, blood volume for sampling is frequently low, resulting in more than 50% of incorrect results[25-26]. Another concern is that blood cultures have low specificity. Mean platelet volume is reported to predict mortality in sepsis patients and is increased in patients with sepsis [27].

Therefore, this research was performed on mean platelet volume compared to the gold standard blood culture. Due to the limitation of culture and increased rate of mortality of early-onset neonatal sepsis, it is vital to identify new perspectives. Studying this parameter may help develop local guidelines for the precise diagnosis, early intervention, and treatment of such burdensome conditions.

MATERIALS AND METHODS

The validation study was performed in Khyber Teaching Hospital, Peshawar. Ethical approval for the research was granted by the ethical board. Neonates attending to inpatient & outpatient departments were approached. After seeking parental consent, a brief history of Neonatal Sepsis and comorbidities was obtained.

A questionnaire about the patient's demographics, disease duration, and treatment record was compiled. After informed verbal & written consent from each patient's parents, samples of the selected neonates (n=322) have been collected and evaluated.

Inclusion criteria included Preterm neonates (28-36 weeks of gestation) of less than 72 hours of age and term neonates of less than 7 days. Exclusion criteria included neonates taking antibiotics and those whose mothers were treated with antibiotics for infections. For the control group, Inclusion Criteria included subjects with no clinical signs of sepsis, having normal MP, not treated with antibiotics, and hospitalized for hyperbilirubinemia and hypoglycemia. The exclusion criteria for control were the same as the case group.

4 mL venous blood was collected from each subject under aseptic conditions. A 2 mL was used for blood culture, and 2 mL was utilized for Mean platelet Volume estimation. Blood culture reports were assessed after 24-48 hours of incubation. Mean platelet volume was analyzed using NIHON KOHDEN MEK 6510 Auto Hematology Analyzer (Tokyo, Japan) at hours 0, 24, and 48.

SPSS 24 was used for data analysis. Standard deviation and Mean were used for continuous data. Blood culture results were taken as the gold standard. Sensitivity and specificity, positive predictive value, and negative predictive value were calculated for MPV. A p-value of less than 0.05 is considered statistically significant to reject the null hypothesis. A sample size of 322 was calculated in Goldberg's Equation through the WHO formula. [28]

RESULTS

Newborns (154 males/47.82%, 168 girls/52.17%) were enrolled in the study. Sepsis and control groups had 201 and 121 neonates respectively. The demographic data are summarized in Table 1. For newborns, diagnostic variables are listed in (Table.2). A substantial variance was observed for MPV amongst the sepsis and control groups.

MPV was compared to the gold standard blood culture test for sensitivity and specificity. MPV shows 77.58% sensitivity

Table 1: Demographic characteristics of the participants

Demographics	Eons (201)	Control (121)
Gender- Male, n (%)	94 (46.76)	60 (49.58)
Gender – female , n (%)	107 (53.24)	61 (50.42)
Birth weight, g (mean ± SD)	2450±630	2735±895
Postnatal Hospitalization, days	5.5 (1-60)	4.8 (1-35)
Chorioamnionitis, n (%)	24 (11.94)	0.0 (0.0)
Cesarean section, n (%)	119 (59.2)	74 (61.15)
Early membrane rupture, n (%)	27 (13.43)	0.0 (0.0)
Mortality, n (%)	38 (18.9)	0.0 (0.0)

n: Number of Cases, EONS: Early onset neonatal sepsis

Table 2: Lab Values (MPV)

Demographics	Eons (201)	Control (121)
MPV (fL) (Median)		
0 hrs	8.2	7.7
24 hrs	8.3	7.9
48 hrs	8.8	7.6

Table 3: validation parameters of the study

Parameters	Sensitivity (%)	Specificity (%)	NPV (%)	PPV (%)
MPV	77.58	55.31	50.00	81.08

DISCUSSION

In the current situation of Pakistan, with limited resources and a high rate of neonatal infections, we must look at this problem with new perspectives. The diagnostic significance of mean platelet volume in early-onset neonatal sepsis has not been documented in the literature so far.

MPV reflects the pro-thrombotic and pro-inflammatory conditions. Active platelets have increased MPV

which means larger platelet size due to increased accumulation of thromboxane A2 and procoagulant surface proteins like glycoprotein IIIa and P-selectin. Since inflammation and a hyper-coagulable condition are associated with increased MPV in septic patients, MPV can be utilized as an integrated marker of both harmful processes in critical illness [29].

According to previous work, on the 1st and 3rd days of sepsis, MPV values were similar in sepsis infants with positive blood cultures [30]. Conversely, Guida et al. found an overall elevation in MPV in patients with sepsis [31].

Our findings suggest a significant diagnostic utility of MPV in diagnosing neonatal sepsis. It is aligned with the perceived conclusions by Tayman et al. and Arayici et al.[30,32]. They suggested that MPV value in sepsis increase, while it goes down after proper therapy. Guclu E from Africa also suggested that MPV remains high in infants with sepsis [33]. Pele-Velez et al presented the same findings that the MPV values are high in infants with neonatal sepsis [34.] These researchers concluded from their research that MPV could be used to diagnose sepsis and monitor the effectiveness of antibiotic treatment.

CONCLUSION

Mean Platelet Volume has high diagnostic utility in the diagnosis of early neonatal sepsis. This parameter can be used in the diagnosis of this condition.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Idrees M:	Main Idea, Research proposal
Rehman MU:	Data Collection and writing
Amir S:	Data Collection and writing
Khan MI:	Data Collection
Waqas M:	Review and proofreading
Rahman IU:	Data Collection Review and Statistical Analysis

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.