

DIAGNOSTIC ROLE OF HEMATOLOGICAL SCORING SYSTEM AS A PRELIMINARY INDICATOR FOR USE OF ANTIBIOTICS IN SEPSIS AMONG NEONATES

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ABSTRACT

BACKGROUND: Sepsis is one of the most common cause of mortality and morbidity in neonates. Use of antibiotics in excessive manner lead to increase in resistance and decrease efficacy. Appropriate patient selection for the use of antibiotics is very necessary to combat this problem.

OBJECTIVE: The objective of this study is to determine the diagnostic significance of hematological scoring system (HSS) in diagnosis of sepsis in neonates and to make call for appropriate use of antibiotics.

METHODOLOGY: The study was conducted in a tertiary care hospital. A total of 85 neonates were selected for the study. For the diagnosis of sepsis, blood culture was kept as gold standard. In all patients, hematological parameters were studied. The data was analyzed using SPSS 24.0. A p-value of <0.05 was considered as statistically significant.

RESULTS: In view of hematological scoring system (HSS), ratio of immature neutrophil to total neutrophil was abnormal followed by immature neutrophils to mature neutrophils. These two parameters were most sensitive in identification of sepsis in neonates. It was also found that certainty of sepsis in neonates was increased by increase in score of HSS. A total score of ≥ 4 was more significant as compared to hematological parameters individually.

CONCLUSION: Hematological scoring system (HSS) is cheap, quick and easy screening measure for the diagnosis of sepsis in neonates. It can reduce the overuse of antibiotics therapy in patients to reduce cost on medication as well as to decrease the antibiotics resistance.

KEYWORDS: Hematological scoring system, sepsis, diagnosis, antibiotics, neonates

INTRODUCTION

Sepsis is the most common cause of morbidity and mortality in neonates¹. Sepsis in neonates (neonatal septicemia) is defined as clinical manifestations (signs and symptoms) along with increased number of bacteria in bloodstream (bacteremia) in first month of life in neonates². There is increased risk of infection in neonates, particularly premature as signs of such infections may be absent or difficult to identify. Therefore fatal sepsis in neonates may occur with minimum alarm³. Timely identification of neonatal sepsis is very important because illness can be rapid and may cause mortality if not controlled⁴. In western countries, the β – hemolytic streptococci (Group B) are most common cause of sepsis in neonates, but in developing countries gram negative rods are the major cause⁵. For the diagnosis of septicemia and bacteremia, blood culture is taken as gold standard investigation. Although the process of identification of sepsis by blood culture takes a lot of time e.g. 48 to 72 hours minimally, and facilities are not readily available in under-privileged areas. The current study is conducted for the assessment of hematological scoring system (HSS) as role in diagnosis of sepsis in neonates and for decision to limit the use of antibiotics to reduce the cost burden on patients and limit the antibiotics resistance.

METHODS AND MATERIALS

This was a prospective study, conducted at a tertiary care hospital. The duration of the study was 8 months (February 2020 to September 2020). A total of 85 neonates were selected for the study. Informed consent was obtained from

parents of the neonates. Neonates with age less than 1 month, clinical suspicion of sepsis or having prompting perinatal factors were included in the study. Neonates with severe jaundice due to any cause were excluded from the study. Detailed history and clinical examination was performed in all patients. Normal control neonates were used as a control group. For the detection of hematological parameters, blood samples were extracted by standard aseptic measure through venipuncture in tube containing EDTA as anticoagulant. All hematological parameters were analyzed by automated hematology analyzer (Mindray BC-1000). Total white blood cell counts were corrected for any presence of nucleated blood cells by microscopy. For the differential white blood cell count, Wright's stain was used for the preparation of smears. Neutrophils having indented nucleus by more than one-half but is had isthmus along lobes was very wide so that two margins were revealed, were defined as band neutrophil⁶. As per Zipursky et al. degenerative changes in neutrophils were categorized as 0 to +4⁷. Myelocytes, promyelocytes, metamyelocytes and band neutrophils were included in immature neutrophils. Toxic granulation, vacuolization and Dohle bodies were included in degenerative changes of neutrophils. According to Rodwell et al. all findings were analyzed as per hematological scoring system (HSS)⁸. Hematological scoring system (HSS) allocates one score for each of 7 criteria which were significantly associated with sepsis (table 1). For an abnormal total count in which mature neutrophils were lacking, a score of 2 was assigned instead of 1 for compensation of low

Immature: Mature ratio. For each of the 7 criteria of hematological scoring system (HSS), specificity, sensitivity, negative and positive predictive value were analyzed.

Blood samples were also sent for culture sensitivity in conventional standard culture bottles and reported after 72 hours. On the basis of culture positivity, the diagnosis of sepsis was confirmed. Infants having negative blood culture but having strong clinical infection history, were termed as probable infection.

A student t-test was applied for the statistical analysis. A p-value of <0.05 was considered as statistically significant.

RESULTS

A total of 85 infants were selected for the study. All patients were categorized as sepsis, probable infection and non-sepsis according to blood culture reports (Figure 1). Patients with positive blood culture reports were allotted in sepsis group. Patients with clinical suspicion of infection but negative culture reports were included in probable infection group. Patients with weak suspicion and negative blood culture reports were included in non-sepsis group.

Male to female ratio in our study was slightly male predominance (1.2:1). Out of 85 patients, 32 (38%) were positive on blood culture. *Escherichia coli* was the most common organism (56%), followed by *Klebsiella*, streptococci and *pseudomonas*. Hematological findings in the context of hematological scoring system (HSS) was evaluated in all patients (Table 3 and 4).

DISCUSSION

Initial signs and symptoms of neonatal sepsis may not be obvious and varies according to age. ⁽⁹⁾ Diagnosis of sepsis/septicemia is defined by blood culture positivity, which takes at least 48 to 72 hours with a positivity in only 10 to 60% cases¹⁰.

By delaying the probable diagnosis of sepsis/septicemia in neonates may cause prolonged and unnecessary exposure to antibiotics. Therefore, relevant clinical parameters are necessary for the help of clinician in diagnosis of sepsis^{9,11}.

In a study by Aggarwal et al. sepsis was the most common cause of morbidity and mortality in neonates and is the sole cause of 30-50% deaths in neonates in developing countries. In tertiary care health facilities, incidence of sepsis in neonates is approximately 38/1,000 live births¹². Hematological parameters in neonates were analyzed by Dulay et al. by assessing 68 neonates. Criteria of laboratory parameters was modified from Rodwell et al. He observed that white blood cell count and absolute neutrophil count were not significant in neonatal sepsis of early onset. Though, relation of hemoglobin, hematocrit, number and absolute counts of bands, lymphocyte and immature: total neutrophil ratio were significant^{12,13}.

In a study by Shirazi et al¹⁴. he demonstrated effectiveness of C-reactive protein and white blood cell count as early septicemia

Table 6: Criteria of Hematological Scoring System (HSS)

Criteria	Defect/Abnormality	Score
Immature: Total neutrophil ratio >0.2	Increased	1
Total neutrophil count	Increased/Decreased	1
Immature: Mature neutrophil ratio	≥0.3	1
Total white blood cell count	Increased/decreased	1
Degenerative neutrophilic changes	≥0.3+	1
Platelet count	≤1,00,000/m ³	1
Total score		
≥5	Interpretation	
3 or 4	Sepsis likely	
≤2	Sepsis suspected	
	Sepsis unlikely	

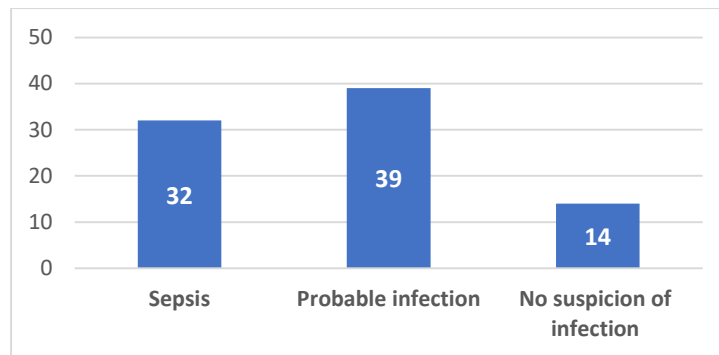


Figure 6: Group Distribution of Patients (n=85)

Table 7: Hematological Scoring System (HSS) Across the Groups (n=85)

Total HSS Score	Patients with Sepsis (n=32)	Patients with Suspicion of Infection (n=39)	Patient with no Suspicion of Infection (n=14)	p-value
≥5	24	12	2	0.002
3-4	7	21	2	0.004
≤2	1	6	10	0.03

Table 8: Performance of Hematological Scoring System (HSS) in Septic Patients (n=32)

HSS Criteria	Specificity	Sensitivity	PPV	NPV
Total White Blood Cell Count	89	49	41	88
Total Neutrophil Count	43	93	22	96
Immature Neutrophil Count	13	82	16	84
Immature: Total Neutrophil Ratio	07	100	17	100
Immature: Mature Neutrophil Ratio	09	100	13	100
Platelet Count	82	71	44	96
Degenerative Neutrophilic Changes	65	52	57	55

PPV = Positive predictive value, NPV = Negative predictive value

indicator in neonates. The major advantage found was the easy performance of hematological scoring system (HSS) and easy application to all neonates¹⁴.

In our study, the findings were in favor of previously performed studies. In this study, it was found that for the diagnosis of septicemia, total white blood cell count had little diagnostic significance due to wide value variations. Total and immature neutrophil count contain low specificity and positive predictive value. Therefore, consideration of these parameters while diagnosing sepsis is less applicable if taken alone. For the consideration of mortality and morbidity, the parameters with increased sensitivity and negative predictive value e.g. immature: total neutrophil ratio and immature: mature neutrophil ratio, are more applicable. Although any single parameters mentioned above is not sufficient for the diagnosis of sepsis, but when all these were combined and analyzed in the shape of hematological scoring system (HSS), an effective and useful screening tool was produced. Although the HSS of ≥ 3 has high sensitivity, the usefulness would be increased if score is ≥ 4 due to high specificity and positive predictive value.

CONCLUSION

For the screening of sepsis in neonates, hematological scoring system (HSS) is very effective diagnostic tool. It standardized and simplified its interpretation due to which it is very easily adaptable measure. Initial diagnosis of sepsis in neonates with the help he hematological scoring system (HSS) may give guidelines for the decision to start antibiotic therapy, reduction in

cost burden on patients and reduction in antimicrobial resistance.

LIMITATIONS

Sample size was small and limited to only neonatal age group. Larger studies on various age groups including adolescents, adults and elders should also be made to see more effective data for the use of hematological scoring system (HSS) as a screening tool in diagnosis of sepsis. Other bio-indicators of sepsis e.g. erythrocyte sedimentation rate (ESR), C-reactive protein, were not included in the study. Correlation of HSS with these parameters may also find beneficial results for more accurate association with sepsis.

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