Original Article

Significance of Hematological Scoring System in Early Diagnosis of Neonatal Sepsis at a Tertiary Care Hospital

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Abstract

Background: Sepsis is the leading cause of death in neonates, accounting for 30%–50% of deaths in developing countries. Early diagnosis of neonatal sepsis remains challenging due to the nonspecific nature of its clinical features. While blood culture is the gold standard for diagnosis, it is time-consuming, taking several days, and can be costly. The Hematological Scoring System (HSS) is an alternative method that utilizes hematologic parameters—such as leukocyte count, polymorphonuclear (PMN) cells, immature PMN count, degenerative changes, and platelet count—for the early diagnosis of neonatal sepsis. Objectives: To determine the significance of the Hematological Scoring System (HSS) for the early detection of neonatal sepsis.

Materials and Methods: This retrospective study enrolled 50 neonates admitted to the NICU at SMS Multi-Speciality Hospital, Chandkheda, Ahmedabad, who were clinically suspected of sepsis. Hematological parameters were measured for all subjects, and each case was analyzed using the HSS.

Results: Among the 50 neonates in this study, the incidence of septicemia was 56% in males and 44% in females. Furthermore, 28% of neonates had an HSS greater than 5.

Conclusion: HSS is a highly sensitive indicator of sepsis. Its use in peripheral smear studies can serve as an effective sepsis screening tool for early diagnosis, thereby helping to reduce neonatal morbidity and mortality.

Keywords:

Hematological Scoring System, neonatal sepsis

Introduction

Sepsis is the leading cause of neonatal mortality and morbidity. Neonatal sepsis is a clinical syndrome characterized by signs and symptoms of infection accompanied by bacteremia within the first month of life. The early signs of neonatal sepsis may be subtle. In developing countries, the incidence of neonatal sepsis ranges from 1.8 to 18 per 1,000 live births, with a mortality rate of 12 to 68 per 1,000 live births. Despite adequate treatment with modern antibiotics, neonatal septicemia remains a challenge due to its high incidence and grave prognosis. Optimal strategies for diagnosis and treatment are difficult to establish.

For early diagnosis of neonatal septicemia, the hematologic scoring system (HSS) developed by Rodwell is preferred because it

incorporates all relevant hematologic parameters. These parameters should reliably predict the presence or absence of infection. The HSS assigns a score of 1 for each of seven hematologic findings, all of which have shown a significant association with sepsis. An exception exists for an abnormal total PMN count, which is assigned a score of 2 if no mature PMNs are observed on the blood smear. The definitive diagnosis of septicemia is made through a positive blood culture. However, because of the high cost of antibiotics, the limited availability of blood culture facilities in some community hospitals, and the delay in obtaining blood culture results, several studies have examined laboratory findings associated with sepsis.

Objective: To provide rapid identification of sepsis based on complete blood count and peripheral blood smear findings in correlation with clinical symptoms, and to avoid the unnecessary use of antibiotics.

Materials and Methods

The present study is a retrospective analysis of the hematological profile of 50 neonates admitted to the neonatal intensive care unit at SMS Multi-speciality Hospital, Chandkheda, Ahmedabad during the period from January 2023 to December 2023. Neonates were enrolled in the study after fulfilling the following inclusion criteria: newborns aged 0 to 28 days, and newborn babies with clinical symptoms and sign of septicaemia. Exclusion criteria: major congenital anomaly, inborn errors of metabolism, neonates who received antibiotics and neonates who received blood transfusion. The blood samples had been collected by peripheral venipuncture using aseptic precautions were sent to the Pathology laboratory in EDTA vacutainer.

The routine hematological investigations included haemoglobin, haematocrit, red blood cell indices (MCV, MCH and MCHC), total WBC count, band cell count, I:T (Immature: Total leucocyte) ratio, I:M(Immature: Mature) ratio degenerative changes and platelet count. These investigations were performed on Mindray BC 6000- Automated Haematology Analyzer with standard calibration. Blood film were prepared and stained with field and Leishman's stain and analysis of the smear findings were done by the pathologists blinded to the infection status of the neonate. The WBC count was corrected for nucleated red cells and a differential count was performed manually. Immature neutrophils included promyelocyte, myelocyte, metamyelocyte and band forms. A band cell was defined as a neutrophil in which, the nucleus was indented by more than half, but in which the isthmus between the lobes was wide enough to reveal two distant margins with nuclear material between. The polymorphonuclear leucocytes were also examined for degenerative morphological changes such as toxic granulation, vacuolization and Dohle bodies

The hematological findings were analysed according to the hematological scoring system of Rodwell et al. which includes the following 7 findings-Total leucocyte count, total Neutrophil (PMN) count, Immature PMN count, Immature to Total PMN ratio (I:T), Immature to Mature PMN ratio (I:M),Platelet count and Degenerative changes in neutrophils. The neonates were analysed according to haematological scoring system and grouped according to the score they got. It helped the clinicians to prioritize and in deciding line of treatment.

Results

We enrolled 50 neonates who suffered from neonatal sepsis from January 2023 to December 2023. Complete blood count and peripheral blood smear tests were conducted, and high sepsis scores (HSS) were identified. Out of the 50 cases, 28 were male and 22 were female neonates. Age group analysis revealed that the majority of neonates, i.e., 78%, were up to 24 hours old, while 14% were between 48 to 72 hours old, and 8% were more than 96 hours old. Out of the 50 cases, a total of 14 neonates had a high likelihood of sepsis (HSS score of ≥ 5).

Table 1: Hematological Scoring System

Criteria	Abnormality	Score
Total WBC count	<5000 >25000(at birth) >30000 (12-24hrs) >21000 day 2 onwards	1
Total PMN count	No mature PMN seen Increased/decreased	2 1
Immature PMN count	Increased	1
I:T PMN ratio	Increased	1
I:M PMN ratio	>0.3	1
Degenerative changes in PMN	Toxic granules/cytoplasmic vacuoles	1
Platelet count	<150000/ul	1

Table 2: Interpretation of HSS

Score	Interpretation
<2	Sepsis less likely
3-4	Sepsis possible
>5	Sepsis very likely

Table 3: Distribution of neonates according to sex

Sex	Frequency	Percentage(%)
Male	28	56
Female	22	44
Total	50	100

Table 4: Interpretation of HSS score in our study

Interpretation	Frequency	Percentage(%)
Sepsis is unlikely (HSS ≤2)	10	20
Sepsis possible (HSS 3or 4)	26	52
Sepsis is very likely (HSS≥5)	14	28
Total	50	100

Table 5: Distribution of neonates according to age

Age	Frequency	Percentage(%)
24 Hours	39	78
72 Hours	07	14
≥96 hours	04	08
Total	50	100

Discussion

Sepsis is the most common cause of neonatal mortality, responsible for approximately 30–50% of total neonatal deaths in developing countries. It is estimated that up to 20% of neonates develop sepsis, with around 1% dying from sepsis-related causes. An early and accurate etiological diagnosis is often challenging, as the disease may initially present with minimal or non-specific symptoms. Delaying treatment until clinical recognition of signs and symptoms of sepsis increases the risk of preventable mortality, although presumptive antibiotic therapy may lead to overtreatment. To reduce the widespread and prolonged use of unnecessary antibiotics and improve outcomes for infants with sepsis, reliable early identification is essential.
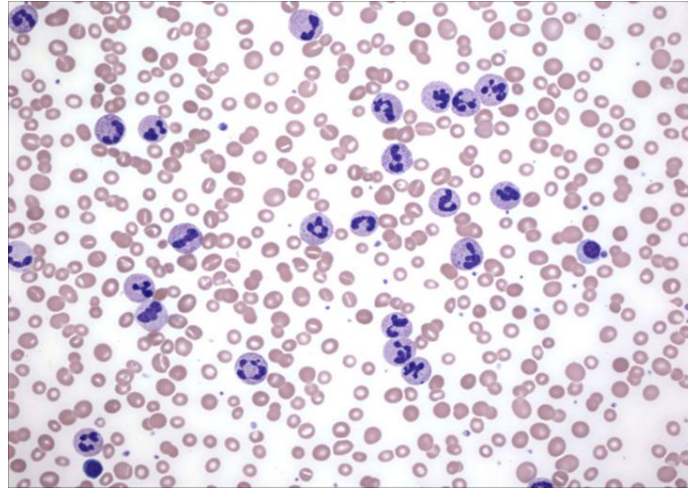
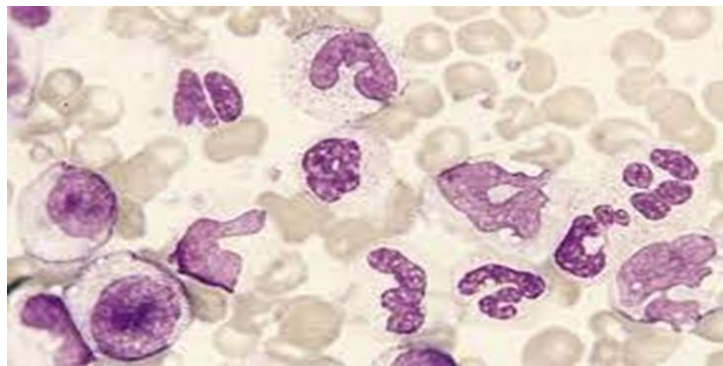*Figure 1: Peripheral Blood Smear Showing Neutrophilic Leucocytosis*

Figure 2: Immature Neutrophils in field stain

This study was designed to assess the performance of the hematological scoring system (HSS) for the early detection of neonatal sepsis in our NICU. In the present study, an HSS score of >3 detected 26 out of 50 cases (52%), making a high HSS score a more reliable predictor of sepsis than a low score, which suggests an absence of disease. A score of ≥3 was predictive of sepsis and served as a more reliable indicator of sepsis than any single parameter. Thus, HSS, which combines seven parameters, is more diagnostic than any single parameter.

Conclusion

In our study, AL patients with hyperdiploidy revealed good prognostic factors, i.e., clinicohematological parameters, while hypodiploidy was associated with poor prognostic factors, although it did not achieve statistical significance. This study suggests that it will be beneficial to perform ploidy analysis by flow cytometry in addition to immunophenotyping at the time of diagnosis. Thus, we recommend that each newly diagnosed acute leukemia case should be analyzed by FCM in addition to karyotyping to assist with early identification and provide prognostically useful information before the initiation of induction therapy and for evaluating aneuploid leukemia following therapy.

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