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Original Research

Prospective research analyzing hematological parameters in cases of newborn sepsis

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ABSTRACT:
Aim: Prospective research analyzing hematological parameters in cases of newborn sepsis. **Materials and methods:** A total of 100 neonates were included in this study. The study included all neonates with features of sepsis and thoseneonates having predisposing factors or history suggestive of sepsis. **Results:** A total of 100 neonates were classified into three categories, sepsis(n=39), probable infection (n=25), and normal (n=36), based on the clinical examination and laboratory findings. The total number of culture positive cases was 42 (42%) and culture was bacteriologically negative in 58(58%) cases. The total number of preterm babies was 56 (56%)while 44(44%) were term babies. Preterm babies were more affected by sepsis than term babies. There were 59 (59%) males and 41(41%) females. 3 (8.33%) of the normal neonates had score ≥5 suggesting the presence of sepsis, 6(16.67%) had scores 3-4 suggesting possibility of sepsis, and 27(75%) normal cases had scores ≤2 which suggested less likely sepsis in these cases. The sensitivity of CRP test was 68% and specificity was 79%. PPV of the CRP test was 69%. White blood cells (WBCs) count had sensitivity of 61% and specificityof 91%. PPV was 83%. This result was statistically significant. Platelet count showed sensitivity of 82%, PPV was 72% and p<0.0001. Cells with degenerative changes showed sensitivity of 71% and specificity of 63%. PPV of the test was 52% and p=0.002. **Conclusion:** Detecting newborn septicemia may be challenging due to the inconspicuous andvarying early symptoms of sepsis at various stages of gestation. The HSS is an uncomplicated, expeditious, and economical instrument that may be used as a screening test for promptly detecting newborn sepsis.
Keywords: Hematological, Newborn, Sepsis, CRP

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INTRODUCTION

Neonatal sepsis is a medical condition characterized by the presence of bacteria in the bloodstream, accompanied by widespread signs and symptoms of infection, occurring during the first four weeks of a baby's life. Pathogenic bacteria that enter the bloodstream may either create a widespread infection without specific localization or become mostly localized in thelungs or meninges [1]. Neonatal sepsis is responsible for about 30-50% of the total neonatal deaths in developing countries. Though, it isa life-threatening condition, yet treatable if diagnosed early. It is a vexing problem because of its nonspecific clinical picture, which makes it difficult to establish an early clinical diagnosis [2]. Newborns, especially the premature are prone to serious infections, because the signs of these infections may be absentor minimal and hard to detect [3]. Thus, fatal septicemia may occur with little warning. Timely diagnosis of sepsis in neonates is critical as the illness can be rapidly progressive andin some instances fatal[4]. The overall incidence of neonatal sepsis occurs between 1and 8 per 1000 live births. In developing countries, mortality rate is between 11-68 per 1000 live births. Neonatal sepsis can be divided into two subtypes: early and late, depending upon whether the onset of symptoms is during the first 72hours of life or later [5].

Early diagnosis of neonatal septicemia is still a great challenge. For early diagnosis of neonatal septicemia, a hematologic scoring system (HSS) of Rodwell [includes total & differential leukocyte count, total

neutrophil count, immature & total neutrophil ratio (IT ratio), immature & mature neutrophil ratio (IM ratio), total immature polymorphonuclear cell (PMNs) count & platelet count] is preferable because it includes all parameters [6]. Haematological parameters accurately predict the presence or absence of infection and are reliable.

MATERIALS AND METHODS

A total of 100 neonates were included in this study.

INCLUSION CRITERIA

The study included all neonates with features of sepsis and those neonates having predisposing factors or history suggestive of sepsis.

EXCLUSION CRITERIA

Neonates born to known immunocompromised mother, with a suspicion of TORCH, malaria, congenital abnormalities, hemolytic jaundice, or inborn error of metabolism, who received antibiotics before taking blood for culture were excluded from the study.

METHODOLOGY

Informed consent was taken from the parents of all the neonates. Taking all aseptic precautions, 2 ml of blood was withdrawn from suspected neonates within 24 h of admission. One milliliter of sample was anticoagulated with EDTA and using Sysmex XS-800i automated hematology analyzer, values of TLC and platelet count were noted and counter checked. Another 1 ml of blood was collected in red Vacutainer and allowed to rest for 30 min. It was then centrifuged and the serum was obtained for CRP estimation. Peripheral blood smear (PBS) was also made from the collected sample and was stained by Leishman's stain. PBS was examined for immature neutrophils and degenerative changes in neutrophils. All PBSs were analyzed in the department of pathology, using HSS as proposed by Rodwell et al. HSS assigns a score of 1 for each of the seven criteria found to be significantly associated with sepsis with the exception of score of 2 for an abnormal total polymorphonuclear neutrophils (PMNs) count. This is done if no mature PMNs are seen on the peripheral smear to compensate for the low I: M (Table1).

Score	Interpretation
≤	Sepsis is very unlikely
3 or 4	Probable sepsis
≥	Sepsis or infection is very likely

Sensitivity, specificity, and positive predictive value (PPV) were calculated for each parameter. p value was also calculated for different parameters. Data were compiled and statistical analysis was done using the SPSS software.

RESULTS

A total of 100 neonates were classified into three categories, sepsis (n=39), probable infection (n=25), and normal (n=36), based on the clinical examination and laboratory findings. The total number of culture positive cases was 42 (42%) and culture was bacteriologically negative in 58(58%) cases. The total number of preterm babies was 56 (56%)while 44(44%) were term babies. Preterm babies were more affected by sepsis than term babies. There were 59 (59%) males and 41(41%) females. The distribution of cases according to sepsis score is given in Table 2. 3 (8.33%) of the normal neonates had score ≥5 suggestingthe presence of sepsis, 6(16.67%) had scores 3-4 suggesting possibility of sepsis, and 27(75%) normal cases had scores ≤2 which suggested less likely sepsis in these cases. In our study, HSS had a sensitivity of 87% and specificity of 79%. HSS had PPV of 75% and p<0.0001. The sensitivity of CRP test was 68% and specificity was 79%. PPV of the CRP test was 69%. White blood cells (WBCs) count had sensitivity of 61% and specificity of 91%. PPV was 83%. This result was statistically significant. Platelet count showed sensitivity of 82%, PPV was 72% and p<0.0001. Cells with degenerative changes showed sensitivity of 71% and specificity of 63%. PPV of the test was 52% and p=0.002 (Table3).

Table 1: Hematological scoring system

Criteria	Abnormality	Score
Total WBC count	≤5000/μL	1
	≥25,000 at birth	1
	≥30,000 after 12–48 h	
	≥21,000 day 2 onward	
Total PMN count	No mature PMN seen	2
	Increased/decreased	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	≤150,000	1

I: T: Immature-to-total neutrophil ratio, I:M: Immature-to-mature neutrophil ratio, ANC: Absolute neutrophil count, PMN: Polymorphonuclear neutrophil, WBC: White bloodcell

Table 2: Distribution of cases according to sepsis score

Sepsis score	Score 0-2 (%)	Score 3-4 (%)	Score >5 (%)	Total
Sepsis	0	5 (12.82)	34 (87.18)	39
Probable sepsis	4 (16)	12(48)	9 (36)	25
Normal	27 (75)	6 (16.67)	3 (8.33)	36
Total cases	32	20	48	100

Table 3: Sensitivity, specificity, and PPV of each test

Investigations	Sensitivity (%)	Specificity (%)	PPV (%)
Total leukocyte count	61	91	83
I:T ratio	93	88	86
I:M ratio	57	93	85
Platelet count	66	82	72
Degenerative changes in PMN	71	63	52
Immature PMN count	95	88	85
PMN count	92	66	66

PMN: Polymorphonuclear neutrophil, I:T: Immature-to-total neutrophil ratio, I:M: Immature- to-mature neutrophil ratio, PPV: Positive predictive value

DISCUSSION

In the present study, the distribution of cases according to sepsis score showed accuracy of 87%. This result was consistent with the studies by Rodwell et al. (96%) and Narasimha and Harendra Kumar (100%)[7,8]. In our study, HSS had a sensitivity of 87% and specificity of 79%. HSS had PPV of 75% and $p<0.0001$. Saleem et al. also found that the HSS was having a sensitivity of 90%, specificity of 74.5%, PPV of 65.9%, and NPV of 93.2% [9]. Manucha et al. observed that hematological score ≥3 had a sensitivity of 86% and NPV of 96% [10]. In our study, there were 59(59%) male and 41 (41%) were female which are similar to the observation made by other authors also. In the present study, 42 (42%) cases were culture positive. Sugandhi et al. [11] observed culture positivity in 42.5% of cases, Namdeo et al.[12]in 50% of cases, and Khatua et al.[13] found culture positivity in 59.8% of cases. In our study, increased or decreased WBC count hada sensitivity of 61%, specificity of 91%, and PPV of 83% which was consistent with other studies. Makkar et al. found that increased or decreased WBC count had a sensitivity of 56.2% and specificity of 91.71% [14]. Thrombocytopenia is associated with poor prognosis in neonatal sepsis. In the present study, 31 of 42 culture- positive cases had thrombocytopenia with a sensitivity of 66%, specificity of 82%, and PPV of 72% which was consistent with other studies. Speer et al. and Rodwell et al. also found thrombocytopenia to be associated with neonatal sepsis. In our study, the sensitivity of CRP test was 68% and specificity was 79%. PPV of the CRP test was 69%. Manroe BL et al observed sensitivity of 61% and specificity of 76% for CRP values[15].

CONCLUSION

Detecting newborn septicemia may be challenging due to the inconspicuous and varying early symptoms of sepsis at various stages of gestation. The HSS is an uncomplicated, expeditious, and economical instrument that may be used as a screening test for promptly detecting newborn sepsis. This applies to all newborns, even those who have had antibiotic treatment prior to assessment, and simplifies the analysis of the hematologic profile.

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