Original Research Article

A prospective study of haematological parameters in neonatal sepsis

Ranjita Kumari[1*], Binod Kumar[2], Purnima Bharati[3]

[1]Tutor, Department of Pathology, Hazaribag Medical College, Hazaribag, Jharkhand, India
[2]Associate Professor, Department of Pathology, Hazaribag Medical College, Hazaribag, Jharkhand, India
[3]Assistant Professor, Department of Pathology, Hazaribag Medical College, Hazaribag, Jharkhand, India

Received: 22-10-2021 / Revised: 28-12-2021 / Accepted: 07-01-2022

Abstract

Introduction: Neonatal sepsis is defined as a clinical syndrome ofbacteraemia with systemic signs and symptoms of infectionin the first 4 weeks of life. When pathogenic bacteria gainaccess into the blood stream, they may cause overwhelminginfection without much localization or may getpredominantly localized to the lung or the meninges. **Materials and Methods:** This was a prospective study done in the departments of Department of Pathology, Hazaribag Medical College, Hazaribag, Jharkhand, India from July 2019 to July 2020. A total of 220 neonates in the department of pediatrics and neonatology were included in the study. 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 Taking all aseptic precautions, 2 ml of blood was withdrawn from suspected neonates within 24 h of admission.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. **Results:** A total of 220 neonates were classified into three categories, sepsis (n=92), probable infection (n=44), and normal (n=84), based on the clinical examination and laboratory findings. The total number of culture positive cases was 92 (41.84%) and culture was bacteriologically negative in 128 (58.18%) cases.The total number of preterm babies was 124 (56.36%) while 96 (43.63%) were term babies. Preterm babies were more affected by sepsis than term babies. There were 132 (60%) males and 88 (40%) females. **Conclusion:** Diagnosis of neonatal septicemia may be difficult as the early signs of sepsis may be subtle and different at different gestational ages. The HSS is a simple, quick, and cost-effective tool which can be used as screening test for early diagnosis of neonatal sepsis. It is applicable to all infants, including those who have received antibiotic therapy before evaluation and simplifies the interpretation of hematologic profile.

Keywords: Neonatal sepsis, EDTA, CRP, TLC, HSS.

Introduction

Neonatal sepsis is defined as a clinical syndrome ofbacteraemia with systemic signs and symptoms of infectionin the first 4 weeks of life. When pathogenic bacteria gainaccess into the blood stream, they may cause overwhelminginfection without much localization or may get predominantly localized to the lung or the meninges[1].

Neonatal sepsis is responsible for about 30-50% of thetotal 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 clinicalpicture. , which makes it difficult to establish an earlyclinical diagnosis[2]. Newborns, especially the premature areprone to serious infections, because the signs of theseinfections may be absent or minimal and hard to detect[3]. Thus,fatal septicaemia may occur with little warning. Timelydiagnosis of sepsis in neonates is critical as the illness can berapidly progressive and in some instances fatal[4].

The overall incidence of neonatal sepsis occurs between 1and 8 per 1000 live births. In developing countries, mortalityrate is between 11-68 per 1000 live births. Neonatal sepsiscan be divided into two subtypes: early and late, dependingupon whether the onset of symptoms is during the first 72hours of life or later[5].

Early diagnosis of neonatal septicaemia is still a great challenge. For early diagnosis of neonatal septicaemia, 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.

*Correspondence
Dr. Ranjita Kumari
Tutor, Department of Pathology, Hazaribag Medical College, Hazaribag, Jharkhand, India.
E-mail: drranjitakumari2014@gmail.com

Materials and methods

This was a prospective study done in the departments of Department of Pathology, Hazaribag Medical College, Hazaribag, Jharkhand, India from July 2019 to July 2020. A total of 220 neonates in the department of pediatrics and neonatology were included in the 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.

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 220 neonates were classified into three categories, sepsis (n=92), probable infection (n=44), and normal (n=84), based on the clinical examination and laboratory findings. The total number of culture positive cases was 92 (41.84%) and culture was bacteriologically negative in 128 (58.18%) cases.The total number of preterm babies was 124 (56.36%) while 96 (43.63%) were term babies. Preterm babies were more affected by sepsis than term babies. There were 132 (60%) males and 88 (40%) females.

The distribution of cases according to sepsis score is given in Table 2. Eight (9.52%) of the normal neonates had score ≥5 suggesting the presence of sepsis, 16 (19%) had scores 3-4 suggesting possibility of sepsis, and 60 (71.4%) normal cases had scores ≤2 which suggested less likely sepsis in these cases.

In our study, HSS had a sensitivity of 86.95% and specificityof 78.12%. HSS had PPV of 74.07% and p<0.0001. Out of 88 cases with reactive CRP, 60 (66%) cases were culture positive
while 28 (22%) were culture negative. The sensitivity of CRP test was 66% and specificity was 78%. PPV of the CRP testwas 68.18%. White blood cells (WBCs) count had sensitivity of 60.86% and specificity of 90.62%. PPV was 82.35%. This result was statistically significant. Platelet count showed sensitivity of 81.25%, PPV was 71.42% and p<0.0001. Cells with degenerative changes showed sensitivity of 70% and specificity of 62.5%. PPVof the test was 51.14% and p=0.0018 (Table3).

Table 1: Hematological scoring system

Criteria	Abnormality	Score
Total WBC count	≤5000/µL ≥25,000 at birth ≥30,000 after 12–48 h ≥21,000 day 2 onward	1 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	≤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 blood cell

Table 2: Distribution of cases according to sepsis score

Sepsis score	Score 0-2 (%)	Score 3-4 (%)	Score >5 (%)
Sepsis (92)	0	12 (13.04)	80 (86.85)
Probable sepsis (44)	8 (18.18)	20 (45.45)	16 (36.36)
Normal (84)	60 (71.4)	16 (19)	8 (9.52)
Total cases (220)	68	48	104

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

Investigations	Sensitivity (%)	Specificity (%)	PPV (%)
Total leukocyte count	60.86	90.62	82.35
I:T ratio	92	89	85.71
I:M ratio	58	92.18	84.37
Platelet count	65.21	81.25	71.42
Degenerative changes in PMN	70	62.5	51.14
Immature PMN count	96	87.50	84.61
PMN count	91.3	65.64	65.62

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 86.96%. This result was consistent with the studies by Rodwell et al. (96%), Narasimha and Harendra Kumar (100%), and Makkar et al. (83.33%). HSS had a sensitivity of 86.95%, specificity of 78.12%, PPV of 74.06%, and net present value (NPV) of 89.2%. 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%. Manucha et al. observed that hematological score ≥3 had a sensitivity of 86% and NPV of 96%[7]. In our study, there were 132 (60%) male and 88 (40%) were female which are similar to the observation made by other authors also.

In the present study, 92 (41.81%) cases were culture positive. Sugandhi et al. observed culture positivity in 42.5% of cases, Namdeo et al. in 50% of cases, and Khatua et al. found culture positivity in 59.8% of cases. In our study, increased or decreased WBC count had a sensitivity of 60.86%, specificity of 90.62%, and PPV of 82.35% 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%[8].Thrombocytopenia is associated with poor prognosis in neonatal sepsis. In the present study, 60 of 92 culture-positive cases had thrombocytopenia with a sensitivity of 65.21%, specificity of 81.25%, and PPV of 71.42% which was consistent with other studies. Shiraji et al. found that thrombocytopenia was 61% sensitive and 82% specific. Speer et al., Rodwell et al., and Basu et al. also found thrombocytopenia to be associated with neonatal sepsis[9].

In our study, CRP had a sensitivity of 66%, specificity of 78%, and PPV of 68.18%. Mathers and Pohlandt observed sensitivity of 61% and specificity of 76% for CRP values. Wagle et al. found CRP values to be 62% sensitive and 87% specific. Chan and Ho observed CRP as 56% sensitive and 72% specific. The study had a few limitations such as the sample size was small and it was not a case–control study[10].

Conclusion

Diagnosis of neonatal septicemia may be difficult as the early signs of sepsis may be subtle and different at different gestational ages. The HSS is a simple, quick, and cost-effective tool which can be used as screening test for early diagnosis of neonatal sepsis. It is applicable to all infants, including those who have received antibiotic therapy before evaluation and simplifies the interpretation of hematologic profile.

References

1. Bang AT, Bang RA, Bactule SB, et al. Effect of home-basedneonatal care and management of sepsis on neonatalmortality: field trial in rural India. Lancet 1999; 354(9194):1955-61.
2. Mathur NB, Saxena LM, Sarkar R, et al. Superiority ofacridine orange-stained buffy coat smears for diagnosisof partially neonatal septicaemia. Acta Paediatr1993;83(6-7):533-5.
3. Xanthour M. Leucocyte blood picture in healthy full termand premature babies during neonatal period. Arch DisChild 1970;45(240):242-9.
4. Speer CP, Gahr M, Schrotter W. Early diagnosis ofneonatal infection. MonatsschrKinderheilkd1985;133(9):665-8.
5. Vergnano S, Sharland M, Kazembe P, et al. Neonatalsepsis: an international perspective. Arch Dis Child FetalNeonatal Ed 2005;90(3):220-4.
6. Khalada B Khair, Rahman MA, Sultana T, et al. Role ofhaematological scoring system in early diagnoses ofneonatal septicemia. BSMMU J 2010;3(2):62-7.
7. Arias F, Daftary SN, Bhide AG. Preterm parturitionsyndrome. In practical guide to high risk pregnancy anddelivery: a south asian perspective. New Delhi: Elsevier2008;3rd ed:193-216.
8. Zipursky A, Palko J et al. The haematology ofbacterial infection in premature infants. Paediatrica1976;57(6):839-53.
9. Rodwell RL, Leslie AL, Tudehope DI. Early diagnosis ofneonatal sepsis using a haematological scoring system. JPaediatr 1988;112(5):761-7.
10. Manroe BL, Weinberg AG, Rosenfeld CR, et al. Theneonatal blood count in health and disease reference values for neutrophilic cells. J Paediatr 1979;95(1):89-98.

Conflict of Interest: Nil Source of support: Nil