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Role of Hematologic Scoring System In Early Diagnosis of Neonatal Septicemia In A Tertiary Care Hospital Of Lower Assam

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ABSTRACT

Neonatal septicemia is the commonest cause of neonatal morbidity and mortality. Objective : To determine role of Hematologic Scoring System (HSS) in early diagnosis of neonatal septicemia in a tertiary care hospital of Lower Assam. Method: A prospective study of 95 neonates with predisposing factors or clinically suspected cases admitted in NICU, FAAMCH was done. The hematological parameters using HSS of Rodwell et al was studied in all cases. Blood culture was taken as standard indicator for septicemia. Results : 20 (21.1%)out of 95 neonates had culture proven sepsis out of which 15% had score 3-4 and 85% had score ›5. HSS had a sensitivity of 85%, specificity of 86.67%, negative predictive value of 95.58%,positive predictive value of 62.96% and accuracy of 86.31% in our study. Conclusion : HSS is a highly sensitive and specific tool which can aid neonatologists in early diagnosis of neonatal septicemia and institute proper antibiotic therapy while awaiting culture reports.

KEYWORDS : Neonatal septicemia, Hematologic scoring system (HSS), Blood culture

Introduction

Neonatal septicemia is the commonest cause of neonatal mortality and morbidity. [1, 2] According to National Neonatal Perinatal Database (NNPD, 2002-03) data incidence of neonatal septicemia is 30 per 1000 live births.[3] In developing countries 30 – 50% of the total neonatal deaths is due to neonatal septicaemia.[2]

Neonatal septicemia refers to a clinical syndrome characterized by systemic signs and symptoms due to generalized bacterial infections with a causative blood culture in the first four weeks of life. When clinical and laboratory findings are consistent with bacterial infection but blood culture is sterile the neonate is labeled as having probable sepsis.[4] Clinical signs and symptoms of neonatal sepsis are subtle and hard to detect. A positive blood culture is the gold standard for diagnosis of neonatal septicaemia.[4, 5]But blood culture reports take 48 – 72 hours resulting in treatment delay.

Due to the risks of permanent morbidity and mortality early recognition, diagnosis and treatment of serious infections in the neonate is essential. Neonatologists have a critical need for laboratory tests that aid in the early diagnosis of neonatal sepsis. The hematologic parameters should accurately predict the presence or absence of infection and be reliable. Hematologic scoring system (HSS) of Rodwell can be used for early diagnosis of neonatal septicemia because it includes multiple parameters.

The current study was taken to determine the role of hematologic scoring system in early diagnosis of neonatal septicemia in a tertiary care hospital of Lower Assam.

Materials and methods –

The present study is a prospective analysis of the hematologic profiles of the neonates admitted in neonatal intensive care unit of Fakhruddin Ali Ahmed Medical College and Hospital from January 2015 to January 2016. 95 neonates who were clinically suspected to have bacterial infection based on predisposing perinatal risk factors and clinical features were taken as study group. Neonates with clinical features suggestive of septicemia receiving antibiotics, neonates with hemolytic jaundice, congenital anomalies and inborn errors of metabolism were excluded from the study. Informed consent was obtained from the parents of all the neonates. Detailed history and clinical findings were recorded in the proforma.

Under complete aseptic conditions, blood sample was obtained by peripheral venipuncture. 1 - 1.5 ml blood was inoculated aseptically into pediatric blood culture bottle HIMEDIA BHI supplemented with w/0.05% sps and sent to Department of Microbiology, FAAMCH for culture and sensitivity. 1.5 ml blood sample was anticoagulated with tripotassium EDTA in vaccutainers to study hematologic parameters in the Department of Pathology, FAAMCH, Barpeta. Sysmex 5 parts automated analyser XS800i was used for obtaining RBC Count, Hb, uncorrected WBC count and Platelet Count. Peripheral blood smear stained with Leishman stain was examined for nucleated RBC, differential count, absolute neutrophil count, immature neutrophils, band forms and degenerative changes in neutrophils. Immature: total PMN ratio and Immature: mature PMN ratio was calculated.

Rodwell et al[6] formulated a scoring system in their study based on normal values, defined by Manroe et al.[7] HSS of Rodwell *et al* assigns a score of 1 for each of seven findings significantly associated with sepsis: Abnormal total leukocyte count, abnormal total PMN count, elevated immature PMN count, elevated immature to total (I: T) PMN ratio, immature to mature (I: M) PMN ratio ≥0.3, platelet count ≤150,000/mm ^{3}, and pronounced degenerative or toxic changes in PMNs. An abnormal total PMN count is assigned score of two instead of 1, if no mature polymorphs are seen on the peripheral smear to compensate for the low I: M ratio.

Table 1: Hematologic scoring system of Rodwell et al

Criteria	Abnormality	Score
Total WBC Count	≤ 5000/µl ≥25000 at birth ≥30000 at 12-24 hours ≥21000 from day 2 onwards	1 1 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/ Dohle bodies	1
Platelet count	≤1.5 lakhs/µl	1

The normal values according to Manroe et al:
Total PMN Count – 1800-5400
Immature PMN Count- 600
Immature: total PMN ratio- 0.12
Immature: mature PMN ratio – 0.3

Immature polymorphs include promyelocyte, myelocyte, metamyelocyte and band forms. Band cell is described as a PMN in which the nucleus is indented by more than one-half, but in which the isthmus between the lobes is wide enough to reveal two distinct margins with nuclear material in between. Degenerative changes include vacuolization, toxic granulations and Dohle bodies.

Score of ≤2 was interpreted as sepsis unlikely; score 3-4: Sepsis is possible and ≥5 sepsis or infection is very likely. Minimum score that can be obtained is 0 and maximum score, 8.

Statistical analysis

Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) was calculated for each parameter. Data was compiled and statistically analyzed by using SPSS software.

Results

The study included 95 neonates which were classified into 3 categories based on clinical findings and laboratory data. (Table 2.1) The diagnosis of blood sepsis was made when there were positive findings on blood culture. Neonates were classified as having probable when the blood culture was negative but there was strong clinical history of infection. Neonates were considered to be normal when blood culture was negative and there was no strong clinical evidence of infection.

Table 2.1- Group distribution of cases according to sepsis score

Groups	Score 0-2 (%)	Score 3-4 (%)	Score › 5(%)	Total cases (%)
Sepsis	0	3 (15%)	17 (85%)	20 (21.1%)
Probable sepsis	12 (33.3%)	16 (44.5%)	8 (22.2%)	36 (37.9%)
normal	27 (69.2%)	10 (25.7%)	2 (5.1%)	39 (41%)
Total	39 (41.4%)	29 (30.5%)	27 (28.4%)	95 (Grand total)

The study had more number of males (67.4%) than females (32.6%). There were 53 (55.8%) preterm and 42 (44.2%) term neonates. Most of them presented at 0 – 24 hours (25.3%) with age ranging from 0-27 days. (Table 2.2)

Table 2.2- Age and sex distribution of cases

Age	Males (%)	Females (%)	Total (%)
0-24 hrs (Day 1)	17(70.8%)	7(29.2%)	24(25.3%)
24-48 hrs (Day 2)	13(68.4%)	6(31.6%)	19(20%)
48-72hrs (Day 3)	9(4.4%)	10(52.6%)	19(20%)
72-96hrs (Day 4)	8(66.7%)	4(33.3%)	12(12.6%)
› 96 hrs	17(81%)	4(19%)	21(22.1%)
Total (%)	64(67.4%)	31(32.6%)	95 (Grand total)

17 out of 20 cases which were culture positive were also sepsis positive on HSS. (Table 2.3)

Table 2.3 – Distribution of cases according to sepsis on blood culture and sepsis on Hematologic scoring system

	Sepsis positive on blood culture	Sepsis negative on blood culture	Total
Sepsis positive on HSS	17 (63%)	10(37%)	27
Sepsis negative on HSS	3(4.4%)	65(95.6%)	68
Total (%)	20(21.1%)	75(78.9%)	95(Grand total)

Immature: total PMN ratio (95%) was highly sensitive followed by Immature: mature PMN ratio (90%) in identifying infants with sepsis. Total leukocyte count (89.3%) followed by Immature: mature PMN ratio (86.6%) was highly specific in diagnosing sepsis.PPV was high for total leukocyte count (65.21%) followed by Immature: mature PMN ratio (64.28%) which was helpful in identifying neonates who really had sepsis. NPV was high in Immature: total PMN ratio (98%), Immature: mature PMN ratio (97.01%) and degenerative changes (94.73%) which indicated that neonates did not have any evidence of sepsis. HSS had a sensitivity of 85%, specificity of 86.67%, NPV of 95.58%, PPV of 62.96% and accuracy of 86.31% in our study. So HSS can be a useful tool for diagnosis of neonatal septicemia as it has high sensitivity, specificity and accuracy. (Table 2.4)

Table 2.4 shows performance of individual hematologic parameters of Hematologic scoring system as well as Hematologic scoring system as a whole.

Parameters	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Total WBC count	75	89.3	65.21	93.05	86.31
Total PMN count	90	76	50	96.6	78.4
Immature PMN count	90	80	56.25	96.77	82.10
Immature : total PMN ratio	95	68	44	98.07	73.68
Immature : mature PMN ratio	90	86.67	64.28	97.01	87.36
Degenerative changes	85	72.66	44.73	94.73	74.74
Platelet count	80	54.66	32	91.11	60
HSS	85	86.67	62.96	95.58	86.31

Discussion-

Early recognition, diagnosis and treatment of neonatal septicemia have always been a challenge to the clinicians. Clinical signs and symptoms are often not detectable resulting in increased risk of neonatal morbidity and mortality due to delay in treatment. On the other hand, presumptive antibiotic therapy may lead to increase in the emergence of drug resistant organisms.

Although blood culture is considered to be the gold standard for diagnosis of septicemia, the technique is time consuming and demands a well equipped laboratory. Blood culture reports take minimum 48 – 72 hours and yield of blood culture is also low (10-60%).[4, 5] In our study 20 (21.1%) out of 95 neonates had culture proven sepsis. However, suspected sepsis group (78.9%) comprises a difficult diagnostic group and could not be ignored as there have been reports of fatal infections in suspected neonates with negative blood culture.[8]

An ideal diagnostic test for diagnosing neonatal septicemia should have high sensitivity and specificity. Test should be cheap, easily performed with quick availability of results. Though there are several methods of rapid detection of microorganisms in suspected neonates using automated blood culture system, DNA probe and fluorometric detection systems[9, 10, 11] these are sophisticated and are not readily available in all hospitals. Even our hospital which is a tertiary care teaching hospital does not have any of these facilities.

In our study considering all four parameters i.e.: sensitivity, specificity, positive predictive value and negative predictive value I: M ratio and I: T ratio were the most reliable tests for diagnosing neonatal septicemia. Degenerative changes in neutrophils were not found to be a very sensitive indicator of sepsis. Thrombocytopenia was consistently associated with poor prognosis. These findings were in comparison with other studies (Rodwell et al, Narasimha et al, Khair et al) [6, 12, 13]

HSS had a high sensitivity, specificity, positive predictive value and negative predictive value in our study. The higher the score the greater was the likelihood of sepsis. A score ≤2 suggests that sepsis was unlikely. It can improve the efficiency of complete blood count as a screening test for neonatal septicemia and provide guideline to decision regarding antibiotic therapy while awaiting the culture report.

Conclusion-

HSS is a highly sensitive and specific test for early diagnosis of neonatal septicemia. It is also simple, quick,cost effective and includes multiple hematologic parameters. It can aid the neonatologists in early detection of neonatal septicemia and institute proper antibiotic therapy thereby reducing the morbidity and mortality as well as minimize the risk of drug resistance due to misuse of antibiotics.

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