

Original Research Article

Evaluation of haematological scoring system as a screening tool for early detection of neonatal sepsis

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Received: 08 June 2023

Revised: 12 October 2023

Accepted: 18 October 2023

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ABSTRACT

Background: Early diagnosis of neonatal septicemia is a vexing problem because of its nonspecific clinical picture. Hence the timely diagnosis of sepsis in neonates is critical as the illness can be rapidly progressive and, in some instances, fatal. The current study was undertaken to assess the significance of the hematological scoring system (HSS) for early detection of neonatal sepsis. Objectives were to assess the effectiveness of HSS in early detection of neonatal sepsis by comparing it with blood culture result, in neonates who were clinically suspected to have bacterial infection

Methods: This is a descriptive study done in TDMCH, Vandanam for a period of 1 year. All babies who were at risk of developing sepsis were studied after applying inclusion and exclusion criteria. Blood samples were collected and subjected to sepsis work up. HSS scoring was done. Sensitivity, specificity, positive predictive value (PPV), Negative predictive value (NPV) of HSS and each of its components were calculated.

Results: Among the 85 neonates studied, 39 (45.9%) were blood culture positive, 42 (49.4%) had HSS score of 5 or more. HSS score had sensitivity of 92.31%, specificity of 86.96%, PPV of 85.71% and NPV of 93.02%.

Conclusions: HSS score of ≥ 5 had high NPV and would play a major role in ruling out neonatal sepsis.

Keywords: HSS, Neonatal sepsis, NPV

INTRODUCTION

Neonatal sepsis is defined as a disease with positive blood culture during the first month of life. It is more common in developing countries compared with developed countries.¹ Neonatal sepsis is associated with a mortality rate that ranges from 13 to 60% in spite of improved antibiotic therapy and care.² Neonatal sepsis is a life-threatening condition, but treatable if diagnosed early. Unfortunately, the early warning signs and symptoms are often nonspecific and can easily be confused with those from non-infective causes. These nonspecific signs and symptoms make it difficult to establish an early clinical diagnosis. The antibiotic therapy is usually initiated based on the clinical suspicion which may result in overtreatment ultimately leading to

emergence of multi drug resistant organisms. In addition, high cost of antibiotics overburdens already underprivileged parents.³ Blood culture is still considered to be 'gold standard' for diagnosis of septicemia however, its accuracy has been questioned because of spurious positive results due to contamination and negative blood cultures in fatal generalized bacterial infections. Yield of a positive blood culture ranges from 8-73% as shown in various studies.³ Moreover, technique of blood culture is time consuming and demands well-equipped laboratory which is not available in most of the community hospitals. When blood and other sterile site cultures are negative, but infant manifests signs consistent with infection they may be considered to have "clinical" sepsis. Importantly, positive blood culture is not required to meet consensus definition for sepsis in

adults and children.⁴ Therefore, there is a need for a test that is cheap, easily performed with quick availability of reports. An ideal diagnostic test for neonatal sepsis should have maximum sensitivity and specificity. In recent years, various investigators have evaluated some highly sensitive and specific inflammatory markers to diagnose neonatal sepsis.³ Although these markers are sensitive and specific, they are sophisticated and expensive and impractical for developing countries.³ HSS by Rodwell et al appears feasible, simple, less time consuming and economical.^{5,6} Hence present study is undertaken to evaluate significance of haematological profile in early diagnosis of neonatal sepsis.

METHODS

A hospital based descriptive study was done after getting approval from the institutional research and ethics committee. The study was done in the NICU of TD medical college, Vandanam for a period of one year from April 2021 to April 2022. Sample size calculated using formula, $n=4pq/d^2$ where p =sensitivity of HSS, $q=1-p$, $d=10\%$ of sensitivity. In study done by Moshira et al HSS was found to have sensitivity of 97%. $n=12$, no of neonates with sepsis. Based on statistics from records, prevalence of sepsis in our institution is 15%. In order to get 12 neonates with sepsis, we had to study 80 neonates at risk of sepsis ($n/p=12/15$). Neonates were selected by consecutive sampling after applying inclusion and exclusion criteria. All babies clinically suspected to have sepsis based on symptoms/risk factors for sepsis were included in study. Babies who received transfusion of blood product before taking blood sample for sepsis work up, took antibiotics before taking blood sample for sepsis work up, with other identified causes of thrombocytopenia, mixed bacterial growth or commensal on culture were excluded from the study. Blood sample collections were done from peripheral vein under aseptic precautions. Collected samples subjected for sepsis work up which included CBC (complete blood count), peripheral smear and blood culture and sensitivity. In all blood culture positive cases and strongly suspected meningitis CSF study was done. Diagnosis of sepsis was made when there were positive findings on blood culture. Infants were classified as having probable sepsis when blood culture was negative, but there was a strong clinical history of infection. Infants were considered normal when blood culture was negative and there was no strong clinical evidence of infection.

Statistical analysis

Data was tabulated using Microsoft excel and presented with the help of descriptive statistics using SPSS software. For quantitative variables, findings were analysed for frequency and percentage. HSS scoring was done. Sensitivity, specificity, PPV, NPV of HSS as well as its components were calculated. All neonatal and maternal risk factors for sepsis, and HSS scores were compared with blood culture results.

RESULTS

Among the 85 neonates studied, 39 (45.9%) were blood culture positive, 42 (49.4%) had HSS score of 5 or more. HSS score had sensitivity of 92.31%, specificity of 86.96%, PPV of 85.71% and NPV of 93.02%.

Table 1: Percentage distribution of sample according to blood culture positivity.

Variables	N	Percentage (%)
Yes	39	45.9
No	46	54.1
Total	85	100

The 45.9% of neonates had positive blood culture results.

Table 2: Percentage distribution of sample according to HSS score.

Variables	N	Percentage (%)
5 or more (Sepsis is very likely)	42	49.4
3 or 4 (Sepsis possible)	20	23.5
2 or less (Sepsis unlikely)	23	27.1
Total	85	100

The 49.4% of neonates had HSS score of 5 or more

Table 3: Sensitivity, specificity, PPV and NPV of HSS score.

Variables	Blood culture	
	Positive	Negative
Score ≥ 5	36	6
Score < 5	3	40
Variables	Value (%)	95% CI
Sensitivity	92.31	79.13-98.38
Specificity	86.96	73.74-95.06
PPV	85.71	73.89-92.71
NPV	93.02	81.72-97.55
Accuracy	89.41	80.85-95.04

HSS score had maximum NPV of 93.02%

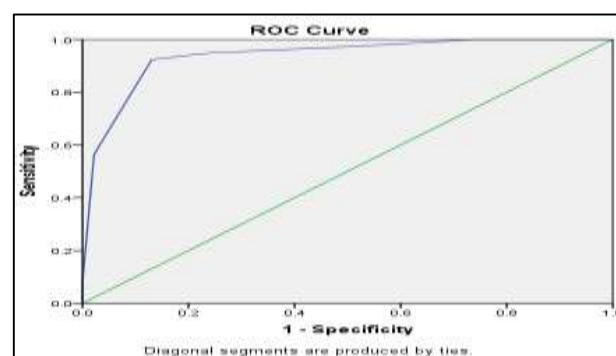


Figure 1: ROC curve analysis for sepsis with total HSS score.

Table 4: Interpretation of ROC curve of HSS core.

Area under the curve	P value	95% CI	Cut off	Sensitivity	Specificity
0.937	<0.001	0.885-0.989	3.5	94.9%	76.1%

The area under the curve is 0.937 which is statistically significant ($p < 0.001$). So total HSS score is a good predictor for sepsis. The cut off for total score is 3.5 with a sensitivity of 94.9% and specificity of 76.1%.

DISCUSSION

Bacterial sepsis is one of the most common challenges in newborn medicine. Neonates are more susceptible to infection because of the immature development of the immune system.⁷ Our study aims to assess the effectiveness of haematological scoring system in early detection of neonatal sepsis by comparing it with blood culture result in neonates who were clinically suspected to have bacterial infection. According to inclusion and exclusion criteria, 85 neonates were studied. 39 cases were culture positive, 85.9% of neonates enrolled in the study had early onset sepsis. Out of 85 neonates 54 (63.5%) were male and 31 (36.5%) were female. Majority of neonates were preterm with 31.8% moderate preterm, 28.2% late preterm, 27.1% very preterm, and 11% were term. Considering mode of delivery, caesarean section contributed most with 63.5% and vaginal delivery 36.5%. According to study done by Derbala et al males were more represented than females (60% and 40%, respectively). Most of the neonates (60%) were preterm. 50% of them was delivered by caesarean section.⁸ According to study by Mary, 59% of babies were males and 41% females. 54% of neonates were preterm. 58% were delivered by caesarean section.⁹ In our study majority of neonates were having low birth weight with 51.8%, 24.7% very low birth weight, 7.1% extremely low birth weight, and 14% with normal weight. The most common neonatal risk factors for sepsis in the study were prematurity/low birth weight (84.7%) followed by central venous catheterization (74.1%). The most common maternal risk factors were PPRM (40%) followed by ROM > 18 hours (23.5%). According to study in Tirunelveli, prematurity (54%) was most common risk factor for sepsis followed by PPRM (24%).⁹ Among symptoms most common was lethargy/irritability (70.5%) followed by tachypnea (64.7%) in our study. According to study by Mary feed intolerance (59%) was most common clinical symptom followed by respiratory distress (32%).⁹ There was statistical association between sepsis and central venous catheterization, and there was also statistically significant association between HSS score and sepsis. In our study 49.4% of neonates had HSS score ≥ 5 , 23.5% had score 3 or 4, 27.1% had score ≤ 2 . HSS score had a sensitivity of 92.31%, specificity of 86.96%, PPV of 85.71% and NPV of 93.02%. According to study done in 2019 at Tirunelveli, HSS score had sensitivity of 13.3%, specificity of 100%, PPV of 100% and NPV of 72.9%.⁹ According to study in Egypt, HSS

score had sensitivity of 95%, specificity of 96.7%, PPV of 26% and NPV of 100%.⁸

In our study immature neutrophil count > 600 had maximum sensitivity (97.44%) and NPV (93.33%). Total count ≤ 5000 had maximum specificity (97.83%), immature: mature neutrophil count ratio ≥ 0.3 had maximum PPV (83.78%). According to study by Narasimha, total PMN count (89.47%) was highly sensitive followed by immature PMN count (78.94%) in identifying infants with sepsis. Total leucocyte count (TLC) (91.66%) followed by immature: total PMN ratio (75%) and platelet counts (75%) were highly specific. The positive predictive value was high for immature: total PMN ratio (88.88%) followed by platelet count (85.71%). Negative predictive value was high in degenerative changes (40%) along with I:T PMN ratio which indicated that the infants did not have any evidence of sepsis.¹⁰ According to study done by Derbala et al thrombocytopenia and degenerative changes were highly sensitive (100%). I/T ratio and I/M ratio had highest specificity. Thrombocytopenia had highest NPV and total count had highest PPV.⁸ According to study by Bhalodia et al total leukocyte count showed high specificity (74.5%) but least sensitivity (66.7%). ANC showed high specificity (92.1%) but least sensitivity (45.8%). I:T ratio showed high specificity (92.1%) and high sensitivity (91.6%). I:M ratio showed high specificity (94.2%) and high sensitivity (93.7%). Platelet count showed high NPV (58%) and least positive predictive value (PPV) (56%).¹¹

Limitations

The peripheral smear results were not reported by a single person which might have leads to inter observer variation.

CONCLUSION

HSS is a simple feasible, quick, cost-effective tool which can be used as a screening test for early identification of neonatal sepsis. There is significant association between HSS score and blood culture positivity, making it an important screening tool. HSS score of ≥ 5 had high NPV and would play a major role in the ruling out neonatal sepsis.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee by Govt. TD Medical College, Vandanam, Alappuzha. No:19/2021

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Cite this article as: Radhakrishnan A, Sankar KRJ. Evaluation of haematological scoring system as a screening tool for early detection of neonatal sepsis. *Int J Contemp Pediatr* 2023;10:1841-4.