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Original Research Article

Diagnostic Utility of Hematological Scoring System in Detection of Neonatal Sepsis

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Abstract

Background: Neonatal sepsis is one of the important causes of morbidity and mortality in the neonatal period. *Objectives:* To analyse the hematological findings according to Rodwells hematological scoring system and correlation with blood culture. *Materials and methods:* A Total of 120 neonates were included in the study. Blood samples from 120 neonates were subjected to blood culture and Hematological scoring system (HSS). They were divided in to 3 groups i.e group 1 (proven sepsis - 32), group 2 (probable sepsis - 56) and group 3 (Normal infant - 32). *Results:* Out of 120 infants, 32 had positive blood culture. Majority (66.6%) were preterm. Male to female ratio was 1.7:1. Out of 32 sepsis cases, 27 (84.3%) had predominant score was 5 $\geq$. Maximum number of cases 31 (55.31%)) showed score with 3-4 in probable sepsis group. Association of hematological parameters and scores was found to be statistically significant ($p<0.05$). Majority of parameters found to have high sensitivity while platelet count and Total Neutrophils count (TNC) had high specificity. Combination of hematological tests found to have high sensitivity and specificity when compared to single hematological test. *Conclusion:* Hematological scoring system is easy, cheap and cost effective screening tool for early diagnosis of neonatal sepsis.

Keywords: Hematological Scoring System; Hematological Parameters; Culture; Neonatal Sepsis.

Introduction

Neonatal sepsis is one of the commonest causes of neonatal death contributing to 16% of all intra mural deaths [1]. It is clinical syndrome characterised by signs and symptoms of infections with or without accompanying bacteraemia in the first month of life due to path physiologic effects of infection. The incidence of neonatal sepsis is approximately 30/1000 live births in India [1]. The infection can be contracted from the mother via ascending infection transpacental route, exposure to infected blood at delivery and invasion of blood stream by bacteria in the first 4 week of life [2]. Early detection of neonatal sepsis is vexing problem due its non specific presentation and the unavailability of tests.

The new born infants are more prone to bacterial infection due to their weak immune system and premature babies are more susceptible. Infection are more common in low birth weight and preterm babies [3]. Positive blood culture is gold standard investigation for diagnosis but it is time consuming and yield is low [4]. Various studies have shown that haematological parameters are simple quick and cost effective diagnostic tests for diagnosis of neonatal sepsis. The present study is undertaken to evaluate the utility of the HSS in the early diagnosis of sepsis.

Materials and methods

This prospective study was carried out in the department of pathology, Narayana Medical College & Hospital during the period of June 2 to May 2017. A total number of 120 neonates were included in the study. Neonates who were clinically suspected to have infection with in 1st month of life based on risk factors and clinical features were taken as study group. Neonates reporting to the department for immunization or attending well baby clinics were taken as controls. Neonates were divided into 3 groups mainly.

Group 1 (Proven sepsis -32) with clinical suspicion of sepsis and positive blood culture

Group 2 (Probable sepsis -56) with clinical suspicion of sepsis and negative blood culture

Group 3 (control=32 normal infant)-without any clinical suspicion of sepsis but negative blood culture

Inclusion criteria

All clinical suspected cases of neonatal sepsis included in the study.

Exclusion criteria

Neonates of mother with PIH and Diabetes.

Neonates who received antibiotics before admission.

Neonates who received blood transfusion before collection of sample.

Congenital anomalies and birth asphyxia.

Under complete aseptic conditions 0.5 to 1ml of blood sample was obtained by peripheral venipuncture.

The blood samples were collected in non siliconized vacuum tubes with tripotassium EDTA as an anticoagulant. Sepsis workup includes complete blood counts along with HSS culture and c-reactive protein. Automated haematology analyser (sysmex XN 1000) was used to analyse the sample and was counter checked by peripheral smear examination. Peripheral blood smears were stained by Leishman method.

Smears were analysed according to Rod Well etal. Haematological scoring system (HSS) [5] assesing the reference values of Manroe et al. [6] (Table 1). The HSS had assigned a score of one for 7 each parameters, found to be associated with sepsis. The total score varies from 0 to 8. These parameters namely abnormal total leukocyte count, abnormal total neutrophil count, elevated immature neutrophil (promyelocyte, myelocyte, metamyelocyte and band form), Immature neutrophil: Total neutrophil, Immature neutrophil: Mature neutrophil, degenerative changes in neutrophils and platelet count. An abnormal total neutrophil count is assigned score of 2 instead of 1 if no mature neutrophils are seen on the peripheral smear to compensate for low I: M ratio. The total score varies from 0 to 8. Interpretation of sepsis score includes, sepsis score < 2 indicating that sepsis was unlikely, score 3-4 indicates probable sepsis and sepsis score ≥5 indicates sepsis is very likely.

Statistical analysis

Sensitivity, specificity and P value were calculated for each parameter of hematologic scoring system and CRP (C - reactive protein) and p value <0.05 was considered as significant.

The statistical analyses were performed using SPSS version 21.0.

Results

Infants were considered to be normal when the blood culture was negative and there was no strong clinical evidence of infection. The sepsis diagnosis was made when there was blood culture positive with clinical evidence of infection. Infants were classified as probable sepsis when the blood culture was negative but there was a strong clinical history of infection. Out of the 120 infants, based on laboratory data, clinical features were classified in to 3 categories i.e sepsis(32 cases), probable infection (56 cases) and normal (32 cases) (Table 2). The study had 77 (64%) males and 43 (35.8%) females with male to female ratio was 1.7:1. 40 (33.3%) were term and 80 (66.6%) were pre term. Commonest manner of delivery was lower segment caserian section

than normal vaginal deivery in proven sepsis (75%) and probable sepsis group (73.21%). Lower birth weight (87.5%) and preterm 28(87.5%) and male gender babies (65.6%) were predominantely noted in proven sepsis than probable sepsis and normal infants groups. Commonest form of presentation was poor neonatal feeding (68.18%) followed by lethargy (29.5%) (Table 3). Commonest asssociated maternal risk factor was premature rupture of membrane in our study (Table 3). In culture positive cases, Gram negative infection was found in 24 (75%) cases where as 25 (8%) cases showed

Table 1: Hematologic Scoring System [5]

Criterion	Abnormality	Score
Total Leukocyte Count(TLC)	≤ 5000/microliter	1
	≥25,000/microlitre at birth ≥30,000/microlitre-12-24 hours after birth ≥21,000/microlitre-day 2onwards	1
Total Neutrophil count(T)	Increase/Decrease	1
	No mature PMN seen	2
Immature Neutrophils count(I)	Increase	1
Immature: Total neutrophil ratio(I:T)	>0.2	1
Immature: Mature neutrophil ratio(I:M)	≥0.3	1
Degenerative changes in neutrophils	toxic granules/cytoplasmic vacuoles/Dohle bodies	1
Platelet Count	≤1,50,000/mm3	1

Normal values [6] - Total Neutrophil count -1800-5400
Immature neutrophils count -600

Table 2: Association of neonatal profile with neonatal sepsis

Patients profile	Proven Sepsis(32)	Probable sepsis(56)	Normal (32)	Total (120)
		Gender		
Male	21 (65.6%)	38(67.8%)	18(56.2%)	77(64.1%)
Female	11(34.3%)	18(32.1%)	14(43.75%)	43(35.83%)
		Term		
Preterm	28(87.5%)	42(75%)	10(31.25%)	80(66.6%)
Term	4(12.5%)	14(25%)	22(68.7%)	40(33.3%)
		Weight		
<2.5 kg	28(87.5)	34(60.7%)	2(6.2%)	64(53.3%)
>2.5 kg	4(12.5%)	22(39.2%)	30(93.7%)	56(46.6%)
		Manner of delivery		
LSCS	24(75%)	41(73.2%)	4(12.5%)	69(57.5%)
NVD	8(25%)	15(26.7%)	28(87.5%)	51(42.5%)

Table 3: Common clinical features in cases presenting with features of sepsis

Clinical features/ risk factors	Frequency	Percentage (%)
	Clinical features	
Poor neonatal feeding	60	68.18
Lethargy	18	20.45
Hypothermia	8	9.09
Respiratory distress	2	2.27
	Maternal risk factors	
Premature rupture of membrane (>24hrs)	55	62.5
Maternal fever >38^{o} C	20	22.72
Urinary tract infection	10	11.36
Foul smelling liquor	3	3.40

gram positive infection (Table 4). Table 5 shows scores of each group. Maximum no of proven sepsis group showed score ≥ 5 (84.3%). Maximum no of infants with probable sepsis group showed score 3-4 (55.35%). Maximum number of normal infants had score 0-2 (65.62%). On comparative analysis of tests used in proven sepsis cases showed I: T ratio (100%), I: M ratio (100%), Immature PMN count (90.62%), total leucocyte count (96.8%) and CRP (100%) had maximum sensitivity and while platelet count (78.18%), Total neutrophil count (83%) and I:T ratio (85%) had maximum Specificity when comparison with single haematological tests (Table 6). The association of sepsis was found to significant with haematological tests and CRP (<0.001). The association of increasing scores was found to be significant with cases (Table 7).

Table 4: Bacteriological Profile in the Blood Culture Positive (Proven Sepsis) Cases (N=32)

Bacteria detected in blood culture	Number of cases	Percentage (%)
Gram negative organism		
Klebsiella pneumoniae	12	37.50
Pseudomonas aeruginosa	3	9.37
E. coli	8	25.00
Enterobacter	1	3.12
Total	24	75
Gram positive organism		
Staphylococcus aureus	3	9.37
Coagulase negative Staphylococci	5	15.62
Total	8	25

Table 5: Score of each of the groups

Groups	Score (0-2)	Score (3-4)	Score ≥5
Sepsis	-	5(15.62%)	27(84.3%)
Probable sepsis	10(17.85%)	31(55.35%)	15(26.78%)
Normal infants	21(65.62%)	11(34.37%)	-

Table 6: Comparative Analysis of Tests Used in Proven Sepsis Population (N=32)

Test	Sensitivity (%)	Specificity (%)	P value
I: T ratio	100%	75.45%	0.000
Total PMN Count	71.88%	83%	0.000
I: M ratio	100%	16%	0.000
Immature PMN Count	90.62%	60%	0.000
Total leucocyte Count	96.8%	53.4%	0.000
Degenerative changes in PMN	81.25%	38.63%	0.000
Platelet Count	81.25%	78.18%	0.000
CRP	100%	55.68%	0.000

Table 7: Analysis of Hematological Scores Obtained in Each Study Group

Score	Probable sepsis (n=56)	Proven Sepsis (n=32)	Normal (n=32)	P value
≥2	48(85.71%)	32(100%)	14(43.75%)	0.0001
≥3	46(82.14%)	32(100%)	11 (34.37%)	0.0001
≥4	39(69.64%)	31(96.87%)	2(6.25%)	0.0001
≥5	15(26.78%)	27(84.37%)	0	0.0001

Discussion

The morbidity and mortality caused by sepsis which makes HSS an important tool in its early diagnosis. Poor developed innate immunity and poor barrier to infection were inherent factors for neonatal sepsis. Pre terms are more susceptible to infection than the term due to their poor immune system, low levels of immunoglobulin's and low weight. In developing countries like India, risk of neonatal sepsis is increased because of less number of institutional deliveries, poor level of hygiene and postnatal follow-up. Poor developed innate immunity and poor barrier to infection were inherent factors for neonatal sepsis. The major problem in neonatal infection is not only identification of the infected infant but also identifying the non-infected infant. Early as well as correct diagnosis is a difficult task but can be made, to an extent, based on clinical suspicion and laboratory tests.

Out of 120 cases, maximum number of cases was of male gender (66.5%), Pre term (87.5%) and low birth weight babies (87.5%) were noted in sepsis proven group than probable sepsis and normal infant groups in our study. These findings were correlated with study carried out by Manisha et al. [7]. Pre term is more susceptible to infection than the term due to their poor immune system, low levels of immunoglobulin's and low weight. In our study also gram negative organisms (75.0%) were commoner than gram positive organisms (25%) as the causative agents. Among gram negative infections, klebsiella (3.75%) was most common etiological agent. Our finding was similar to study carried out by Amritha Duhan et al [8].

Majority of sepsis cases were with score ≥5 and probable sepsis cases were with score 3-4. Maximum number of normal infants cases were with score 0-2. These findings were correlated with study carried out by Manisha et al. [7]. Narasimha et al. [15] found that 100% infants with proven sepsis had score ≥5. Most common clinical presentation was poor neonatal feeding (68.18%). This finding was correlated with study carried out by Verma P et al. [9]. Most common maternal risk factor was premature rupture membrane (62.5%). This finding was correlated with Vasantha et al. [10].

On evaluating the parameters of HSS, the association of sepsis was found to be significant ($p < 0.05$) with all haematological parameters in our study whereas Amrutha duhan study [8] shows haematological parameters like I: T ratio, I: M ratio, immature PMN count, total WBC count and thrombocytopenia had statistically significant. I: T ratio, Immature PMN count and I: M ratio had high sensitivity while I: T ratio, platelet count and total neutrophil count had high specificity in our study. All these findings were correlate with study carried out by Asitava Debray et al. [11]. Elevated I: T ratio was found to be the most reliable indicator of sepsis in our study, also other studies like those done by Amrutha et al. [8], Asitava Debray et al. [11]. I: T ratio test can be helpful initial screen when used in combination with risk factors and other tests. The association of increasing scores was found to be significant with sepsis cases. A score of more than 3 was present in all 32 proven cases and 45 (86.5%) in probable cases. These findings were correlated with Amritha Duhan et al. [8]. Combination haematological parameters had maximum sensitivity (93.75%) and specificity (74.54%) in our study. These findings were correlated with other studies like Jadhav [12], Vinay [13] and Lakey et al. [14].

Haematological scoring system can improve the diagnostic accuracy of complete blood count, but it is important to simplify and standardize the interpretation of this global test [15]. Recently attention has been directed to the leukocyte cell surface antigen as the diagnostic marker of sepsis [15]. Different methods for rapid detection of microorganisms like DNA probes, automated blood culture system and flurometric detection system are available, but still HSS can be used as screening test for diagnosis sepsis [16]. It has high sensitivity and specificity with the certainty of sepsis being present at higher scores.

Conclusion

HSS is a simple, quick cost effective screening test for early diagnosis of neonatal sepsis and can be performed easily in all hospitals with basic lab setup. Combination of haematological parameters act as rapid adjunct to diagnose neonatal sepsis than single haematological parameter. Early diagnosis of sepsis can avoid unnecessary exposure of infants to antibiotics and there by preventing the development of resistance to these drugs.

References

1. Sankar MJ, Agarwal R, Deorari AK, Paul Uk. Sepsis in newborn. Indian J Pediatr 2008;75(3):261-6.
2. Behrman RE, Ktregman RM, Jeanson H, Nelson Text book of Pediatrics. 17 th ed. Philadelphia: W.B. Saunders Publishers; 2004.pp.811-4.

3. Borna S, Borna H. Khazardoost S, Hantoush zadesh S. Perinatal out come in preterm Premature Rupture of membranes with Amniotic fluid index< (AFI<5). BMC Pregnancy and child birth .2004;4-15.
4. Buttery JP. Blood culture in newborns and children: Optimizing an every test. Arch Dis child Fetal Neonatal 2002;87(1):25-8.
5. Rodwell RL, Leslie AL, Tudehope DT. Early diagnosis of neonatal sepsis using hematologic scoring system. J. Pediatr. 1988;112:761-67.
6. Manroe BL Weinberg AG, Rosen feld CR, Browne R. The Neonatal blood count in health and disease. Reference value for neutrophilic cells. J Pediatr. 1979;95(3):89-98.
7. Manisha Makkar, Chinki Gupta, N.C. Mahajan. Performance evaluation of hematologic scoring system in early diagnosis of neonatal sepsis. Journal of clinical neonatology. 2013;2(1):25-29.
8. Amrita Duhan, Anu Baswal, Preeti Raikwar, Anita Punia, Kalpana Beniwal, Hemalata T. Kamya. Utility of hematological parameters in detection of neonatal sepsis. JKIMSU, 2016;5(3):98-106.
9. Asitava Debroy, Deepti Joshi, Tulika Sinha A. Reappraisal of the Haematological scoring system for early diagnosis of neonatal sepsis in a remote geographical location of North East India;Indian Journal of pathology and oncology, 2016;3(3) 366-71.
10. Verma Pradeep, Pramod Kumar Berwal, Niranjan Nagaraj, Sarika Swami, Prathusha Jivaji, Satya Narayan. Neonatal sepsis: epidemiology, clinical spectrum, recent antimicrobial agents and their antibiotic susceptibility patterns. Int J Contemp Pediatr.2015;2(3):176-80.
11. Vasantha AR, Kutty SN, Joseph Thedore. Neonatal sepsis: Aetiological agents and risk factors. J Acad Clin Microbiol 2017;19:36-41.
12. Jadhav S, Misra R, Vyaahare C, Angadi K, Gandham N, Ghosh P. Role of sepsis screen in the diagnosis of neonatal sepsis. Medical journal of Dr DY Patil university.2013;6:254-57.
13. Vinay BS, Girish GN, Adhikari S, Hugara S. Evaluation of septic screen as a diagnostic tool for neonatal sepsis ia a tertiary hospital at Mysore. Sch J App Med Sci 2015;3(1):1005-10.
14. Lakhey A, Shakya H. Role of sepsis screening in early diagnosis of neonatal sepsis. Journal of pathology of Nepal. 2017;7(1):1103-12.
15. Narasimha A, Harendra Kumar ML. Significance of hematological scoring system (HSS) in early diagnosis of neonatal sepsis using a hematological scoring system. Indian J Hematol blood transfuse 2011;27:14-17.
16. Varsha, Rusia V, Sikka M, Faridi MM, Madan N. Validity of hematologic parameters in identification of early and late on set neonatal infection. Indian