International Journal of Clinical and Diagnostic Pathology

ISSN (P): 2617-7226
ISSN (E): 2617-7234
www.patholjournal.com
2019; 2(1): 10-13
Received: 08-11-2018
Accepted: 12-12-2018

Bhuvanamha Devi Ramamurthy
Assistant Professor, Department of Pathology, SRM Medical College Hospital & Research Centre, Potheri, Chennai, Tamil Nadu, India

Shivashekar G
Professor, Department of Pathology, SRM Medical College Hospital & Research Centre, Potheri, Chennai, Tamil Nadu, India

Balaji R
Assistant Professor, Department of Community Medicine, SRM Medical College Hospital & Research Centre, Potheri, Chennai, Tamil Nadu, India

Correspondence
Bhuvanamha Devi Ramamurthy
Assistant Professor, Department of Pathology, SRM Medical College Hospital & Research Centre, Potheri, Chennai, Tamil Nadu, India

Haematological scoring system: Can it be used as a routine screening tool in early diagnosis of neonatal sepsis?

Bhuvanamha Devi Ramamurthy, Shivashekar G and Balaji R

DOI: https://doi.org/10.33545/pathol.2019.v2.i1a.03

Abstract
Background: Septicaemia neonatarum is a clinical syndrome characterized by signs and symptoms of infection accompanied by bacteremia in the first month of life. Early diagnosis of neonatal sepsis is essential for early therapy.
Objective: To evaluate the role of hematologic scoring system (HSS) in the early diagnosis of neonatal sepsis.
Materials & Methods: This is cross sectional study. It includes 185 neonates admitted in NICU, tertiary care centre in Tamilnadu, who were clinically suspected of sepsis. Hematological parameters were measured in all cases and blood culture was done.
Results: On statistical evaluation, Total PMN, immature PMN count, and Immature to total neutrophil ratio had good sensitivity. Score ≥ 5 was most reliable indicator of sepsis.
Conclusion: HSS is useful screening tool in diagnosing the neonates with sepsis and provides a guideline for appropriate, prompt antibiotic therapy and reducing the mortality.

Keywords: Haematological scoring system, early diagnosis, neonatal sepsis

Introduction
One of the most common cause of neonatal mortality is sepsis. It accounts for about 30 – 50% total neonatal death in developing countries. Early diagnosis of neonatal septicemia is a great challenge despite advances in diagnostic modalities due to its non-specific subtle manifestation. Blood culture provides definite diagnosis. However this process takes about 48 – 72 hours [1] and such facilities may not be available in rural areas of developing countries. While the pediatrician's concern is to start the antibiotics at the earliest as the illness progresses more rapidly than the adults and premature newborn are very much prone to fatal complication. Hence there is need for rapid diagnostic system which is easy, cost effective and universally available.
For early diagnosis of neonatal septicemia, a haematologic scoring system of Rodwell [2] (defined by Manroe *et al.*) [3] is preferable, as it involves only haematological parameters for critical analysis of sepsis. Though different studies have suggested the utility of Hematology scoring system in making an early diagnosis of neonatal sepsis, it is not widely being used in routine practice, as it is not standardized. Therefore the objective of present study is to evaluate the role of haematological scoring system in early diagnosis of neonatal septicaemia.

Materials & methods
This is cross sectional study conducted at Department of Pathology (Haematology unit) in our tertiary care hospital, during the period June 2017 to March 2018. 185 newborns aged 0 – 28 days, with the clinical suspicion of neonatal sepsis admitted in Neonatal intensive care unit, were included in this study. Neonates with congenital anomaly, hemolytic jaundice and inborn errors of metabolism were excluded from the study. Complete clinical details were obtained. Under the aseptic precautions 0.5ml – 1ml blood was collected within 24 hours of admission, by peripheral venipuncture, in tripotassium ethylene diamine tetra acetic acid containing non-siliconized vacutainer tubes. Leishman stained peripheral blood smears were examined under oil immersion lens of light microscope at magnification of 1000x. Complete blood count was done using 6 part automated cell counter Sysmex XN 1000. Total PMN, immature PMN and mature PMN calculated on basis of WBC count obtained by cell counter

and differential count obtained by examining peripheral smear. Degenerative changes like vacuolation, toxic granulation & dohle bodies were noted (0 – 4+ given by Zipursky *et al.*) [4].

In this study we adapted Rodwell *et al.* formulated a hematology scoring system (modification of Manroe et l HSS), which includes 7 parameters (Table 1). The collected data was statistically evaluated.

Results

In our study period, 185 neonates were evaluated with hematological scoring system for early diagnosis of sepsis. The neonates with gestational age less than 37 weeks (89%) and low birth weight (52%) were more commonly affected with sepsis. The male female ratio is 1: 1(Table 2). It was observed that higher the score (≥5) greater the possibility of sepsis similarly lesser the score (<2) lesser the chance of infection. On evaluation of individual hematology parameters (Table 3) - I: T ratio, Total neutrophil count, immature neutrophil count and degenerative changes had high sensitivity and negative predictive value. Alteration in total leucocyte count, I: M ratio and platelet count had high specificity of 89.1%, 86.5% and 85.9% respectively. I: M ratio had optimal sensitivity and specificity of 86.2% and 86.5% respectively. Tests with high sensitivity and high negative predictive value are most desirable as all sepsis cases can be identified. However no individual parameter can be considered to be adequate for diagnosing neonatal sepsis. The best cut off score was determined with the receiver operating characteristic curves (ROC) and area under curve (AUC) was calculated. Area under the curve was noted as 0.963 and the total hematology score ≥ 5 had sensitivity of 100% and specificity of 86.5% (Figure 1).

Discussion

Neonatal septicemia is a syndrome clinically characterized by symptoms and signs of infection, accompanied by bacteremia in the initial month of life. The commonest cause of neonatal mortality is neonatal sepsis accounts about 16% of all mortality rate. According to National neonatal perinatal database [5], the incidence of neonatal sepsis is 30/1000 live births. Most neonatal bacterial infection occur during first week of life (Early onset sepsis) and result from spread of microorganism colonizing maternal genital tract into amniotic cavity either via transplacental route, ascending infection through infected birth canal or exposure to infected blood at delivery. The neonates due to weaker immune system are very much prone to infection than aged children; premature babies are even more at risk.

The goal of clinician is to identify at risk infants and treat them early with appropriate drugs to minimize the morbidity and mortality. However, blanket broad spectrum therapy to non-infected neonates raises a situation of antibiotic resistance (Kumhar *et al* & Monga K *et al*) [6, 7]. So there is absolute necessary for developing a system for early diagnosis which is almost available universally, rapid and cost effective. The Rodwell [2] *et al* hematological scoring system (Defined by Manroe) [3], has the advantages of low cost, less time consuming, practically available in all laboratories, easily available and accessible.

In our study preterm babies and low birth weight babies were the risk factors commonly noted, which is similar to the observation made by Supreetha *et al.* [8] & Haque KN *et al*. [9] Early onset neonatal sepsis was noted in 75% of neonates, owing to the fact, that these babies have poor defensive immune system. Out of 185 newborns, 29 babies had positive blood culture. Most common organism isolated was Escherchia coli followed by Klebsiella org. Majumdar *et al.* [10] made similar observation.

Majumdar *et al*, [10] Ghosh *et al*, [11] Narasimha *et al*, [12] analyzed 50 smears of new born & found I:T ratio followed by I:M ratio were most sensitive indicators in neonatal sepsis diagnosis. In the present study, also I:T ratio had high sensitivity and negative predictive value. Similar to our study, Fathia Meirina *et al.* [13] found that total PMN cell count and I:T ratio had a high sensitivity whereas total leucocyte count and I:M ratio had high specificity. I: T PMN ratio had 100% sensitivity, specificity 57%, PPV of 43% and NPV of 100%. PMN degenerative change was not found in all subjects. In the present study, degenerative changes of neutrophils had high sensitivity as they are never seen in healthy babies and their presence invariably indicates sepsis.

Manisha makkar *et al.* [14] conducted similar study in 110 infants and noted that immature PMN count was the most sensitive and I: M PMN ratio the most specific indicator. But total PMN count had limited role in sepsis screening, so as by Akenzua *et al*. [15] Thrombocytopenia had high specificity in our study similar observation was made by Manisha makkar [14]. It occurs due to increased platelet destruction, sequestration secondary to infection and generalized bone marrow failure (Speer *et al*.) [16]. In the present study we rise in nucleated RBCs was noted; however it was not statistically not evaluated.

Conclusion

In the present study, I: M had optimal sensitivity and specificity. When the haematology score is more than 5, the accuracy of diagnosing neonatal sepsis was also high. Haematological scoring system allows objective assessment of haematological changes. Hence it improves the efficacy of complete hemogram as screening tool. Though newer methods are in existence, the simple, economical, readily available haematological scoring system holds its place in diagnosing the sepsis with certainty, especially at high scores. Future studies including nucleated RBCs would reveal the association of it with the neonatal sepsis.

Table 1: Hematology Scoring System by Rodwell *et al.*

Haematology parameters	Range	Score
Total leucocyte count	< 5000 or >25000, 30000 & 21000(at birth, 24 hrs & day 2 onwards of life)	1
Total PMN count	<1800 or >4500	1
	No mature PMN	2
Immature PMN count	>600	1
I: T ratio	>0.12	1
I: M ratio	≥0.3	1

Degenerated changes in PMN	>3+	1
Platelet count	<150000	1

Total score: 8; Minimum score: 0; Maximum score: 8
Interpretation: Score 0 ≤2: No sepsis; Score 3- 4: probable sepsis; Score ≥ 5: proven sepsis

Table 2: Demographic profile of neonatal sepsis cases

Baseline Parameters		Score ≤2	Score 3-4	Score ≥5	Chi square	P value
Gestational age	Preterm	18	39	50	72.26	0.0001
	Term	58	19	1		
Gender	Male	28	20	15	0.76	0.684
	Female	48	38	36		
Birth weight	LBW	2	9	25	45.147	0.0001
	Normal	69	48	23		
	Macrosomia	5	1	3		

Table 3: Statistical evaluation of neonatal sepsis cases

Parameters	Sensitivity	Specifictiy	PPV	NPV
Score <2	100%	48.7%	26.6%	100%
Score ≥5	100%	85.9%	56.9%	100%
Total leucocyte count	24.1%	89.1%	29.2%	86.3%
Total PMN count	100%	33.3%	21.8%	100%
Immature PMN count	100%	35.9%	22.5%	100%
I: T ratio	100%	48.7%	26.6%	100%
I: M ratio	86.2%	86.5%	54.3%	97.1%
Degenerated changes in PMN	100%	78.8%	46.8%	100%
Platelet count	34.5%	85.9%	31.3%	87.6%

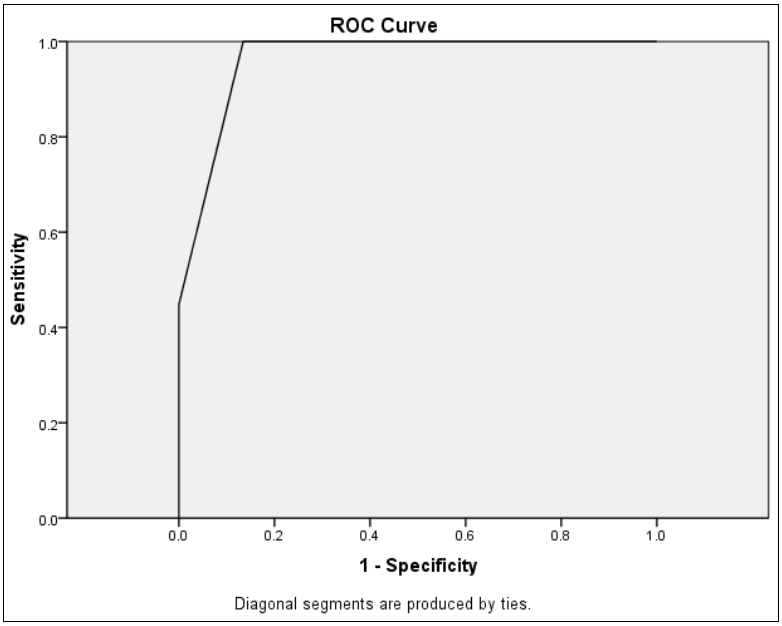

Fig 1: The receiver operating curve was calculated and area under the curve was 0.963

References

1. Chandna A, Rao MN, Srinivas M, Shyamala S. Rapid Diagnostic Tests in Neonatal Septicemia. Indian J Pediatr. 1988; 55:947-953.
2. Rodwell RL, Leslie AL, Tudehope DI. Early diagnosis of neonatal sepsis using a hematologic scoring system. J Pediatr. 1988; 112:761-7.
3. Manroe BL, Weinberg AG, Rosenfeld CR, Browne R. The neonatal blood count in health and disease. I. Reference values for neutrophilic cells. J Pediatr. 1979; 95:89-98.
4. Zipursky A, Palko J, Milner R, Akenzua GI. The hematology of bacterial infections in premature infants. Pediatrics. 1976; 57:839-53.
5. National Neonatal Perinatal Database report, 2002-2003. http://www.nnfi.org/images/NNPD2002-03.pdf. (Last accessed on Jan 22, 2016).
6. Kumhar GD, Ramachandran VG, Gupta P. Bacteriological analysis of bloodculture isolates from neonates in a tertiary care hospital in India. J Health Popul Nutr. 2002; 20(4):343-347.
7. Monga K, Fernandez A, Deodhar L. Changing bacterial patterns in neonatal septicacemia. Indian J Pediatr. 1986; 53:505-508.
8. Supreetha MS, Sathyavathi Alva R, Shivendra VS, Kariappa TM. Evaluation of Neonatal Septicaemia Using Hematological parantelers. International J of Recent Scientific Research. 2015; 6(2):2775-2778.

9. Haque KN. Neonatal Sepsis in the Very Low Birth Weight Preterm Infants: Part 1: Review of Pathophysiology. Journal of Medical Sciences. 2010; 3(1):1-10.
10. Majumdar A, Angshuman Jana, Anirban Jana. Hematologic scoring system (HSS): A guide to decide judicious use of antibiotics in neonatal septicaemia in developing countries. Journal of Applied Hematology. 2013; 4(3):110-113.
11. Ghosh S, Mittal M, Jaganathan G. Early diagnosis of neonatal sepsis using a hematological scoring system. Indian J Med Sci. 2001; 55:495-500.
12. Narasimha A, Harendra Kumar ML. Significance of Hematological Scoring System (HSS) in early diagnosis of neonatal sepsis. Indian J Hematol Blood Transfus. 2011; 27:14-7.
13. Fathia Meirina, Bidasari Lubis, Tiangsa Sembiring, Nelly Rosdiana, Olga Siregar R. Hematological scoring system as an early diagnostic tool for neonatal sepsis. Paediatrica Indonesia. 2015; 55(6):315-322.
14. Manisha Makkar, Chinki Gupta, Rambha Pathak. Performance Evaluation of Hematologic Scoring Sytem in Early Diagnosis of Neonatal Sepsis. J Clin Neonatal. 2013; 2(1):25-29.
15. Akenzua GI, Hui YT, Milner R, Zipursky A. Neutrophil and band counts in the diagnosis of neonatal infections. Pediatrics. 1974; 54:38-42.
16. Speer CP, Gahr M, Schröter W. Early diagnosis of neonatal infection. Monatsschr Kinderheilkd. 1985; 133:665-8.