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Original Research Article

Assessing Efficacy of Various Hematological Parameters in Comparison with Blood Culture in Neonates Presented with Septicemia

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Abstract

Aim: The aim of the present study was to analyse the efficacy of various hematological parameters in comparison with blood culture in neonates presented with septicemia.

Methods: The present study was a prospective study of 200 cases of neonatal sepsis admitted to Neonatal Intensive Care Unit (NICU), DMCH, Darbhanga, Bihar, India with clinical evidences of septicaemia for the period of 3 years. Detailed clinical history was taken and thorough clinical examination was done for every neonate admitted in NICU.

Results: The present study showed a male preponderance. Majority of neonates are of age group less than 7 days (80%), followed by age group of 7-14 days (12%) and 15-28 days (8%) and significant number of neonates presented with sepsis were full term (52%), followed by 32% cases being pre term and 16% cases of late pre term. Majority of babies neonates in present study were having low birth weight (54%), while 6% cases were presented with very low birth weight and 40% are of normal birth weight. Out of 200 neonates, 88 had onset of sepsis within first 72 hours of life, while remaining 112 had late onset of symptoms (>72 hours). Out of 200 cases, 150 cases were culture positive while remaining 50 cases were culture negative. Nearly half of the neonates born by LSCS (48%), followed by normal vaginal birth (47%), and remaining 10 cases by forceps and vaccum assisted delivery respectively. 34 patients had abnormal TLC and140 had abnormal neutrophil count. 114 patients had absolute immature neutrophil count and 22 patients had increased immature to total neutrophil count ratio. 56 patients had nucleated RBCs, 78 patients had abnormal platelet count and 174 patients had increased CRP.

Conclusion: Degenerative neutrophil change like toxic granulation was found to be the most useful parameter in detecting sepsis early. CRP also had high sensitivity. NRBC count, I/T Ratio and I/M Ratio were not found to be very useful tests.

Keywords: septicemia, hematological parameter, blood culture, TLC, PPV, NPV

Introduction

Neonatal sepsis is a systemic illness caused by bacteria, viruses, or fungal infections. Furthermore, it is linked to hemodynamic alterations and clinical findings, as well as bringing substantial morbidity and mortality. [1] Neonatal sepsis is a clinical syndrome caused by systemic bacterial infection documented by a positive blood culture in the first 4 weeks of life. [2] It can be defined by positive blood and/or cerebrospinal fluid (CSF) culture. [3] Sepsis occurring in the first 72 hours of life is defined as early-onset sepsis (EOS) and that occurring beyond 72 hours as late-onset sepsis (LOS). [1,4,5]

According to the global burden of disease study 2016/2017, there are 1.3 million yearly incident cases of neonatal sepsis worldwide, resulting in 203,000 sepsis-attributable deaths. [6,7] In 2014, roughly 5.3–8.7 million disability-adjusted life-years were lost in Sub-Saharan Africa due to neonatal sepsis and subsequent long-term morbidity. [8] A systematic review and meta-analysis conducted in Ethiopia confirmed that the prevalence of neonatal sepsis was found to be 45%. [9] The Amhara region had the highest prevalence of neonatal sepsis (64%). [9] Hematological parameters are straightforward variables that may be derived from a patient's hemogram. [10] The ability to count the various subsets of leukocytes in a patient's peripheral blood is a helpful tool for detecting a variety of disorders and diseases. Neutrophils play a critical part in the immune response during infection by producing cytokines that attract macrophages and phagocytizing cellular

debris. An elevated absolute neutrophil count (ANC) is a common observation in an infectious or inflammatory illness. [11]

WBC counts alter significantly during a systemic inflammatory response, resulting in neutrophilia and / or relative lymphocytopenia. Thrombocy topenia is common complication in neonatal sepsis. Sepsis-induced thrombocytopenia is caused by a decrease in platelet synthesis in the bone marrow, which can be caused by antibiotics, the inhibitory impact of pathogenic toxins, inflammatory mediators in hematopoiesis, or hemophagocytosis. [12]

The aim of the present study was to analyse the efficacy of various hematological parameters in comparison with blood culture in neonates presented with septicemia.

Materials and Methods

The present study was a prospective study of 200 cases of neonatal sepsis admitted to Neonatal Intensive Care Unit (NICU), DMCH, Darbhanga, Bihar, India with clinical evidences of septicaemia for the period of 3 years. Detailed clinical history was taken and thorough clinical examination was done for every neonate admitted in NICU. Appropriate samples were taken from each neonates and received to Central Diagnostic Laboratory, Darbhanga, Bihar, India and processed respective sections accordingly.

EDTA samples were processed on Automated hematology analyzer and TLC and Platelet counts were obtained.

Differential leukocyte count, Immature granulocytes, Degenerative neutrophilic changes and Nucleated RBCs were noted by peripheral smear examination. Low platelet counts were confirmed on smear stained with Field stain or Giemsa stain.

The indices were calculated as follows:

- I/T ratio = Total number of immature neutrophils/ Total number of neutrophils
- I/M ratio = Total number of immature neutrophils/ Total number of mature neutrophils

The plain sample was used for CRP level estimation. Culture results were observed after 48 hours.

Stastical analysis

Sensitivity, Specificity, Positive predictive value (PPV) and Negative predictive value (NPV) were calculated for each parameter.

Results

Table 1: Baseline characteristics

Gender	**N**	**%**
Male	150	75
Female	50	25
Age groups		
Less than 7 days	160	80
7-14 days	24	12
15-28 days	16	8
Term		
Pre term	64	32
Full term	104	52
Late pre term	32	16
Birth weight		
Low birth weight	108	54
Very low birth weight	12	6
Normal	80	40
Onset of symptoms		
First 72 hours	88	44
Late onset	112	56
Culture		
Positive	150	75
Negative	50	25
Delivery		
NVD	96	48
LSCS	94	47
Vaccum assisted	10	5

The present study showed a male preponderance. Majority of neonates are of age group less than 7 days (80%), followed by age group of 7-14 days (12%) and 15-28 days (8%) and significant number

of neonates presented with sepsis were full term (52%), followed by 32% cases being pre term and 16% cases of late pre term. Majority of babies neonates in present study were having low birth weight (54%), while 6% cases were presented with very low birth weight and 40% are of normal birth weight. Out of 200 neonates, 88 had onset of sepsis within first 72 hours of life, while remaining 112 had late onset of symptoms (>72 hours). Out of 200 cases, 150 cases were culture positive while remaining 50 cases were culture negative. Nearly half of the neonates born by LSCS (48%), followed by normal vaginal birth (47%), and remaining 10 cases by forceps and vaccum assisted delivery respectively.

Table 2: TLC, Absolute Neutrophil Count, Absolute Immature Neutrophil Count, Immature to Total Neutrophil Count Ratio

Total leukocyte count (/cumm)	Culture		Total
	Positive	Negative	
Abnormal <5000 or >25000	30	4	34
Normal	122	44	166
Total	152	48	200
Absolute neutrophil count (/cumm)			
Abnormal <1800 or >5400	106	34	140
Normal	46	14	60
Total	152	48	200
Absolute immature neutrophil count (/cumm)			
Abnormal >600	84	30	114
Normal	68	18	86
Total	152	48	200
Immature to total neutrophil count ratio			
Increased (>0.2)	16	6	22
Normal (≤0.2)	134	42	178
Total	152	48	200

34 patients had abnormal TLC and140 had abnormal neutrophil count. 114 patients had absolute immature neutrophil count and 22 patients had increased immature to total neutrophil count ratio.

Table 3: Nucleated RBCS, Platelet Count and C-Reactive Protein Level

Nucleated RBCs	Culture		Total
	Positive	Negative	
Present	42	14	56
Absent	110	34	144
Total	152	48	200
Platelet count (/cumm)			
Abnormal (<150x10^3)	60	18	78
Normal	92	30	122
Total	152	48	200
C-reactive protein			
Increased (>3 mg/L)	128	46	174
Normal	24	2	26
Total	152	48	200

56 patients had nucleated RBCs, 78 patients had abnormal platelet count and 174 patients had increased CRP.

Discussion

Neonatal sepsis is the presence of generalized systemic features of infection. Probable sepsis includes clinical and laboratory findings which are consistent with bacterial infection but without a positive culture. Neonatal sepsis includes various systemic infections of the neonates such as pneumonia, meningitis, septicemia, arthritis, osteomyelitis, and urinary tract infections. [13] Systemic signs include lethargy, hypotonia, tachycardia, abdominal distension, fever, chest retractions, grunting, shock, apnea, pallor, jaundice, bradycardia, and increased ventilator requirements. Sepsis is more common in preterm and low birth weight neonates due to low immunity to combat bacterial infection. Depending on the onset of symptoms, neonatal sepsis is classified into early-onset sepsis which presents at or before 72 h of life

and late-onset sepsis which usually presents after 72 h of life. [14] Blood culture is the gold standard test for the diagnosis of neonatal sepsis [13] which should be performed in all cases of suspected sepsis before starting antibiotics. However, it is a time-consuming procedure requiring 48–72 h.

The present study showed a male preponderance which is comparable with studies done by Khair et al [14], Darnifayanti D et al.[15] Majority of neonates are of age group less than 7 days (80%), followed by age group of 7-14 days (12%) and 15-28 days (8%) and significant number of neonates presented with sepsis were full term (52%), followed by 32% cases being pre term and 16% cases of late pre term. Vinay BS et al. also reported similar findings in their study (90%). [16] Majority of babies neonates in present study were having low birth weight (54%), while 6% cases were presented with very low birth weight and 40% are of normal birth weight. Anand et al [17] and Sinha et al [18] reported low birth weight in 68%, 81.3% and 64.9% of cases respectively.

A diagnostic test is used in preference to a definitive gold standard test when the definitive test is invasive, expensive, time consuming and so impractical for use in routine clinical practice for early diagnosis. Out of 200 neonates, 88 had onset of sepsis within first 72 hours of life, while remaining 112 had late onset of symptoms (>72 hours). Out of 200 cases, 150 cases were culture positive while remaining 50 cases were culture negative. Nearly half of the neonates born by LSCS (48%), followed by normal vaginal birth (47%), and remaining 10 cases by forceps and vaccum assisted delivery respectively. 34 patients had abnormal TLC and140 had abnormal neutrophil count. These findings are comparable to study conducted by Rodwell RL et al [19], Khair et al. [20] 114 patients had absolute immature neutrophil count and 22 patients had increased immature to total neutrophil count ratio. 56 patients had nucleated RBCs, 78 patients had abnormal platelet count and 174 patients had increased CRP.

Conclusion

Degenerative neutrophil change like toxic granulation was found to be the most useful parameter in detecting sepsis early. CRP also had high sensitivity. NRBC count, I/T Ratio and I/M Ratio were not found to be very useful tests. These tests do not require sophisticated equipment and the results can be obtained within few hours. Hence these parameters aid in early clinical decision making; without having to wait for the blood culture reports for initiation of treatment.

References

1. Shane AL, Sánchez PJ, Stoll BJ. Neonatal sepsis. The lancet. 2017 Oct 14;390(101 04): 1770-80.
2. Ogundare E, Akintayo A, Aladekomo T, Adeyemi L, Ogunlesi T, Oyelami O. Presentation and outcomes of early and late onset neonatal sepsis in a Nigerian Hospital. African health sciences. 2019 Nov 5;19(3):23 90-9.
3. Gomella TL, Cunningham M, Eyal F. Management, Procedures, on-call problems, diseases, and drugs. LANGE. 2009;7:65-70.
4. Stoll BJ, Hansen NI, Sánchez PJ, Faix RG, Poindexter BB, Van Meurs KP, Bizzarro MJ, Goldberg RN, Frantz III ID, Hale EC, Shankaran S. Early onset neonatal sepsis: the burden of group B Streptococcal and E. coli disease continues. Pediatrics. 2011 May 1;127 (5):817-26.
5. Shane AL, Stoll BJ. Neonatal sepsis: progress towards improved outcomes. Journal of Infection. 2014 Jan 1;68:S24-32.
6. Collaborators G. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017; 2018.
7. Harikrishnan S, Jeemon P, Mini GK, Thankappan KR, Sylaja PG. GBD 2017 causes of death collaborators. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the global burden of disease study 2017.
8. Ranjeva SL, Warf BC, Schiff SJ. Economic burden of neonatal sepsis in sub-Saharan Africa. BMJ global health. 2018 Jan 1;3(1):e0 00347.
9. Assemie MA, Alene M, Yismaw L, Ketema DB, Lamore Y, Petrucka P, Alemu S. Prevalence of Neonatal Sepsis in Ethiopia: A Systematic Review and Meta-Analysis. International journal of pediatrics. 2020;20 20(1):6468492.
10. Gozdas HT, Gel KT, Yasayacak A, Kesgin MT, Akdeniz H. The role of hematological parameters in estimating nosocomial sepsis. Age (mean±SD). 2019;69:16-2.
11. Al-Gwaiz LA, Babay HH. The diagnostic value of absolute neutrophil count, band count and morphologic changes of neutrophils in predicting bacterial infections. Medical Principles and Practice. 2007 Aug 17;16(5): 34 4-7.
12. Al Saleh K, AlQahtani RM. Platelet count patterns and patient outcomes in sepsis at a tertiary care center: beyond the APACHE score. Medicine. 2021 May 7;100(18):e25013.
13. Sankar MJ, Agarwal R, Deorari AK, Paul VK. Sepsis in the newborn. The Indian Journal of Pediatrics. 2008 Mar;75:261-6.

14. Aletayeb SM, Khosravi AD, Dehdashtian M, Kompani F, Mortazavi SM, Aramesh MR. Identification of bacterial agents and antimicrobial susceptibility of neonatal sepsis: A 54-month study in a tertiary hospital. African Journal of Microbiology Research. 201 1 Mar 4;5(5):528-31.
15. Darnifayanti D, Tjipta GD, Rusdidjas R, Lubis BM. Immature-to-total neutrophil ratio as an early diagnostic tool of bacterial neonatal sepsis. Paediatrica Indonesiana. 2015 Jun 30; 55(3):153-7.
16. Bs V, Girish GN, Adhikari S, Hugara S. Evaluation of septic screen as a diagnostic tool for neonatal sepsis in a tertiary hospital at Mysore. Sch J Appl Med Sci. 2015;3:1005-.
17. Anand NK, Gupta AK, Mohan M, Lamba IM, Gupta R, Srivastava L. Coagulase negative staphylococcal septicemia in newborns. Indian pediatrics. 1991 Nov 1;28(11):1241-8.
18. Sinha N, Deb A, Mukherjee AK. Septicemia in neonates and early infancy. The Indian Journal of Pediatrics. 1986 Mar;53:249-56.
19. Rodwell, Leslie, Tudehope. Early diagnosis of neonatal sepsis using a hematologic scoring system. J Pediatr. 1988;112(5):761-7.
20. Khair KB, Rahman MA, Sultana T, Roy CK, Rahman MQ, Shahidullah M, Ahmed AN. Role of hematologic scoring system in early diagnosis of neonatal septicemia. Bangab andhu Sheikh Mujib Medical University Journal. 2010;3(2):62-7.