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Original Research Article

Comparative study of micro ESR with CRP and blood culture sensitivity

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ABSTRACT

Background: Neonatal sepsis is one of the leading causes of morbidity and mortality among neonates in India. Indian association of paediatrics has developed sepsis screen which is useful for early diagnosis. To test the reliability of micro ESR as bedside tool in early diagnosis of neonatal sepsis we conducted this study. Comparison of Micro-erythrocyte sedimentation rate (micro ESR) with C-reactive protein (CRP) and blood culture sensitivity in neonatal sepsis. To establish a relation between severity of sepsis and Micro-erythrocyte sedimentation rate.
Methods: This is a cross sectional study done at neonatal intensive care unit (NICU), at our institute over a period of six months. Fifty neonates with risk factors for sepsis and who had a positive sepsis screen were enrolled prospectively into the study.
Results: Out of 50 samples collected, micro ESR (>15 mm/hour) was positive in 12 cases (24%) and CRP was positive in 18 cases (36%). After procuring the blood culture report, 48 cases had neonatal sepsis (84%). Our study showed that micro-ESR as a bedside test had a positive correlation with mortality (p value <0.001) when compared with CRP values (p value=0.546) in neonatal sepsis. As expected, elevated micro ESR and high CRP value had 100% correlation but was not statistically significant (p=0.319). In all the 12 cases with raised micro ESR had 100% blood culture positivity but significance could not be established.
Conclusions: Micro-ESR had a significant correlation with mortality in neonatal sepsis.

Keywords: Blood culture sensitivity, C-reactive protein (CRP), Micro-erythrocyte sedimentation rate (micro ESR), Neonatal sepsis

INTRODUCTION

Sepsis is identified as a major factor in neonatal mortality and morbidity. Incidence of neonatal sepsis is around 49-170/1000 live births in developing countries as per literature and accounting for 30/1000 live births in India.[1] Early onset neonatal sepsis (EOS) is in the initial 72 hours since birth and late onset neonatal sepsis (LOS) after 72 hours.[1] In EOS, 85% of the newborns present within 24 hours (median age of onset is 6 hours), 5% present within 24-48 hours, and a smaller percentage present between 48-72 hours.[2] Blood culture is gold standard for diagnosis of neonatal sepsis. Symptomatic neonates have fast track treatment whereas it might get delayed asymptomatic neonates. Hence Indian Association of Pediatrics has developed the sepsis screen which comprises of total leukocyte count (TLC), absolute neutrophil count (ANC), micro erythrocyte sedimentation rate (m-ESR), C-reactive protein (CRP), immature to total neutrophil ratio (I-T ratio).[3] Sepsis screen is a useful tool in identifying neonatal sepsis in asymptomatic neonates with peri-natal risk factors. Prolonged time

frame for obtaining a blood culture sensitivity report prompted the use of sepsis screen as a diagnostic and prognostic tool for neonatal sepsis. ESR determination in a capillary tube is termed micro ESR.[4] Micro-ESR is a simple quick bedside test which is cost effective and easily reproducible. The objective of this study is to compare micro-erythrocyte sedimentation rate (micro ESR) with C-reactive protein (CRP) and blood culture sensitivity in neonatal sepsis and to establish a relation between severity of sepsis and micro-erythrocyte sedimentation rate.

METHODS

Study type

This was a cross-sectional study.

Study duration

Duration of the study was for 5 months starting from January 2023 to the end of May 2023.

Study place

Cheluvamba hospital, Mysore Medical College and Research Institute, Mysore was the epicenter for the study.

Source of data

All the neonates with risk factors for sepsis and a positive sepsis screen were enrolled in the study.

Sample size

Sample is calculated using the following formula

$$n = \frac{(Z1\text{-}a)2 \times p \times q}{d2}$$

Z–Z score for confidence interval, A–Level of significance, p–Prevalence of increased ESR in confirmed neonatal sepsis 6% 3, q–1–p, d-Absolute precession, maximum allowable error 5%. Sample size: 50

Statistical analysis

The data collected was entered in the MS Excel master sheet. Data was tabulated and analysed using software OpenEpi version 3.01 and Statistical Package for Social Sciences (SPSS) version 22 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY, USA: IBM Corp.). Categorical data have been presented as numbers and percentages (%) and quantitative data in terms of mean and standard deviation. Categorical variables have been analysed using Pearson's chi-square test and Fisher exact test. Quantitative variables have been analysed using Mann-Whitney U test. Receiver Operator Curve (ROC) has been used for calculation of sensitivity and specificity. A p value of <0.05 has been considered as statistically significant.

Sampling method

Simple Random Sampling method.

Neonates fulfilling the inclusion and exclusion criteria were enrolled into the study.

Inclusion criteria

Perinatal risk factors- rupture of membranes >24 hours, spontaneous preterm labour, Chorio-amnionitis, prolonged labour, unclean per vaginal examinations, perinatal asphyxia. Positive Sepsis Screen–total leukocyte count (TLC), absolute neutrophil count (ANC), micro erythrocyte sedimentation rate (m-ESR), C-reactive protein (CRP), immature to total neutrophil ratio (I-T ratio).

Exclusion criteria

Neonates admitted as suspected neonatal sepsis and with Hb <10% and >20%10. Neonates already on antibiotic treatment

Procedure

Informed consent was obtained from caregivers and samples were collected from the neonates. Capillary blood was obtained by a fingertip, heel or toe puncture. Blood is collected into a heparinized microhematocrit tube. The internal diameter of the tube was 1.1 - 1.2 mm, 75 mm long and 0.2 mm thick. After collection of the blood in the micro heamtocrit tube, one end of the tube was sealed off with clay. Excess blood was wiped off the opposite end and taped immediately to a surface which holds the tube vertically. The distance from the top of the meniscus to the packed red cell column after one hour was documented as mm/hr. Micro ESR level is said to be elevated if the height of the plasma column is more than 15 mm/hr.[5] Following which blood culture sensitivity was sent in neonates with positive sepsis screen. The babies continued to get treatment as per protocol irrespective of the micro ESR values.

RESULTS

We enrolled 50 neonates which fulfilled our inclusion criteria of which 54% were females and 46% were males. Birth weight was less than 2.5 kgs in 27 cases. CRP was raised in 45 cases. Micro ESR which was done in initial 1st hour of admission was significantly high in 12 cases. Blood culture sensitivity showed positive growth in 42 cases. Total of 86% of the cases improved and were discharged home rest succumbed to death due to sepsis (Table 1).

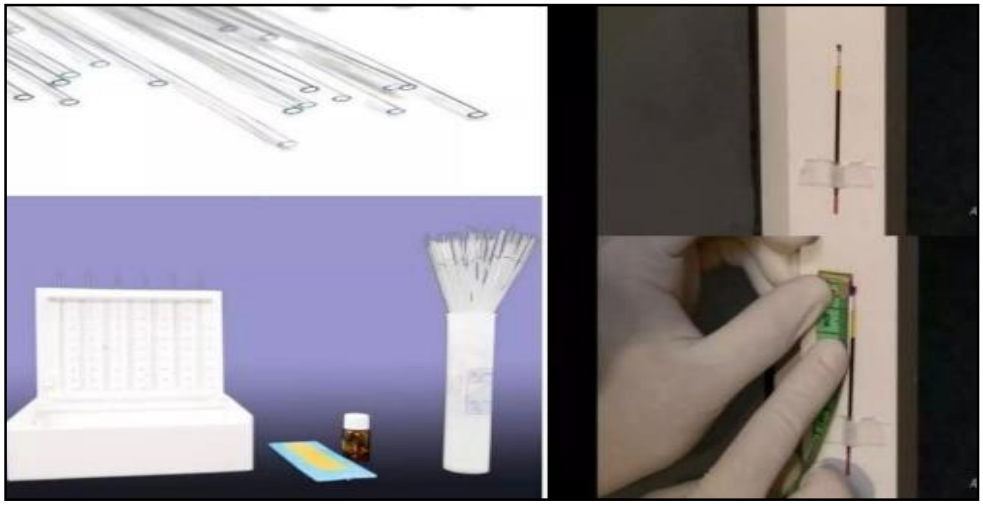

Figure 1: Micro ESR estimation.

When we analyse Table 2, we see that micro ESR value when >15 mm/hour had a significant impact on mortality with p value <0.001 which highlights the value of the test. CRP on the other hand did not have statistical significance.

In our study group, blood culture was positive in 42 cases, 7 neonates succumbed to sepsis. All neonates without culture positivity were discharged.

Non-parametric parameters were compared with the outcome of the patient which showed that micro ESR was more than 15 mm/hour in patients with adverse outcome (death) and majority of the patients who were discharged had micro ESR <15 mm in the 1st hour. This is also statistically significant with a p value of <0.001.

Table 1: Frequency distribution of study subjects (n=50).

Parameters	Number	%
Gender		
Female	27	54.0
Male	23	46.0
Birth weight		
<2.5 kg (LBW)	27	54.0
≥2.5 kg (Normal)	23	46.0
Micro ESR levels		
Normal	38	76.0
High	12	24.0
CRP level		
Normal	05	10.0
High	45	90.0
Blood culture report		
Growth	42	84.0
No growth	08	16.0
Final outcome		
Discharged	43	86.0
Death	07	14.0

Table 2: Comparison of final outcome with associated factors.

Parameters	Outcome		Total
	Death	Discharged	
Micro ESR value			
Normal	1 (2.6%)	37 (97.4%)	38
High	6 (50%)	6 (50%)	12
P value	<0.001		
CRP value			
Normal	1 (20%)	4 (80%)	5
High	6 (13.3%)	39 (86.7%)	45
P value	0.546		

Table 3: Comparison of micro ESR levels with CRP values.

Parameters	Micro ESR levels		Total
	Normal	Elevated	
CRP value			
Normal	5 (13.2%)	0 (0%)	5 (10%)
High	33 (86.8%)	12 (100%)	45 (90%)
P value	0.319		

Table 4: ROC curve for micro ESR as predictor of outcome.

Area under curve	95% CI		P value
	Lower bound	Upper bound	
0.817	0.619	1.000	0.008
Co-ordinates of the curve			
Micro ESR	**Sensitivity**	**Specificity**	
15.0	85.7%	86.0%	
16.5	85.7%	88.4%	

DISCUSSION

World health organization identifies sepsis as a major contributor to global mortality. Sepsis represents a major contributor to global mortality and has been declared as a priority by the WHO.[6] The highest sepsis incidence across all age group is found in neonates affecting an estimated 3 million babies worldwide with mortality of 11-19% and a total of 30-50% in developing countries.[6]

A single reliable marker for sepsis is yet to be established. Guidelines have markers of systemic inflammation and immune response to include, total leukocyte counts, absolute neutrophil count, immature to mature granulocyte ratio and CRP. Newer sensitive markers include IL-6 and IL-8, CD 11b as markers for sepsis but are not cost effective.

Micro ESR is a simple, easy to perform bed side test which is cost effective. Interpretation of the test is easy and less time consuming. Sensitivity and specificity is 63.3 % and 60% respectively in screening neonatal sepsis. In our study we had sensitivity and specificity of 85.7% and 86% respectively.[7] In a study by Kafle R et al with study sample of 75, showed of the 25 (33.3%) neonates with elevated micro ESR level 12 (48%) had positive blood culture.[8] Ghaliyah Aziz Kutty et al, study with sample size of 50 showed elevated micro ESR in 18 (36%) cases of which 16 (84%) showed positive blood culture, Contrary to this, our study has shown a 100% correlation when micro ESR was positive with positive blood culture report and a 50% mortality rate with micro ESR positivity 12 (24%).[9]

In another study Gugnani P et al, of the 270 neonates enrolled culture positive cases were 137 (50.7%), 115 cases (83.90%) were CRP positive. This study reported that a significant 83.9% of culture positive neonates were CRP positive. Comparable results were obtained in our study 82.6% of cases with positive CRP had positive blood culture.[10]

In a study by Thirunavukkarasu Babu A et al comparative efficacy of m-ESR and CRP, out of the 202 study participants 49 had positive CRP. Among these 33 (67.3%) showed elevated m-ESR.11 The percent agreement between m-ESR values with CRP values was 79.2%. Our study showed comparable results with100% agreement. Study done by Sunil Raja Manandhar and Rydam Basnet in Katmandu Medical College showed out of 75 babies, confirm sepsis is 13 (17.3%), Micro-Erythrocyte sedimentation level is elevated in 25 (33.3%) babies with a mean micro-Erythrocyte sedimentation level 9.32±5.4 (2-18) mm in 1st hr.[11]

In a study by Thirunavukkarasu Babu A et al their study included EOS (82%) and LOS (17.3%) among which 24.2% had elevated CRP level.[12] Contrary results were seen in, our study which had 45 cases with raised CRP, 39 cases with raised CRP also had positive blood culture report and a 13.2% mortality rate with CRP positivity. In Shailesh Vartak et al study the sensitivity of CRP was found to be 89% showed concordance with studies done by Zaki et al and Misra et al. This study also concluded that among single screening test CRP had highest sensitivity.[10] In our study also 84% of the cases had confirmed sepsis and micro ESR was found to be elevated in 24% of the cases, it was also noted that cases which had elevated micro ESR had poor prognosis.

CONCLUSION

As a predictor for sepsis, micro ESR is a good bedside tool for prognostication in neonatal sepsis. Mortality in neonatal sepsis has a significant correlation with micro ESR

The study limitations like larger sample size was required for predicting positive impact on micro ESR in sepsis. Comparing micro ESR with newer investigations like procalcitonin could not be done due to resource limitation.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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