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A Comparative Study in Sepsis and Normal Neonates-A Microbiological Perspective

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The present study was designed to determine the incidence and causative organisms of bacterial sepsis in neonates by using blood culture techniques in the infected neonates and to evaluate the contribution made by C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), white cell count (WCC) and haemoglobin in mothers. Of this CRP, ESR, WCC were very high, but hemoglobin count was low in most of the sepsis mothers. Assessing CRP, ESR, WCC is a more reliable way to indicate sepsis and it was noted that the gram-negative bacteria are responsible for septicemia in maximum number of cases.

Key words: Neonates, sepsis, C-reactive protein, erythrocyte sedimentation rate

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INTRODUCTION

Sepsis is the commonest cause of neonatal mortality, it is responsible for about 30-50% of the total neonatal deaths in developing countries (Bang *et al*., 1999; Stoll, 1997). It is estimated that up to 20% of neonates develop sepsis and approximately 1% die of sepsis related causes (Stoll, 1997). The evaluation of tests for neonatal sepsis is important because the infection may present a very serious threat to the baby. There is an urgent need to know whether the baby has sepsis to institute treatment as quickly as possible (Chiesa *et al*., 2004). Sepsis related mortality is largely preventable with rational antimicrobial therapy and aggressive supportive care.

Advances in neonatal intensive care during the last decades with survival of very tiny babies those with severe neonatal problems and prolonged hospitalization has led to the diversity of old and new neonatal infections which posses an ongoing challenge to neonatologists (Singh, 1986). The infectious agents associated with neonatal sepsis have changed over the past 50 years *Staphylococcus aureus* and *Escherichia coli* were the most common infectious hazards for neonates in the 1950's in United States, group B *Streptococcus* (GBS) then replaced *S. aureus* as the most common Gram-positive agent causing early onset sepsis. However, *S. aureus* and *E. coli* are now observed more frequently.

Babies with high risk factors are subjected to simple laboratory investigation, which are practical, feasible and are reliable early indicators of neonatal sepsis (Rodwell *et al*., 1988). They include, blood culturing, C-reactive protein (CRP) estimation, erythrocyte sedimentation rate (ESR), white cell count (WCC) and haemoglobin estimation in mothers. Therefore, this study was designed to evaluate the contribution made by CRP, ESR, WCC and haemoglobin in mothers and to identify the organism by using blood culture techniques in the infected neonates.

MATERIALS AND METHODS

The routine investigation data were collected from the various private and government hospitals, which are situated in Trichy. Infants were classified as clinically infected (sepsis) or non-infected (normal), based on the initial clinical presentation and results of routine investigations (a) white blood cell, (b) ESR. Upon identification of eligible infants, written parental consent was obtained. The available specimens of blood of 30 neonates with sepsis and 30 normal infants were obtained from labs for following the further investigations: blood culture (Washington, 1975), CRP (Ballou and Kushner, 1992) and a venous blood sample was collected from mother for the estimation of haemoglobin (Kapoor *et al*., 2002).

Blood cultures are made whenever there is a reason to suspect clinically significant septicemia. In many situations, blood cultures are the only immediate source of the etiological agent of severe or life threatening infections and diagnosis depends on them. The blood was inoculated directly into culture media containing anticoagulant and incubated at 35°C. Blood culture bottles were inspected daily for evidence of growth without disturbing sediment blood. Evidence of growth was examined by observing the turbidity if evidence of growth was seen, the top of the rubber diaphragm was decontaminated with 70% alcohol and 0.25 mL of contents was aspirated with a needle and syringe. The aspirated material was used to prepare a smear and Gram staining was done followed by biochemical testing. Thus the organism was identified.

RESULTS AND DISCUSSION

From the study it is evident that in normal newborns none of them showed any abnormal signs and symptoms, where as in all sepsis case the infant showed at least one or more symptoms, which is more prominent from the study. Hemoglobin level was analyzed for both sepsis case and normal case mothers (Table 1). The hemoglobin level of sepsis mothers 33.3% were between 9.1-10 g dL^{-1} and this may indicate a possible infection in the sepsis mothers. Hence a high chance of maternal transmission.

CRP was found to be positive in all sepsis cases and the values were very high, 80% had values higher than 11.1-13.5 mg dL^{-1}, which is evident from the study that the newborn is already susceptible to the infection (Table 1) (Sabel and Wadsworth, 1979). CRP is now regarded as a routine test in this setting, into which considerable resources are being directed. There may be indications for measuring CRP in acute medical patients, such as monitoring the progression of illness (Leaver *et al*., 1995; Lobo *et al*., 2003; Reny *et al*., 2002). The detection of severe infectious illness is the aim of using an acute inflammatory marker and a full blood count is available, one needs to consider whether expending resources on CRP estimation is worthwhile.

WCC was also very high during onset of infection nearly 50% had 22501-25000 cell mm^{-3} which is proved from the study that the newborn is combating with infection during the onset of infection. WCC was

Table 1: Biochemical parameters and blood culturing

S. No.	Parameters	Normal n:30	Sepsis n:30
1	**Hemoglobin (g dL^{-1}) in mother alone**		
	8.1-9.0	--	7 (23.3%)
	9.1-10.0	--	10 (33.3%)
	10.1-11.0	--	9 (30.0%)
	11.1-12.0	--	4 (13.3%)
	12.1-13.0	--	--
	13.1-14.0	--	--
	14.1-15.0	2 (6.7%)	--
	15.1-16.0	5 (16.7%)	--
	16.1-17.0	7 (23.3%)	--
	17.1-18.0	5 (16.7%)	--
	18.1-19.0	3 (10.0%)	--
	19.1-20.0	4 (13.3%)	--
	20.1-21.0	2 (6.7%)	--
	21.1-22.0	2 (6.7%)	--
2	**CRP (mg dL^{-1})**		
	Positive	0	30 (100.0%)
	Negative	30 (100.0%)	0
	Less than 0.6	11 (36.7%)	--
	0.6-1.0	9 (30.0%)	--
	1.1-1.5	8 (26.7%)	--
	1.6-2.0	1 (3.3%)	--
	2.1-2.5	--	--
	2.6-3.0	--	--
	3.1-4.0	1 (3.3%)	--
	4.1-10.0	--	--
	10.1-10.5	--	2 (6.7%)
	10.6-11.0	--	4 (13.3%)
	11.1-11.5	--	7 (23.3%)
	11.6-12.0	--	5 (16.7%)
	12.1-12.5	--	5 (16.7%)
	12.6-13.0	--	5 (16.7%)
	13.1-13.5	--	2 (6.7%)
3	**ESR (mm)**		
A	**½ h**		
	0	18 (60.0%)	--
	1	9 (30.0%)	--
	2	2 (6.7%)	--
	3	--	--
	4	--	--
	5	1 (3.3%)	--
	6	--	--
	7	--	--
	8	--	--
	9	--	--
	10	--	--
	11	--	1 (3.3%)
	12	--	1 (3.3%)
	13	--	3 (10.0%)
	14	--	11 (36.7%)
	15	--	8 (26.7%)
	16	--	6 (20.0%)
B	**1 h**		
	0	2 (6.7%)	--
	1	9 (30.0%)	--
	2	7 (23.3%)	--
	3	8 (26.7%)	--
	4	--	--
	5	2 (6.7%)	--
	6	1 (3.3%)	--
	7	1 (3.3%)	--
	8-14	--	2 (6.7%)
	15-20	--	--
	21-25	--	16 (53.3%)
	26-30	--	9 (30.0%)
	31-35	--	2 (6.7%)
	36-40	--	--
	41-45	--	1 (3.3%)
	46-50	--	--

Table 1: Continued

S. No.	Parameters	Normal n:30	Sepsis n:30
4	**WCC (cells mm^{-3})**		
	7501-10000	5 (16.7%)	--
	10001-12500	8 (26.7%)	--
	12501-15000	7 (23.3%)	--
	15001-17500	6 (20.0%)	--
	17501-20000	3 (10.0%)	4 (13.3%)
	20001-22500	1 (3.3%)	11 (36.7%)
	22501-25000	--	15 (50.0%)
5	**WCC**		
A	**Neutrophil (%)**		
	Less than 25	1 (3.3%)	--
	26-35	1 (3.3%)	--
	36-45	5 (16.7%)	--
	46-55	8 (26.7%)	--
	56-65	12 (40.0%)	5 (16.7%)
	66-75	2 (6.7%)	12 (40.0%)
	76-85	1 (3.3%)	13 (43.3%)
B	**Lymphocyte (%)**		
	11-20	1 (3.3%)	13 (43.3%)
	21-30	2 (6.7%)	13 (43.3%)
	31-40	11 (36.7%)	4 (13.3%)
	41-50	9 (30.0%)	--
	51-60	5 (16.7%)	--
	61-70	1 (3.3%)	--
	71-80	1 (3.3%)	--
C	**Eosinophil (%)**		
	1	3 (10.0%)	1 (3.3%)
	2	13 (43.3%)	3 (10.0%)
	3	11 (36.7%)	5 (16.7%)
	4	2 (6.7%)	4 (13.3%)
	5	1 (3.3%)	5 (16.7%)
	6	--	4 (13.3%)
	7	--	4 (13.3%)
	8	--	3 (10.0%)
	9	--	1 (3.3%)
6	**Blood culturing**		
	Escherichia coli	--	8 (30.0%)
	Klebsiella	--	7 (23.3%)
	Streptococcus group B	--	7 (23.3%)
	Staphylococcus aureus	--	6 (20.0%)
	Achromobacter	--	1 (3.3%)

done, in all sepsis cases the count of neutrophils were high nearly 83.3% had ranges between 66-85% indicating the newborn is already susceptible to the infection (Table 1) (Kuchler *et al*., 1976).

On blood culturing of the suspected newborns *E. coli* was isolated in 30% cases. *Klebsiella*, in 23.3% cases and GBS in 23.3%, *S. aureus* in 20% and in *Achromobacter* 3.3% cases. Thus from the study it is proved that the impact of gram negative organisms were more in causing septicemia in newborn than gram positive organisms (Table 1). Jaswal *et al*. (2003) demonstrated that the incidence of blood culture positivity was 42%, out of which 47.62% were gram positive and 52.48% gram negative. Amongst gram negative, *Klebsiella* was the commonest organism (23.8%) followed by *E. coli* (19.04%) and *Acinetobacter* (9.52%). Amongst gram positive, coagulase positive *Staphylococci* accounted for 28.27% cases. CRP was positive in 50% and raised micro ESR in 48% cases.

CONCLUSION

On blood culturing, 56.6% were gram negative and 43.4% were gram positive. Hence gram-negative bacteria are responsible for septicemia in maximum number of cases. The useful parameters for diagnosis are CRP, ESR, WCC and blood culturing highly helped in diagnosis of sepsis cases. Of this CRP, ESR, WCC were very high, but hemoglobin count was low in most of the sepsis mothers.

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