## **Original Research Article**

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# Prospective study to evaluate the risk factors associated with mortality in neonatal septicemia

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#### **ABSTRACT**

**Background:** Neonatal sepsis is a clinical syndrome of bacteremia characterized by systemic signs and symptoms of infection in the first month of life. Neonatal sepsis refers to infection occurring within the neonatal period i.e. first 28 days of life for a term baby and up to 4 weeks beyond the expected date of delivery in a preterm baby. Neonatal sepsis is one of the major cause of neonatal morbidity and mortality.

**Methods:** The present study is a prospective observational study conducted in the neonatal intensive care unit (NICU) of Sri Guru Ram Das Institute of Medical Sciences and Research (SGRDIMSAR), Sri Amritsar over a period of one year from January 2015 to January 2016. Aim of the study is to know the incidence of neonatal sepsis, to study bacteriology of neonatal septicemia and to evaluate the risk factors associated with mortality in neonatal sepsis in our hospital.

**Results:** During the study period (January 2015 to January 2016), 727 neonates were admitted in NICU of SGRDIMSAR, Sri Amritsar. Out of them, 109 neonates were diagnosed as having septicemia. Incidence of neonatal sepsis in our hospital in this study is 149.9/1000 neonatal admissions. 59 (54.1%) neonates had positive blood culture. Out of 109 septic neonates, 50 died and 59 survived. Mortality observed in the present study is 45.9%.

Conclusions: It is concluded from present study that the main factors associated with neonatal mortality are low birth weight, prematurity, positive blood culture, neutropenia and prolonged prothrombin time. Some of the risk factors like low birth weight and prematurity are preventable by proper antenatal check ups and measures can be taken for safe and hygienic delivery. Babies with risk factors should be monitored closely for early detection of sepsis and the neonates with sepsis having abnormal laboratory parameters should be subjected to appropriate therapeutic intervention in order to decrease the mortality.

Keywords: Blood culture, CRP, Mortality, Neonatal sepsis

### **INTRODUCTION**

Neonatal sepsis is a clinical syndrome of bacteremia characterized by systemic signs and symptoms of infection in the first month of life. Sepsis is broadly classified into early and late onset sepsis. The incidence of culture proven sepsis varies between 1-8 cases per 1000 live births with equal distribution of early and late onset cases.<sup>1,2</sup> Various community and hospital based studies report sepsis as a cause of neonatal death in 20-

50% of the cases.<sup>3,4</sup> Out of 4 million newborns dying each year world-wide, 36% are due to severe neonatal infections.

Sepsis is broadly classified into early and late onset neonatal sepsis. Early onset sepsis (EOS) usually presents within first 72 hours of life. It can manifest as a fulminant disease with immediate onset of respiratory distress after delivery (with or without cardiovascular instability) or on day 1 to 3 of postnatal life after an asymptomatic period.<sup>5</sup>

The source of infection is generally maternal genital tract which is colonized with aerobic and anaerobic organisms that may result in ascending infection and colonization of neonate at birth. Vertical transmission of bacterial agents may also occur in utero or more commonly during labour.

The organisms responsible for the early onset sepsis are group B Streptococcus and *E. coli* in the west, while in India most cases are due to gram negative organisms especially *E. coli*, Klebsiella and Enterobacter sp. Pneumonia is the commonest focal infection. Listeria monocytogenes is isolated less frequently but carries significant mortality, and is an important cause of meningitis.<sup>6</sup>

Late onset sepsis (LOS) usually present after 72 hours of age. The source of infection is either nosocomial or community acquired and neonates usually present with septicemia, pneumonia or meningitis. Organisms that have been implicated causing LOS are coagulase negative Staphylococci, Staphylococcus aureus, *E. coli*, Klebsiella, Pseudomonas, Enterobacter and anaerobes.<sup>7</sup>

Presence of following risk factors has been associated with increased risk of early onset sepsis that is Low birth weight (<2500 grams), Prematurity, Febrile illness in the mother within two weeks prior to delivery, Foul smelling liquor amnii, Prolonged rupture of membranes >18 hours, more than three vaginal examinations during labour, prolonged and difficult delivery with instrumentation, perinatal asphyxia (APGAR score <4 at 1 minute of age) or difficult resuscitation. 8.9

Factors predisposing to Late onset sepsis include are stay in intensive care unit, not receiving enteral feeds for long time, having an indwelling catheter, or receiving total parenteral nutrition (TPN).<sup>10</sup>

The clinical signs of neonatal sepsis are subtle and often the diagnosis is difficult to establish on the basis of clinical findings alone. The blood culture remains the Gold Standard for diagnosing sepsis though its sensitivity is 50-80%. A definitive diagnosis is based on culture reports which are not available for atleast two days. So, to improve the diagnostic accuracy, a sepsis screen comprising adjunctive tests like total leukocyte count, absolute neutrophil count, micro-ESR (erythrocyte sedimentation rate), immature to total neutrophil ratio and C-reactive protein (CRP) has been proposed by various authors to corroborate the diagnosis of sepsis. Neutropenia and increased prothrombin time are independent predictors of mortality in neonatal sepsis. 13

The present study was designed to evaluate risk factors that increase mortality in neonatal sepsis with routinely available clinical and laboratory parameters so that early intervention could be possible before the disease reaches critical stage. This study has tried to evaluate various risk factors for fatal neonatal septicemia.

#### **METHODS**

The present study was prospective study conducted in the neonatal intensive care unit (NICU) of Sri Guru Ram Das Institute of Medical Sciences and Research (SGRDIMSAR), Sri Amritsar over a period of one year from January 2015 to January 2016. Aim of the current study was to know the incidence of neonatal sepsis among the neonates admitted in our hospital, to study bacteriology of neonatal septicemia and to evaluate the risk factors associated with mortality in neonatal sepsis.

It was observational prospective study. During the study period, total 727 neonates neonates were admitted in NICU of SGRDIMSAR, Sri Amritsar. Out of them, 109 neonates were diagnosed as having septicemia.

#### Inclusion criteria

- Neonates with clinical features of neonatal sepsis.
- Physical examination demonstrating either circulatory or respiratory dysfunction. Circulatory dysfunction was evidenced by the presence of tachycardia (heart rate greater than 160/min) or bradycardia (heart rate less than 100/min) or capillary refill time more than 3 seconds. Respiratory dysfunction was evidenced by the presence of grunting, nasal flaring, retractions, tachypnea (respiratory rate more than 60/min) or apnea lasting for more than 20 seconds.
- One or more of the following laboratory criteria (a) positive blood culture; (b) polymorphonuclear band cells more than 20%; (c) positive C-reactive protein.

In each neonate with clinical features of sepsis, a detailed history was taken. The parents were interviewed regarding the place and mode of delivery, birth weight and possible risk factors for acquiring sepsis. The gestational age was calculated using New Ballard Score. A detailed clinical examination was done.

Blood samples were taken under all aseptic precautions. Blood culture, CRP, complete blood count, band cell count, prothrombin time was done in all cases. Other investigations like lumbar puncture, x-ray chest and urine analysis were carried out as and when required. The neonates were followed up to determine the final outcome. Those who died served as cases while those discharged after recovery were taken as controls. CRP was done using NycoCard CRP test. Blood cultures were done by using BACTEC and Vitek-2 system.

## Statistical analysis

The data was analysed with the help of computer SPSS17.0 and Microsoft Excel for windows. Relationships with the outcome i.e. mortality due to neonatal sepsis was evaluated. Chi square test was used to ascertain statistical significance among the proportion and the strength of their association was computed by

odd's ratio (95% confidence interval). Variables showing statistically significant association with the outcome (p <0.05) were considered as potential risk factors for the mortality. These variables were simultaneously subjected to stepwise multivariate logistic regression analysis to determine the independent risk factors for the fatal outcome.

#### **RESULTS**

During the study period (January 2015 to January 2016), 727 neonates were admitted in NICU of SGRDIMSAR, Sri Amritsar. Out of them, 109 neonates were diagnosed as having septicemia. Incidence of neonatal sepsis in our hospital in this study was 149.9/1000 neonatal admissions. 59 (54.1%) neonates had positive blood culture. Out of 109 septicemic neonates, 50 died and 59 survived. Mortality observed in the present study was 45.9%.

Table 1: Clinical features in septicemic neonates.

Clinical feature	Number	Percentage
Lethargy	86	76.1
Refusal to feed	82	75.2
Respiratory distress	72	66.1
Hypothermia	42	38.5
Hyperthermia	31	28.4
Abdominal distension	13	11.9
Convulsions	11	10.1
Jaundice	11	10.1
Apnea	8	7.3
Irritability	4	3.7
Vomiting	3	2.8
Sclerema	2	1.8
Diarrhea	2	1.8

Table 2. Bacterial profile of septicemic neonates with positive blood cultures.

Culture organism	Total (n=59	Total (n=59)		Case (n=25)		Control (n=34)			
Organism	No.	<b>%</b>	No.	%	No.	<b>%</b>			
Gram positive b	Gram positive bacteria								
Staphylococcus aureus	7	11.8	2	8	5	14.7			
Enterococci	4	6.7	2	8	2	5.8			
CONS	3	5	2	8	1	2.9			
Aerobic spore bearer	2	3.3	0	-	2	5.8			
Fungal (organis	sm)								
Candida	4	6.7	2	8	2	5.8			
Gram negative	bacter	ia							
Klebsiella	11	18.6	5	20	6	17.64			
Pseudomonas	2	3.3	2	8	0	-			
Acinetobacter	11	18.6	6	24	5	14.7			
Citrobacter	6	10.16	4	16	2	5.8			

 $X^2 = 7.146$ ; p<0.622

Lethargy was most common presenting complaint seen in 86 (76.1%) neonates followed by refusal to feed which was seen in 82 (76.1%) and respiratory distress in 72 (66.1%).

Temperature instability in the form of hypothermia was seen in 42 (38.5%) and hyperthermia in 31 (28.4%). Abdominal distension was present in 13 (11.9%) patients, convulsions in 11 (10.1%), jaundice in 11 (10.1%), apnea in 8 (7.3%), irritability in 4 (3.7%), vomiting in 3 (2.8%), sclerema and diarrhea in 2 (1.8%) patients each.

Positive blood culture was obtained in 54.1% (59/109) neonates. Gram negative organisms Acinetobacter and Klebsiella were the predominant organisms isolated accounting 18.6% (11) each followed by Staphylococcus aureus which is gram positive organism in 11.8% (7), Citrobacter 10.1% (6), Enterococci and Candida in 6.7% (4) each, CONS (coagulase negative staphylococci) 5% (3), Pseudomonas and aerobic spore bearer in 3.3% (2) each.

Acinetobacter and Klebsiella was common isolate in cases and control. Citrobacter was more common in cases. Staphylococcus aureus was more common in controls. Enterococci was isolated both from cases and controls. Pseudomonas was only isolated from cases and aerobic spore bearer was only isolated from control group.

Table 3: Bacterial isolates in early and late onset sepsis.

Organism isolated		onset s (n=28)		Late onset sepsis (n=22)	
	No.	<b>%</b>	No.	<b>%</b>	
Acinetobacter	6	21.4	5	22.7	
Citrobacter	4	14.2	2	9	
Staphylococcus aureus	2	7.1	5	22.7	
Klebsiella	5	17.8	6	27.2	
Enterococci	3	10.7	1	4.5	
Candida	2	7.1	2	9	
Pseudomonas	2	7.1	0	-	
CONS	2	7.1	1	4.5	
Aerobic spore bearer	2	7.1	0	-	

 $X^2 = 21.762$ ; p<0.243

Acinetobacter was the predominant organism isolated in both early (21.4%) and late onset sepsis (22.7%) followed by Klebsiella which was more commonly isolated in late onset sepsis (27.2%) in comparison to early onset sepsis (17.8%) while Staphylococcus aureus was more common in late onset sepsis (22.7%) as compared to early onset sepsis (7.1%).

Citrobacter was isolated in 14.2% in early onset sepsis as compared to 9% in late onset sepsis.

Candida and CONS were isolated equally both from early and late onset sepsis. Pseudomonas and aerobic spore

bearer were more commonly isolated in early onset sepsis.

Table 4: Bacterial isolates and their sensitivity to various antibiotics.

Antibiotics	Organisms						
	Acinetobacter	Citrobacter	Klebsiella	Pseudomonas	Staph. aureus	Enterococci	CONS
Gentamycin	4 (36)	3 (50)	1 (19)	2 (10)	4 (57)	1 (25)	-
Amikacin	4 (36)	3 (50)	1 (19)	2 (10)	5 (71)	-	1 (33)
Netilmycin	7 (63.6)	3 (50)	3 (27)	1 (50)	6 (85)	-	2 (66)
Amoxicillin	1 (9)	-	-	-	6 (85)	-	1 (33)
Levofloxacin	10 (90.9)	-	4 (36)	1 (50)	-	-	-
Ciprofloxacin	4 (36)	1 (16)	2 (18)	1 (50)	4 (57)	1 (25)	-
Gatifloxacin	3 (27)	1 (16)	-	-	-	1 (25)	1 (33)
Ofloxacin	4 (36)	-	1 (9)	1 (50)	6 (85)	1 (25)	-
Vancomycin	-	-	4 (36)	-	6 (85)	1 (25)	-
Linezolid	-	-	-	1 (50)	6 (85)	3 (75)	2 (66)
Ceftriaxone	2 (18)	3 (50)	-	2 (100)	-	-	-
Cefotaxime	3 (27)	-	4 (36)	1 (50)	2 (33)	-	-
Cefopodoxime	1 (9)	-	-	-	1 (14)	-	1 (33)
Ceftazidime	5 (45)	-	2 (18)	1 (50)	-	-	-
Cefepime	2 (18)	-	1 (9)	1 (50)	-	-	-
Piperacillin- tazobactum	6 (54)	-	2 (18)	1 (50)	5 (71)	1 (25)	1 (33)
Cefoxitin	-	-	-	-	4 (57)	-	1 (33)
Imipenem	4 (36)	-	5 (45)	-	2 (33)	-	1 (33)
Chloramphenicol	5 (45)	-	1 (9)	1 (50)	6 (85)	1 (25)	-

In the present study, the antibiotic sensitivity pattern of various isolates was observed. Klebsiella isolates were more susceptible to imipenem (45%); cefotaxime, vancomycin, levofloxacin (36%) each; ciprofloxacin, ceftazidime, piperacillin-tazobactum (18%); gentamycin, amikacin (19%); ofloxacin, chloramphenicol (9%) each.

The isolates of staphylococcus aureus were more susceptible to netilmycin, amoxicillin, ofloxacin, vancomycin, linezolid, chloramphenicol (85%) each; amikacin, piperacillin (71%)each; gentamycin, ciprofloxacin (57%). No sensitivity was seen with ampicillin.

Citrobacter isolates showed sensitivity of 50% each to ceftriaxone, gentamycin, amikacin, netilmycin each; 16% each to ciprofloxacin and gatifloxacin. No sensitivity was seen with ampicillin.

Gram negative organisms were sensitive to gentamycin, amikacin. netilmycin, ceftriaxone. ciprofloxacin, gatifloxacin, levofloxacin. linezolid. imipenem, chloramphenicol whereas gram positive organisms were sensitive to amoxicillin, cefotaxime, cefepime, linezolid, ciprofloxacin, gatifloxacin, vancomycin, ofloxacin, piperacillin. Acinetobacter isolates were most sensitive to gentamycin, amikacin, netilmycin, levofloxacin, chloramphenicol and Klebsiella was most sensitive to imipenem. Almost all isolates were resistant to ampicillin.

**Table 5: Relation of weight with mortality.** 

Weight	Case	S	Cont	rol	Crude	95%
weight	No. % No. %		odd's ratio	CI		
Upto 1500gm N=27	17	63	10	37	3.091	1.057- 9.039
1501- 2000gm N=21	12	57.1	9	42.9	2.424	0.779- 7.542
2001- 2500gm N=30	10	33.3	20	66.7	0.909	0.316- 2.616
Above 2500gm N=31	11	35.5	20	64.5	Reference	

 $X^2 = 7.498$ ; p<0.058

63% of septicemic neonates with birth weight upto 1500 grams expired where maximum mortality was observed followed by 57.1% (12/21) mortality in neonates with birth weightbetween 1501-2000 grams and 32.2.%

(11/31) mortality in neonates with birth weight more than 2500 grams. Least mortality 33.3% (10/30) was observed in neonates with birth weight between 2001-2500 grams. The overall risk of death in neonates with birth weight upto 1500 grams was observed to be 3.091 (OR) with 95% CI (1.057-9.039) (p<0.039) and in neonates with birth weight between 1501-2000 grams the overall risk of death was observed to be 2.424 (OR) with 95% CI (0.779-7.542). This observation was not statistically significant (p<0.058).

Table 6: Relation of gestational age with mortality.

Gestational age	Case (n=5		Con (n=5		Crude odd ratio	95 CI
(weeks)	No.	<b>%</b>	No.	%	oud ratio	
Upto 32 (n=14)	12	85.7	2	14.3	13.143	2.698- 64.028
33-36 (n=28)	17	60.7	11	39.3	3.385	1.353- 8.473
More than 36 (n=67)	21	31.3	46	68.7	Reference	

 $X^2 = 17.131$ ; p<0.001

Maximum mortality was observed in neonates with gestational age upto 32 weeks where 85.7% (12/14) neonates expired followed by 60.7% (17/28) in neonates with gestational age between 33-36 weeks and least mortality was observed in neonates with gestational age 37 and above. The overall risk of death in septicemic neonates with gestational age upto 32 weeks was observed to be 13.143 (95 CI 2.698-64.028) and in neonates with gestational age between 33-36 weeks the risk of death was observed to be 3.385 (95 CI 1.353-8.473). The observation showed that the mortality in sepsis was inversely related to the gestational age and was statistically significant (p<0.001).

68% (34/50) of septicemic neonates with prolonged prothrombin time died as compared to neonates with normal prothrombin time where mortality was only 27.1% (16/59). The overall risk of fatal outcome in septicemic neonates with prolonged prothrombin time was observed to be 5.714 (OR) with 95% CI between 2.5-12.987. This observation was statistically significant (p<0.0001).

Table 7: Relation of prothrombin time (PT), absolute neutrophil count (ANC) and blood culture with mortality.

	PT		ANC (neutrope	ANC (neutropenia)		Blood culture	
	Normal	Prolonged	Present (n=37)	Absent (n=72)	Positive (n=54)	Negative (n=55)	
Case (n=50)	16 (27.1%)	34 (68%)	35 (94.6%)	15 (20.8%)	28 (51.8%)	22 (40%)	
Control (n=59)	43 (72.9%)	16 (32%)	2 (5.4%)	57 (79.2%)	26 (48.1%)	33 (60%)	
Crude odd ratio	5.714		66.66		1.615		
95 CI	2.5-12.987		14.285-33.33		0.756-3.448		
$X^2$	18.217		53.554		1.541		
p-value	< 0.0001		< 0.0001		< 0.214		

94.5% (35/37) of septicemic neonates with neutropenia expired as compared to septicemic neonates without neutropenia 20.8% (15/72) where the mortality was observed 5 times less. Analysis of the strength of the association revealed that septicemic neonates with neutropenia were 66.66 times more susceptible to death with 95% CI 14.285-33.33. This observation was statistically significant (p<0.0001).

51.8% (28/54) of the septicemic neonates with positive blood culture died as compared to 40% (22/55) septicemic neonates with negative blood cultures. The overall risk of death in neonates with positive blood cultures was observed to be 1.615 (crude OR) with 95% CI between 0.756-3.448. This observation was not statistically significant (p<0.214).

## **DISCUSSION**

In the present study, the incidence of septicemia was 149.9/1000 NICU admissions. Chacko et al, Sharma et al

and Choudhary et al reported incidence of septicemia as 37.2/1000 live births, 33.7/1000 and 51/1000 live births respectively. 1,14,15

In present study, as per Table 1, lethargy was most common clinical feature in current study (76.1%) followed by refusal to feed (75.2%), respiratory distress (66.1%), hypothermia (38.5%), hyperthermia (28.4%), abdominal distension (11.9%), jaundice (10.1%), convulsions (10.1%), apnea (7.3%), irritability (3.7%), vomiting (2.8%), sclerema (1.8%) and diarrhea (1.8%). Kathua et al<sup>16</sup> reported refusal to feed as common clinical presentation (92%) followed by lethargy (74%), diarrhea (74%), abdominal distension (60.1%), hypothermia (30.4%), (46.8%),jaundice (38%),vomiting hyperthermia (24.8%), respiratory distress (24%), sclerema (17.4%), apnea (13%) and convulsions (10.8%).16 Malik et al reported refusal to feed as the commonest clinical feature (77%) followed by hyperthermia (60%), lethargy (51%), hypothermia (46.6%), abdominal distension (35%) and respiratory

distress (26%).<sup>17</sup> The differences in the percentage of different clinical features at the time of admission could be because of different population groups in various studies.

In present study, 59 out of 109 neonates had positive blood culture as per Table 2. The culture positive rate was 54.1% which is comparable to culture positive rate of 43% observed by Chackoo et al, 59.8% by Khatua et al. 1,16 This difference in positivity of blood culture is because blood culture positivity depends on many factors like specimen collection, blood volume and the number and timing of blood culture.

Acinetobacter and Klebsiella was the predominant pathogen of neonatal sepsis in current study as depicted in Table 3 that is (18.64%) followed by Staphylococcus (11.8%), Citrobacter (10.16%), Enterococcus and Candida (6.7%), CONS (5%) and Pseudomonas (3.3%). Tallur et al reported Klebsiella as the predominantly isolated pathogen in his study (33.7%). Sharma et al and Choudhury et al reported *E. coli* as the predominant pathogen in their study. Malik et al observed Klebsiella as predominant organism accounting 55.6%. Other organisms isolated were Staphylococcus aureus (9.5%), Acinetobacter (17.4%), *S. faecalis* (5.5%), *E. coli* (3.7%) and *P. mirabilis* (1.9%). Among fungi, Candida was isolated from 2 cases of septicemia. Their observation is in close relation with current study.

In present study, Acinetobacter was the predominant organism isolated in both early (21.4%) and late onset sepsis (22.7%) followed by Klebsiella which was more isolated in late onset sepsis (27.2%) than in early (17.8%). Staphylococcus aureus was more common in late onset sepsis (22.7%) than in early onset sepsis (7.1%). Citrobacter was isolated in 14.2% in early onset sepsis and 9% in late onset sepsis. Candida and CONS were isolated both from early and late onset sepsis. Pseudomonas and aerobic spore bearer were more commonly isolated in early onset sepsis. Placezek et al and Jiang et al reported group B Streptococci and *E. coli* as the frequently encountered pathogens in early onset sepsis and CONS, *E.coli* and Klebsiella as commonly isolated organisms in late onset sepsis. 19,20

In the present study, as shown in Table 4, Klebsiella isolates were more susceptible to imipenem (45%): cefotaxime. vancomycin, levofloxacin (36%): piperacillin-tazobactum ciprofloxacin. ceftazidime. (18%); gentamycin, amikacin (19%); ofloxacin, chloramphenicol (9%). Mathur et al reported that only 3.3% of Klebsiella isolates were sensitive to ampicillin and 39.3% were sensitive to gentamycin.13 Tallur et al observed that 25% of Klebsiella isolates were sensitive to ampicillin, 40% isolates were sensitive to gentamycin and maximum sensitivity was seen with amikacin (82%).<sup>18</sup>

In the present study, the isolates of staphylococcus were more susceptibe to netilmycin, amoxicillin, ofloxacin, vancomycin, linezolid, chloramphenicol (85%) each; amikacin, piperacillin-tazobactum (71%); gentamycin, ciprofloxacin (57%). No sensitivity was seen with ampicillin. These observations were consistent with the observations of Tallur et al who reported 50% isolates of staphylococcus aureus were sensitive to amikacin, 29% to gentamycin and 21% to ampicillin.<sup>18</sup>

In present study, Citrobacter isolates showed sensitivity of 50% to ceftriaxone, gentamycin, amikacin, netilmycin each; 16% to ciprofloxacin and gatifloxacin. No sensitivity was seen with ampicillin. These observations were different from that of Bhakoo et al who reported that all isolates of Citrobacter were sensitive to gentamycin and 83% were sensitive to chloramphenicol.<sup>21</sup>

Present study showed mortality in septicemic neonates was 51.8%. Mathur et al reported mortality of 48.5%. <sup>13</sup> Tallur et al observed mortality of 47.52%. <sup>18</sup>

In the present study as shown in Table 5 ,63% of septicemic neonates with birth weight upto 1500 grams expired where maximum mortality was observed followed by 57.1% (12/21) mortality in neonates with birth weight between 1501-2000 grams and 32.2% (11/31) mortality in neonates with birth weight more than 2500 grams. Least mortality 33.3% (10/30) was observed in neonates with birth weight between 2001-2500 grams. Choudhury et al and Mathur et al also observed higher mortality (55.95% and 60.2% respectively) in babies less than 2000 grams. <sup>13,15</sup>

In present study as shown in Table 6, maximum mortality was observed in neonates with gestational age upto 32 weeks where 85.7% (12/14) neonates expired followed by 60.7% (17/28) in neonates with gestational age between 33-36 weeks and least mortality (31.3%) was observed in neonates with gestational age 37 and above. Bhakoo et al observed higher mortality of 78% in preterm neonates upto 34 weeks of gestation, 73% between 35-36 weeks of gestation and least mortality (53%) in neonates with gestational age more than 36 weeks.<sup>21</sup>

51.8% (28/54) of the septicemic neonates with positive blood culture in our study died as compared to 40% (22/55) septicemic neonates with negative blood cultures. Khatuaet al also observed higher mortality in neonates with positive blood culture (69%) than in neonates with negative blood culture. <sup>16</sup> In present study, positive blood culture had no significant association with mortality (p<0.214). This is comparable with the observations of Mathur et al (p<0.08). <sup>13</sup>

In the present study, 94.5% (35/37) of septicemic neonates with neutropenia expired as compared to septicemic neonates without neutropenia 20.8% (15/72) where the mortality was observed 5 times less. Present observations were supported by Ohlssonet al who reported mortality of 63% in neutropenic neonates.<sup>22</sup> 68% (34/50) of septicemic neonates in our study with

prolonged prothrombin time died as compared to neonates with normal prothrombin time where mortality was only 27.1% (16/59) [OR 5.714; 95 CI 2.5-12.987]. These results are comparable with the observations of Mathur et al (OR 1.04; 95 CI 1.002-1.08).<sup>13</sup>

## **CONCLUSION**

In present analysis, factors associated with neonatal mortality were found to be low birth weight, prematurity, positive blood culture, neutropenia and prolonged prothrombin time. Some of the risk factors like low birth weight and prematurity are preventable by proper antenatal check ups and measures can be taken for safe and hygienic delivery. Babies with risk factors should be monitored closely for early detection of sepsis, even with routinely available clinical and laboratory parameters. Risk of fatality can be identified timely and the neonates with sepsis having abnormal laboratory parameters should be subjected to appropriate therapeutic intervention in order to decrease the mortality.

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Institutional Ethics Committee

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