Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2015; 3(8D):3036-3042 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Research Article

Analysis of Risk Factors and Prognosis for Neonatal Sepsis in a Tertiary Care Hospital of Tripura

Jayanta Poddar[1], Jayanta Debnath[2*], Soma Saha[3]

[1]Associate Professor, Department, of Pediatrics, Tripura Medical College & Dr. B.R. Ambedkar Memorial Teaching Hospital, Hapania, Agartala, Tripura (West), India.

[2]Assistant Professor, Department, of Microbiology, Tripura Medical College & Dr. B.R. Ambedkar Memorial Teaching Hospital, Hapania, Agartala, Tripura (West), India.

[3]Assistant Professor, Department, of Medicine, Tripura Medical College & Dr. B.R. Ambedkar Memorial Teaching Hospital, Hapania, Agartala, Tripura (West), India.

***Corresponding author**
Dr. Jayanta Debnath
Email: drjdebnath@gmail.com

Abstract: Neonatal mortality is recognized as an important global public health problem, of which more than one-third is due to severe infections and a quarter due to the clinical syndrome of neonatal sepsis. The present study was undertaken to evaluate the risk factors associated with neonatal sepsis and formulate a proper guideline for management on analysis of the antimicrobial susceptibility patternin this geographical area of North East India. On clinical suspicion of septicaemia, at least two sets of test for blood culture were performed. The data obtained of culture proven septicaemia were analysed in reference to onset and associated risk factors. Sepsis was suspected in 150 cases and blood culture was positive in 59(39.3%) cases. Early Onset Septicaemia (EOS) was confirmed in 34 neonates (57.6%) and Late Onset Septicaemia (LOS) in 25 patients (42.4%). The most important maternal and neonatal risk factor found associated with the proven cases of septicaemiawere maternal pyrexia (16.9%) and Low Birth Weight (71.2%) respectively. Septicaemia was more associated with Operative delivery (64.4%). Among the clinical features, Pneumonia was found in 55.9% neonates followed by respiratory distress and tachypnea. *Staphylococcus aureus* was the most predominant blood culture isolate (32.2%) followed by *Klebsiella pneumoniae* (22%).All the gram positive blood culture isolates were sensitive to Vancomycin. The Cephalosporins, Clindamycin and Amikacin were found significantly sensitive in *Staphylococcus aureus*(94.7%). All gram negative isolates were sensitive to Imipenem, followed by Piperacillin-tazobactum and Amikacin. The first line regimen for treatment of cases of septicaemia in our setting was chosen to be Amikacin along with a third generation Cephalosporin like Cefotaxime.
Keywords: Neonatal septicaemia, Risk factors, Antibiotic sensitivity.

INTRODUCTION

Neonatal mortality is recognized as an important global public health problem. More than one-third are due to severe infections and a quarter due to the clinical syndrome of neonatal sepsis [1]. Inspite of recent advances in neonatal care, worldwide neonatal mortality has been set to 30/1000; resulting in more than four million deaths per year and 95% of these deaths occur in developing countries [2]. Three conditions: infection, birth asphyxia and consequences of premature birth / Low Birth Weight are responsible for majority of these deaths[1]. Identifying the risk factors and analysis of prognosis of the neonates with sepsis prevailing in different geographical contexts has become a crucial issue of optimizing neonatal care. Though in the 'Eight Millennium Development Goals' to reduce the child mortality stated sixteen evidence based cost effective interventions during the pre-conception, antenatal, intrapartum and post-natal periods, but the evidence of effectiveness of interventions for management of neonatal sepsis was less widely accepted.[3,4].

Therefore, the present study was undertaken to evaluate the risk factors associated with neonatal sepsis and formulate a proper guideline for management, on analysis of the antimicrobial sensitivity pattern.

MATERIAL AND METHODS

The neonates admitted in the Neonatal Intensive Care Unit (NICU) of Dr. BR Ambedkar Memorial Teaching Hospital, Agartala were recruited for a period from January 2013 to December 2014. On clinical suspicion of septicaemia, atleast two sets of test

for blood culture were performed and such neonates included in the study.

The clinical diagnosis of sepsis was established on the basis of sign and symptoms like refusal of feed, diarrhoea, vomiting, irritability, jaundice, lethargy and respiratory distress. Neonates showing two or more risk factors like Maternal pyrexia, Urinary tract infection (UTI), Premature Rupture of Membrane (PROM), Meconium Stained Liquor (MSL), Perinatal Asphyxia, Low Birth Weight (LBW), etc. were selected for the study.

Following history of all recruited neonates were recorded:

- Postnatal age
- Onset of septicemia : - Early Onset Septicemia (EOS) - < 72 hours of birth
  - Late Onset Septicaemia (LOS) - > 72 hours of birth
- Birth Weight : - Low - <2.5 Kg
  - Normal - >2.5 Kg
- Gestational Age : - Preterm <36 weeks
  - Term > 36 weeks
- PROM > 24 hours
- Mode of Delivery - Operative / Assisted / Vaginal Delivery

About 1-2 ml of blood was collected from the neonates and immediately transferred to 20 ml Brain Heart Infusion Broth for blood culture, maintaining all aseptic precautions. The Culture and Antimicrobial Susceptibility Testing (AST) was done in the Microbiology Laboratory of the Institute following standard CLSI guidelines [5]. Subculture was attempted in MacConkeys agar, Sheep Blood agar and Chocolate agar every alternate day till the 7th day, for possibility of any growth. The media plates showing growth were subjected to identification by Gram staining, Colonial characteristics, Biochemical tests and other applicable special tests. AST was subsequently performed following Kirby Bauer Disc Diffusion method. The data obtained of culture proven septicaemia were analysed in reference to onset and associated risk factors.

RESULTS

During the study period, sepsis was suspected in 150 cases and blood culture was positive in 59 cases, thereby giving a positivity rate of 39.3%. EOS was confirmed in 34 neonates (57.6%) and LOS in 25 patients (42.4%). The most important maternal risk factor found associated with the proven cases of septicaemia was maternal pyrexia (16.9%). In EOS, the major risk factors included maternal pyrexia (20.6%), PROM (17.6%) and MSL (14.7%). In LOS the observation was maternal pyrexia (12%), chorioamnionitis (8%) and maternal UTI (8%).

Table 1: Maternal risk factors

Risk Factor	EOS (n=34)	LOS (n=25)	Total (n=59)
Pyrexia	7 (20.6%)	3 (12%)	10 (16.9%)
PROM	6 (17.6%)	1 (4%)	7 (11.8%)
MSL	5 (14.7%)	1 (4%)	6 (10.2)
Chorioamnionitis	1 (2.9%)	2 (8%)	3 (5.1%)
UTI	1 (2.9%)	2 (8%)	3 (5.1%)

It was observed that 65.8% cases of Caesarean section group had EOS whereas in case of vaginal delivery 57.8% neonates had LOS. There were only two cases of Outlet Forceps delivery, of which each had EOS and LOS. It is clearly evident that operative delivery predispose in the causation of neonatal septicaemia.

Table 2:Mode of delivery versus onset of septicaemia

Mode of delivery	EOS (n=34)	LOS (n=25)	Total (n=59)
LSCS	25 (65.8%)	13 (34.2%)	38 (64.4%)
NVD	8 (42.1%)	11 (57.9%)	19 (32.2%)
Assisted	1 (50%)	1 (50%)	2 (3.4%)

The male neonates (64.4%) had preponderance over female (35.6%) in both types of onset of septicaemia. LBW was found as an important predisposing factor for septicaemia. A total of 71.2% babies with LBW had septicaemia. Also 70.6% and 72% neonates had LBW with EOS and LOS respectively. On analysis of the gestational age, it was observed that 54.2% Preterm neonates had septicaemia compared to 45.8% full term neonates. EOS was more common in Preterm neonates (61.8%) whereas LOS was more found in Full term neonates (56%).

Table 3:Neonatal risk factors

Risk factor	Category	EOS (n=34)	LOS (n=25)	Total (n=59)
Sex	Male	23 (67.6%)	15 (60%)	38 (64.4%)
	Female	11 (32.3%)	10 (40%)	21 (35.6%)
Birth weight	< 2.5 Kg	24 (70.6%)	18 (72%)	42 (71.2%)
	≥ 2.5 Kg	10 (29.4%)	7 (28%)	17 (28.8%)
Gestation	Preterm	21 (61.8%)	11 (44%)	32 (54.2%)
	Term	13 (38.2%)	14 (56%)	27 (45.8%)

On analysis of the clinical features associated with septicaemia, Pneumonia was found in 55.9% neonates followed by respiratory distress and tachypnea, though meningitis was confirmed in only 5.1% cases. In EOS cases, Pneumonia and associated features predominated with 70.6% cases whereas in LOS, jaundice (68%) along with other gastrointestinal symptoms was the major features.

Table 4:Clinical features associated with neonatal septicaemia

Clinical features	EOS (n=34)	LOS (n=25)	Total (n=59)
GIT			
Vomiting	3	7	10
Diarrhea	6	8	14
Necrotizing colitis	-	1	1
Cardiac			
Shock	4	2	6
Cyanosis	3	4	7
CNS			
Meningitis	3	-	3
Seizures	6	6	12
Irritability	3	4	7
Jaundice	6	17	23
Respiratory			
Pneumonia	24	9	33
Distress	18	11	29
Tachypnoea	27	11	38
Meconium aspiration	6	0	6
Others			
Fever	13	8	21
Refusal to feed	11	14	25
Hypothermia	3	2	5
Hypoglycemia	3	1	4
Umbilical sepsis	2	1	3

The Gram Positive organisms (54.2%) predominated over Gram negative organisms (45.8%). *Staphylococcus aureus*was the most predominant isolate (32.2%) followed by *Klebsiella pneumoniae* (22%), *Staphylococcus epidermidis* (15.3%), *E.coli* (13.5%), *Pseudomonas aeruginosa*(8.5%), *Acinetobacter spp.*(5.1%) and *Enterococci spp*(3.4%).

Table 5:Blood culture isolates

Organism	EOS (n=34)	LOS (n=25)	Total (n=59)
S.aureus	16 (47.1%)	3 (12%)	19 (32.2%)
K.pneumoniae	12 (35.3%)	1 (4%)	13 (22%)
S. epidermidis	-	9 (36%)	9 (15.3%)
E.coli	5 (14.7%)	3 (12%)	8 (13.5%)
P.aeruginosa	-	5 (20%)	5 (8.5%)
Acinetobacter spp.	-	3 (12%)	3 (5.1%)
Enterococci spp.	1 (2.9%)	1 (4%)	2 (3.4%)

The antibiotic sensitivity pattern of the gram positive blood culture isolates indicates that all isolates were sensitive to Vancomycin, whereas all isolates were resistant to Ampicillin, Cotrimoxazole and Penicillin.

The Cephalosporins, Clindamycin and Amikacin were found significantly sensitive in *Staphylococcus aureus*(94.7%), *S.epidermidis*(100%) and*Enterococci spp*(100%).

Table 6: Antibiotic susceptibility pattern of Gram positive isolates

Isolate	Ac n(%)	G n(%)	Ak n(%)	E n(%)	Cd n(%)	Va n(%)	Cf n(%)	Cp n(%)	Ci n(%)	Ce n(%)
S.aureus (n=19)	8 (42.1)	7 (36.8)	18 (94.7)	7 (36.8)	18 (94.7)	19 (100)	15 (78.9)	18 (94.7)	18 (94.7)	18 (94.7)
S.epidermidis(n=9)	6 (66.7)	3 (33.3)	9 (100)	6 (66.7)	9 (100)	9 (100)	9 (100)	9 (100)	9 (100)	9 (100)
Enterococci Spp.(n=2)	1 (50)	0	2 (100)	0	2 (100)	2 (100)	2 (100)	2 (100)	2 (100)	2 (100)

Ac – AmoxycillinClavulanicacid ; G – Gentamicin; Ak – Amikacin;E - Erythromycin; Cd – Clindamycin; Va – Vancomycin; Cf – Ciprofloxacin; Cp – Cephalexin; Ci – Ceftriaxone; Ce – Cefotaxime.

The spectrum of antibiotic sensitivity for gram negative isolates showed all isolates to be sensitive to Imipenem followed by Piperacillin-tazobactum andAmikacin. The isolates were least sensitive to Cefixime, Ofloxacin, Piperacillin and Cefuroxime.

Table 7:Antibiotic susceptibility pattern of Gram negative isolates

Isolate	As n(%)	Ak n(%)	I n(%)	Pt n(%)	Pc n(%)	Ci n(%)	Ce n(%)	Cpm n(%)	Cu n(%)	Cfx n(%)	Of n(%)
K.pneumoniae (n=13)	7 (53.8)	9 (69.2)	13 (100)	9 (69.2)	3 (23.1)	6 (46.2)	6 (46.2)	6 (46.2)	3 (23.1)	1 (7.7)	3 (23.1)
E.coli (n=8)	7 (87.5)	7 (87.5)	8 (100)	7 (87.5)	1 (12.5)	3 (37.5)	3 (37.5)	3 (37.5)	3 (37.5)	0	1 (12.5)
P.aeruginosa (n=5)	2 (40)	3 (60)	5 (100)	5 (100)	2 (40)	1 (20)	1 (20)	3 (60)	0	0	0
Acinetobactersp p(n=3)	2 (66.7)	2 (66.7)	3 (100)	3 (100)	2 (66.7)	2 (66.7)	2 (66.7)	2 (66.7)	0	0	0

As – Ampicillin sulbactum ; Ak – Amikacin ;I - Imipenem; Pt – PiperacillinTazobactum ;Pc – Piperacillin; Ci – Ceftriaxone ; Ce – Cefotaxime ; Cu – Cefuroxime ;Cfx – Cefixime; Of – Ofloxacin.

There were total of 8 (13.5%) neonatal deaths in the present study. Maximum numbers of deathswere due to *Klebsiella pneumoniae*4(50%), followed by*P.aeruginosa*2(25%) and one each due to*S.aureus* and *Acinetobacter spp.*

DISCUSSION

During the present study, out of 607 admissions in NICU, 150 cases were clinically suspected to have septicaemia giving a clinical incidence of 24.7%. This varies from 4.4% to 51.5% as reported by other authors [6,7]. There were 59 blood culture confirmed cases, thereby giving a bacteriological incidence of 9.7%. This is similar to findings reported by Kuruvilla et al [6]. There occurred 57.6% cases of EOS and 42.4% cases of LOS. The data can be compared to one study from South India stating 59% EOS and 41% LOS cases [8].

Maternal pyrexia near term do indicate the presence of infection and thus responsible for maternal transmission to the non-immune baby. In present study, 16.9% neonates had their mothers near term with pyrexia, of which 20.6% had EOS and 12% had LOS. In a study from South India, there were 6.6% cases of EOS and 1.1% cases of LOS associated with maternal pyrexia [6].

The risk of neonatal septicaemia increases with PROM, as following rupture of amniotic membrane, the organisms present in the vagina may gain access to uterine cavity leading to infection in foetus. Beargie et al. reported a preponderance of gram positive organisms in maternal vagina in late pregnancy [9]. In the present study 11.8% neonates with septicaemia were born to mothers having PROM. We found 17.6% EOS cases and 4% LOS cases to be associated with PROM. A similar study reported this association as 24% in EOS and 7% in LOS[10].

Presence of foul smelling liquor is indicative of amnionitis which results by colonization of amniotic fluid even in presence of intact membrane or following rupture of foetal membranes thereby predisposing to infection. In the present study, 10.2% babies were born to mothers associated with MSL. Few other Indian studies reported associated chorioamnionitis to be 3.1% and 6% [6,11].

Any Genitourinary tract infection at parturition definitely predispose to neonatal sepsis. In present study, 5.1% babies were born to mother with UTI and out of them 2.9% were in cases of EOS and 8% in LOS. E.coli was isolated in urine culture from all mothers who had UTI and four of them had asymptomatic bacteruria. A study reported 1.5% mothers with UTI, of which 3.3% and 1.1% cases had EOS and LOS respectively [6].

Kishore et al. studied the colonization rate of new-borns from three superficial sites of throat, ear and perianal area and found that it was significantly higher in infants born following instrumental delivery (89.5%) compared to spontaneous vaginal delivery (52.4%)[12]. In the present study, 64.4% babies with septicaemia were delivered by LSCS, 3.39% babies born by outlet forceps, giving an incidence of 67.8% instrumental delivery. Other studies reported the number of instrumental delivery associated with septicaemia as 55.2%, 46.7% and 46% respectively [6,12,13].

In the present study, there were 64.4%male and 35.6% female babies giving a ratio of 1.8:1. The incidences of septicaemia in males were 67.6% in EOS and 60% in LOS. This finding is consistent with another Indian study stating 70% males having EOS, 68.4% having LOS and 68.8% total cases of septicaemia [6]. The male preponderance may be attributed to the hypothesis based on presence of genes responsible for production of immunoglobulin on X chromosome. Female receives two 'X' chromosomes each from two partners. So they have heterozygous locus for diversity in production of Immunoglobulin whereas male possess only one X chromosome [14].

LBW and prematurity predispose to infection in a neonate as enhanced by low IgG levels. The transfer of IgG from mother to foetus is not sufficient in small for date babies who are often the product of placental insufficiency. In present study, 71.2% babies with LBW had septicaemia, of which 70.6% neonates with LBW had EOS and 72% had LOS. This observation is consistent with other studies stating incidence of such association at 79.3%, 59.4% and 54.5% [15,16,17].

In the present study, 54.2% preterm neonates had septicaemia, of which 61.7% preterm neonates had EOS whereas 56% full term neonates had LOS. Other studies have reported such association of preterm neonates with septicaemia from 22% to 73% [13,10]. Preterm neonates are at higher risk of infection due to their low immunity and need for invasive procedures like Intravenous lines, Endotracheal intubation and mechanical ventilation.

The blood culture positivity rate in the present study was 39.3%. It is to be considered that a negative blood culture does not rule out septicaemia. Various factors like administration of antibiotics to mother or baby before blood collection, possibility of infection with fastidious organisms and anaerobes, etc. pose difficulty in isolation unless advanced automated or molecular techniques are employed, which may be expensive in routine laboratory protocol.

In the present study, *Staphylococcus aureus* was the predominant isolate (32.2%) followed by *Klebsiella pneumoniae* (22%), *Staphylococcus epidermidis* (15.3%), *E.coli* (13.5%), *Pseudomonas aeruginosa* (8.5%), *Acinetobacterspp*(5.1%) and *Enerococcispp* (3.4%). The predominant isolate in EOS was *Staphylococcus aureus* (47.1%) and in LOS it was *Staphylococcus epidermidis* (36%).

Though most of the Indian studies have reported the Gram Negative bacteria like *E.coli* and *K.pneumoniae* as predominant isolate, few other studies have reported the incidence of *Staphylococcus aureus* isolate as 29.5%, 35% and 38% [18,19,20]. Along with the maternal risk factors, this indicates the possibility of cross infection in NICU from index case, which could be prevented by following standard measures like universal precautions, elimination of source of infection & hand hygiene by health care providers.

The gram positive isolates were found more sensitive to majority of antibiotics than the gram negative organisms, as also observed by Mathur et al [21]. The predominant isolate, *Staphylococcus aureus* showed 100% sensitivity to Vancomycin and resistance to Ampicillin and penicillin in all isolates, as also observed by Kuruvilla et al. [6]. They were significantly sensitive to Cephalosporins like Cephalexin, Ceftriaxone and Cefotaximeand was 94.7% sensitive to Amikacin compared to 36.8% for Gentamicin. This has also been observed by Kumar et al [22]. The sensitivity to Ciprofloxacin was 78.9%. But considering the poor CSF penetrability and adverse effects of Ciprofloxacin in infants, cephalosporins&Amikacins can be considered as 1st line of treatment followed by Fluoroquinolones. This observation can be compared with a study by Agnihotri et al. [19]. Other gram positive isolates were significantly sensitive to Cephalosporins, Ciprofloxacin, Vancomycin and Amikacin, thereby not changing the chosen antibiotic policy.

The predominant gram negative isolates of *Klebsiella pneumoniae* and*E.coli* showed a pattern of multi drug resistance, which is consistent with observations cited by other authors [6,21,22]. This indicates the emergence of highly resistant mutants especially found with nosocomial pathogens. However,

all of these isolates were sensitive to Imipenem, followed by Piperacillin-tazobactumandAmikacin with significant resistance to Quinolones andPenicillins.

From the antibiogram, Imipenem was found to be the most effective drug against all gram negative isolates. But it is to be avoided in neonates due to reported incidence of seizures following its use. Moreover, such antibiotic should not be used empirically, and should be reserved for exceptional situations which warrants its use, considering the in – vitro susceptibility of the prevailing regimen. Therefore keeping aside the reserve drugs like Imipenem and Vancomycin, Amikacin was found to be the drug of choice for both groups of organisms. This observation is consistent with the observation stated by Diwakar et al. [8].

CONCLUSION

In the present study, the important predisposing maternal risk factors to neonatal septicaemia were found to be maternal pyrexia and PROM with foul smelling liquor. Preterm and LBW babies had more incidences of septicaemia and showed preponderance in cases of EOS. Neonatal mortality in this study was 13.5% and all of them were Preterm and LBW neonates. *Staphylococcus aureus* followed by *Klebsiella pneumoniae* were the common causative agents of septicemia. The overall drug of choice was found to be Amikacin. Considering the recommendation to use combination of drugs in septicemia, Amikacinalong with a third generation Cephalosporin like Cefotaxime were chosen to be the first line regimen for treatment of cases of septicaemia in our setting. Highly susceptible drugs like Imipenem, Piperacillin-tazobactum and Vancomycin were kept reserved for unusual situations depending upon Antibiotic sensitivity reports, thereby keeping rationality in use of antibiotics.

The predominant isolate of *S.aureus* along with significant association of maternal risk factors indicates the possibility of cross infection in NICU from index case, for which emphasis need to be laid on prevention strategies like universal precautions, elimination of source of infection and appropriate antibiotic prophylaxis.

REFERENCES

1. QaziSA, StollBJ; Neonatal Sepsis: A major global public health challenge. Pediatr Infect Dis J, 2009; 28(1): S1-S2.
2. Ahman E, Zupan J; Neonatal and Perinatal Mortality: Country, Regional and Global Estimates. France: World Health Organization Press, 2007.
3. Darmstadt GL, Bhutta ZA, Cousens S; Evidence based cost effective interventions: How many newborn babies can we save? *Lancet*, 2005; 365 : 977-988.
4. Baqui AH, El-Arifeen S, Darmstadt GL; Effect of community based newborn care intervention package implemented through two service-delivery strategies in Sylhet district, Bangladesh: a cluster randomised controlled trial. *Lancet*, 2008; 371:1936-1944.
5. Clinical and Laboratory Standards Institute; Performance standards for antimicrobial susceptibility testing. 20th informational supplement. CLSI document. Wayne, PA, CLSI: 2010: M 100 – S 20.
6. Kuruvilla KA,Pillai S, Jesudasan M, Jana AK; Bacterial profile of sepsis in neonatal unit in South India. Indian Pediatr,1998; 35: 851-857.
7. Sharma PP, Halder D,Dutta AK, Dutta R, Bhatnagar S; Bacteriological profile of neonatal septicemia. *Indian Pediatr*,1987; 24: 1011-1017.
8. Diwakar KK, Ananthen KS;Developing a protocol for empirical antibiotics for neonatal sepsis based on data on antibiotic sensitivity patterns at two tertiary neonatal units in Southern India. J ClinDiagn Res, 2008; 2(5): 1057-1064.
9. Beargie R, Lynd P; Perinatal infections and vaginal flora. Am J ObstetGynecol, 1975; 122: 31-33.
10. ChughK, Agarwal BB, Kaul VK, Arya SC; Bacteriological profile of neonatal septicemia. Indian J Pediatr, 1988; 55: 961-965.
11. Yadav AK, Wilson CG; Polymerase chain reaction in rapid diagnosis of neonatal sepsis. Indian Pediatr,2005; 42: 681-685.
12. Kishore K, Deodari AK; Early onset neonatal sepsi: Maternal transmission from maternal genital tract. Indian Pediatr, 1987; 24: 45-48.
13. Raghavan M, Mondal GP; Perinatal risk factors in neonatal infections. Indian J Pediatr,1992; 59: 335-340.
14. Chandana Anita, Rao M, Nagaraja; Rapid diagnostic tests in neonatal septicemia. Indian J Pediatr,1988; 55: 947-953.
15. Khatua SP, Chatterjee BD; Neonatal septicemia. Indian J Pediatr,1986; 53: 509-514.
16. TallurSashikala S, NadgirSobha D;Clinico-bacteriological study of neonatal septicemia in Hubli. Indian J Pediatr, 2000; 67: 169-174.
17. Agrawal M, Chaturvedi P; Coagulase negative Staphylococcal septicemia in newborns. Indian Pediatr,1990; 27(2): 163-169.
18. Rahman S, Hameed A, Roghani MT, Ullah Z; Multidrug resistant neonatal sepsis in Peshawar, Pakistan. Arch Dis Child Fetal Neonatal Ed, 2002; 87: F52-54.
19. Agnihotri N, Kaistha N; Antimicrobial susceptibility of isolates from neonatal septicemia. Jpn. J. Infect.Dis, 2004; 57: 273-275.
20. Shrestha P, Das BK; Clinical and bacteriological profile of blood culture positive sepsis in newborns. J. Nepal Pediatr. Soc, 2007; 27: 64-67.

21. Mathur M, Shah H, Dixit K, Khambadkone S, Chakrapani A; Bacteriological profile of neonatal septicemia cases. J Postgrad Med, 1994; 40(1): 18-20.
22. Kumar Ghanshyam D, Ramchandran VG; Bacteriological analysis of blood culture isolates from neonates in a tertiary care hospital in India. J Health PopulNutr, 2002; 20(4): 343-347.