The Journal of
OBSTETRICS AND GYNECOLOGY of India

J Obstet Gynecol India Vol. 58, No. 1 : January/February 2008 pg 32-40

Original Article

Perinatal risk factors and microbial profile of neonatal septicemia: A multicentred study

Vinodkumar CS [1], Neelagund YF [2], Kalsurmath Suneeta [3], Banapurmath Sudha [4], Kalappannavar NK [5], Basavarajappa KG [1]

[1] Department of Microbiology and [2] Division of Research in Medical Sciences, Gulbarga University, Gulbarga and Departments of [3] Physiology, [4] Obstetrics and Gynecology, and of [5] Pediatrics, S.S. Institute of Medical Science and Research Centre, Davanagere

Abstract

Objectives : To study the incidence, microbial profile and predisposing risk factors of neonatal septicemia, the optimum time for culture observations in diagnosis of septicemia and the rationalization of prophylactic antibiotics in high risk cases. *Methods :* This is a prospective study of 1647 babies suspected of neonatal septicemia based on symptomatology and clinical diagnosis. Blood culture and other laboratory diagnostic procedures were analyzed. Predisposing risk factors were correlated with incidence of neonatal septicemia. An optimal time for culture observation was obtained and rationalization of therapy discussed. *Results :* The incidence of neonatal septicemia was high (53.2%). Young mothers from rural areas of low socioeconomic status, history of prolonged labor, premature rupture of membranes, poor antenatal care, home deliveries by untrained persons, low birth weight, prematurity, male sex, and instrumental deliveries were predisposing factors for neonatal sepsis. Culture reading for isolation of organisms by day 4 detected 99.55% of infective organisms. More than 50% of neonates developed sepsis within 48 hours of birth. Gram negative bacteria were the predominant organisms to be isolated. Multidrug resistant organisms were found to be most pathogenic. Broad spectrum antibiotic use was the main cause for candidemia (8.3%) resistant to fluconazole. *Conclusion :* Neonatal septicemia can be prevented in 50% of cases by antenatal care and institutional delivery. Routine use of broad spectrum antibiotics alters the microbial flora resulting in emergence of resistant organisms and fungal infections. The optimal time for reading culture for detecting most organisms in neonatal septicemia is 4th day.

Key words: neonatal septicemia, microbial profile, blood culture, perinatal risk factors

Introduction

Neonatal septicemia is a clinical syndrome characterized by systemic signs of infection in first month of life. Septicemia is a leading cause of neonatal mortality and morbidity (30-70%) in our country. Incidence of neonatal sepsis varies from 3 to 50/1000 live births. Early onset (<72 hours) of neonatal septicemia may be acquired by ascending infection in utero. Late onset sepsis may be acquired intrapartum, after delivery, by aspiration, or by hospital infection.

Many perinatal risk factors predispose neonates for

Paper received on 07/11/2006 ; accepted on 03/09/2007

Correspondence :
Dr. Vinod Kumar CS
Lecturer, Department of Microbiology
S.S. Institute of Medical Science & Research Centre,
NH-4, By Pass, Vidhyanagar Post Box - 1
Davanagere, Karnataka.
Mobile : 9448219837, Email : vinodmicro@yahoo.com

sepsis, which can be prevented by timely intervention. Routine antibiotic prophylaxis to neonates contributes to emergence of multidrug resistant organisms and fungal infections, which are difficult to treat. Identification of the organisms by blood culture is the most important step in diagnosis and management of neonatal sepsis. The time of observation of culture varies and needs optimization for greater efficiency in diagnosing sepsis.

The present prospective study aimed at identification of the microbial profile and risk factors of neonatal septicemia, and of optimal culture observation time for identification of infective organisms.

Methods

This is a prospective analysis of 1647 clinically suspected septicemic babies aged 0-28 days admitted to our neonatology unit during the period of 2001 to 2005. A detailed history of age, sex, birth weight, gestational age, and clinical symptoms of septicemia was recorded. Antenatal and postnatal history of the mother like age, weight, antenatal complications of pregnancy, genital infections, duration of labor, obstetric intervention, previous treatment details, mode and route of delivery etc. were documented. A detailed clinical examination of the neonate, weight, gestational age, neonatal complications, and signs of sepsis and site of infection were noted [1-3].

The routine investigations and specific septic profile for diagnosis of infection were carried out. Four mL of blood for culture was drawn in a sterile syringe after skin preparation by 2 step process with 70% alcohol and povidone iodine application and drying for one minute. Depending on site of infection, culture specimens were collected for identification of organism. The organisms were isolated and identified by standard microbiological techniques. Culture was observed from 1st to 7th day. The maternal, perinatal, and neonatal risk factors were correlated with incidence of neonatal septicemia and microbial profile. Optimal culture reading time was evaluated. Antibiotic sensitivity pattern was evaluated by Kirby-Bauer's disc diffusion methods [1,2].

Results

Clinical features of neonatal sepsis - Clinical features of neonatal septicemia are shown in Table 1. The clinical features at admission were refusal of feeds (76.5%), lethargy (72.4%), irritability (61.5%), and hypothermia (44.8%). Most babies had many clinical features in combination.

Incidence of positive blood culture – Out of 1647 cases subjected to blood culture, 877 (53.2%) showed growth of microorganisms while 770 (46.8%) showed no growth even after incubation for 7 days.

Microbial flora - The microbial profile of neonatal septicemia is depicted in Table 2. Gram negative bacilli were predominant organisms isolated. Klebsiella (236/877;26.9%) and Staphylococcus aureus (176/77;20%) were the major bacteria isolated. The other organisms isolated included coagulase negative staphylococcus (CONS), candida, E.coli, acinetobacter sps, Pseudomonas aeruginosa and enterobacter sps.

Maternal risk factors - Various maternal risk factors like socioeconomic status, maternal age, antenatal check ups, complications of pregnancy, and maternal vaginal infection were correlated with incidence of neonatal septicemia and microbial profile.

Table 1. Clinical features of septicemia (n=1647).

Clinical features	Number	(Percentage)
Refusal of feed	1261	(76.5)
Lethargy	1193	(72.4)
Irritability	1013	(61.5)
Hypothermia	738	(44.8)
Respiratory distress	440	(26.7)
Jaundice	427	(25.9)
Vomiting	392	(23.8)
Apnea	371	(22.5)
Abdominal distension	363	(22.0)
Hyperthermia	221	(13.4)
Pustular skin lesions/abscess	133	(8.1)
Seizures	130	(7.9)
Sclerema	124	(7.5)
Cyanosis	91	(5.5)
Conjunctival discharge	78	(4.7)
Bulging of anterior fontanalle	22	(1.3)
Diarrhea	12	(0.7)

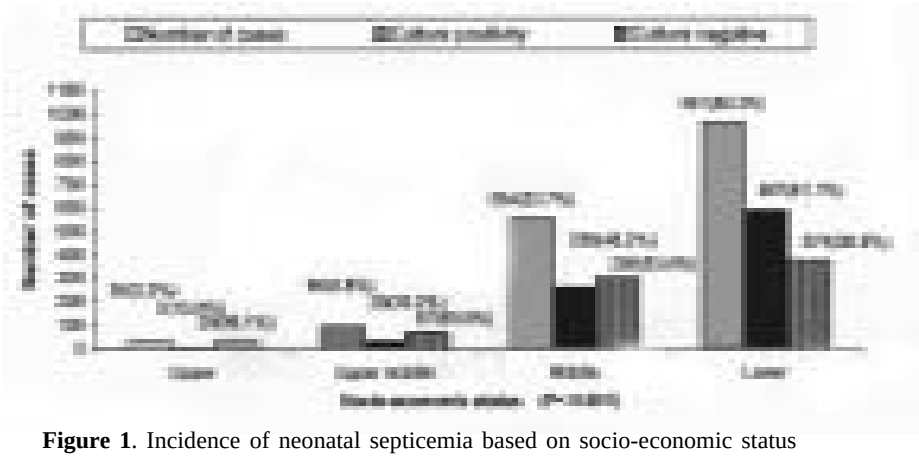

Figure 1. Incidence of neonatal septicemia based on socio-economic status

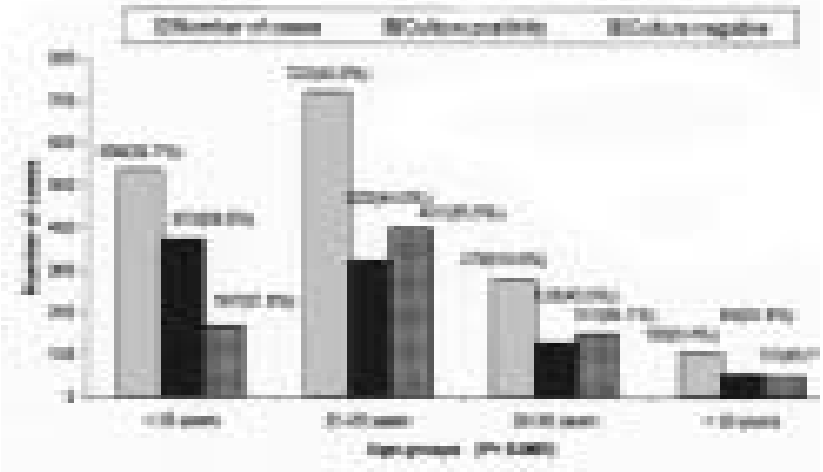

Figure 2. Incidence of neonatal septicemia in mothers of different age groups (n=1647).

Table 2. Maternal risk factors and septicemia (n=1647).

Complications	Number	(Percentage)
Preterm delivery	963	(58.5)
Anemia	554	(33.6)
Obstetric intervention (cesarean section/forceps)	351	(21.3)
Prolonged rupture of membrane (for >24 hours)	249	(15.1)
Prolonged labor	212	(12.9%)
Intrauterine growth retardation	161	(9.8)
Hypertension	154	(9.4)
Meconium stained liquor	137	(8.3)
Premature rupture of membranes	124	(7.5)
Urinary tract infection	64	(3.9)
Intrapartum fever	44	(2.7)
Genital infection	12	(0.7)

a) Socioeconomic status - Incidences of neonatal septicemia based on socioeconomic status of parents is depicted in Figure 1. The majority of parents of the neonates in the study group were from lower socioeconomic class (58.3%), followed by middle class (33.7%), upper middle class (5.8%) and upper class (2.2%). Culture positivity was high in lower socioeconomic class (61.1%) followed by middle (46.2%), upper middle (30.2%) and upper class (13.9%). The differences in the culture positivity among different socio-economic classes were statistically highly significant (P<0.001).

b) Maternal age - A correlation between maternal age and incidence of neonatal septicemia is depicted in Figure 2. Out of 1647 neonates, 539 (32.7%) were born to mothers less than 20 years of age, 723 (43.9%) to 21-25 years, 279 (16.9%) to 26-30 years and 106 (6.4%) to more than 30 years of age. The incidence of culture positivity was highest in maternal age less than 20 years (69%), followed by more than 30 years (51.9%),

26-30 years (45.9%) and 21-25 years (44.5%) age group. The differences in the culture positivity among different maternal age groups were statistically highly significant (P<0.001).

c) Antenatal checkup - 6.8% of mothers had no antenatal check up and 87.5% of the babies born to these mothers had symptoms of septicemia.

d) Perinatal risk factors - The incidence of neonatal septicemia associated with maternal complications is shown in Table 2. Preterm labor (58.5%), maternal anemia (33.6%), obstetric intervention (21.3%), prolonged (>24 hours) rupture of membranes (PROM) (15.1%), and prolonged labor (12.9%) were major risk factors.

e) Intrapartum risk factors - Vaginal delivery was the commonest mode of delivery and was recorded in 1369 (83.1%) cases; 278 (16.9%) were delivered by lower segment cesarean section (LSCS) and 73 (4.4%) by forceps. Culture positivity was 55.6% in vaginally delivered, 67.1% in instrumentally delivered and 38.5% in those delivered by lower segment cesarean section (LSCS). Most of the babies with septicemia were delivered by normal vaginal route (716/877;81.6%) with klebsiella species 216 (30.5%) being common isolate followed by Staphylococcus aureus 155 (21.6%). Among babies born by instrumental delivery CONS (14/53;26.4%) was common organism isolated followed by candida species (12/53;22.6%), and klebsiella species (10/53;18.9%). Among babies delivered by cesarean section, the common isolates

Table 3. Mode of delivery and neonatal septicemia in culture positives (n=877).

Organisms isolated	Mode of delivery						Total (n=877)	
	Normal vaginal (n=718)		Forceps (n=53)		Cesarean section (n=108)			
	Number	(Percent)	Number	(Percent)	Number	(Percent)	Number	(Percent)
Klebsiella sps	216	(30.5)	10	(18.9)	06	(5.6)	236	(26.9)
Staphylococcus aureus	155	(21.6)	01	(1.9)	20	(18.7)	176	(20)
Coagulase negative staphylococus	75	(10.5)	14	(26.4)	29	(27.1)	118	(13.4)
E.coli	88	(12.3)	04	(7.5)	—		92	(10.5)
Acinetobacter sps	51	(7.1)	—		03	(2.8)	54	(6.1)
Pseudomonas aeruginosa	15	(2.1)	08	(15.1)	19	(17.6)	42	(4.8)
Enterobacter sps	21	(2.9)	—		09	(8.4)	30	(3.4)
Citrobacter freundii	16	(2.2)	—		05	(4.7)	21	(2.4)
Enterococci fecalis	04	(0.6)	—		03	(1.9)	7	(0.9)
Streptococci viridans	05	(0.7)	—		—		5	(0.6)
Alkaligenes fecalis	—				03	(5.7)	3	(0.3)
Streptococci pneumoniae	—				01	(1.9)	1	(0.1)
Candidas sps	70	(9.8)	12	(22.6)	14	(13.1)	96	(10.9)
Total	716	(81.6)	53	(6.0)	108	(12.3)	877	(100)

Table 4. Neoantal risk factors (n=1647).

Culture	Sex		Birth weight		Gestational age		Onset of septicemia	
	Male (n=963)	Female (n=684)	Low (n=1124)	Normal (n=523)	Preterm (n=986)	Term (n=661)	Early (n=1202)	Late (n=445)
Culture positive	532 (55.2)	345 (50.4)	689 (61.3)	188 (35.9)	610 (61.9)	267 (40.4)	665 (55.3)	212 (47.6)
Culture negative	431 (44.8)	339 (49.6)	435 (38.7)	335 (64.1)	376 (38.1)	394 (59.6)	537 (44.7)	233 (52.4)
P value	P>0.05		P<0.001		P<0.001		P<0.01	

Table 5. Days on which organisms were recovered from blood cultures (n=877).

Organisms	Number of blood cultures yeilding organisms on day							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Klebsiella pneumonia e(191)	0	92	85	12	02	0	0	0
Klebsiella oxytoca (41)	0	10	23	04	03	0	01	0
Staphylococcus aureus (176)	03	63	87	16	07	0	0	0
Coagulase negative staphylococcus (118)	0	45	59	11	01	0	02	0
Candida albicans (22)	0	10	12	0	0	0	0	0
Candida tropicalis (39)	0	16	23	0	0	0	0	0
Candida guillermondi (17)	0	03	14	0	0	0	0	0
Candida krusei (14)	0	03	08	03	0	0	0	0
Candida parapsilosis (04)	0	0	02	02	0	0	0	0
E.coli (92)	0	67	09	16	0	0	0	0
Acinetobacter baumanni(45)	0	14	22	08	0	0	0	01
Acinetobacter iwoffi (09)	0	07	02	0	0	0	0	0
Pseudomonas aeruginosa (42)	0	12	26	04	0	0	0	0
Enterobacter sps (30)	0	22	08	0	0	0	0	0
Citrobacter sps (21)	0	09	12	0	0	0	0	0
Enterococci sps (07)	0	02	04	01	0	0	0	0
Streptococci viridians (05)	02	03	0	0	0	0	0	0
Alkaligenes fecalis (03)	00	00	01	00	02	0	0	0
Streptococci pneumoniae (01)	00	00	01	00	00	00	00	00
Total (877)	05	378	398	77	15	00	3	1
Cumulative detection of organisms	05	383	781	858	873	873	876	877

were CONS (29/108;27.1%), Staphylococcus aureus (20/108;18.7%) and pseudomonas species (19/108;17.6%) (Table 3).

f). Place of delivery - It was observed that 1320 (80.1%) of the 1647 babies in the study group were delivered in hospital and 327 (19.9%) at home by untrained persons. The incidence of culture positivity was 67% (219/32) in home delivered babies as compared to 49.8% (658/1320) in hospital delivered babies. In hospital delivered babies common organisms isolated were klebsiella species in 196 (29.8%), Staphylococcus aureus in 90 (13.7%), and candida species in 87 (13.2%). Among 128 (19.5%) home delivered neonates common isolates and were E.coli 59 (26.9%) followed by Staphylococcus aureus 48 (21.9%), klebsiella species 36 (16.4%) and Streptococcus viridans 05 (0.6%).

Neonatal risk factors

a) Sex - More male babies were found to be culture positive as seen in Table 4. Among 963 males babies 532 (55.2%) were culture positive and out of 684 females babies 345 (50.4%) were culture positive. The difference in the culture positivity was statistically not significant (P>0.05) (Table 4).

b) Gestational age - Preterm babies were highly significantly more susceptible to infection than term babies (61.9% vs 40.4%; P<0.001). (Table 4).

c) Birth weight - Culture positivity was highly significantly more in low birth weight (LBW) babies than in normal birth weight babies (61.3% vs 35.9%; P<0.001) (Table 4).

d) Time of onset of septicemia - Culture positivity was

highly significantly more in babies developing septicemia within 7 days of birth than those developing it later (55.3% vs 47.6%; P<0.01%) (Table 4).

Perinatal mortality

Of the 877 culture positive septicemia babies 147 (16.7%) died due to complications like hypothermia (114), meningitis (65), respiratory failure (89), sclerema (44), refractory seizures (48), and apnea (21). Some neonates had more than one complication. Of the 730 culture negative septicemic babies 20 (2.7%) died due to complications like respiratory distress (14), abdominal distention (2), sclerema (7), apnea (5), and seizures (7).

Culture incubation period to detect neonatal septicemia

Days on which the microorganisms were recovered from blood culture are shown in Table 5. Five (0.5%) organisms were recovered on the day of culture (day 0), 383 (43.7%) by day 1, 781 (89.1%), by day 2, 858 (97.8%) by day 3, and 873 (99.5%) by day 4. The positive predictive value of blood culture that was negative at day 4 was clinically similar to that of waiting for 7 days of culture observation which saves time initiating treatment.

Table 6. Antimicrobial susceptibility pattern of gram positive isolates.

Drugs		Staphylococcus aureus (n=176)	Coagulase negative streptococci (n=118)	Enterococci fecalis (n=07)	Streptococcus viridians (n=05)	Streptococcus pneumoniae (n=01)
Ampicillin	S	20 (11.4)	48 (40.7)	00	05 (100)	01 (100)
	R	156 (88.6)	70 (59.3)	07 (100)	00	00
Amikacin	S	111 (63.1)	79 (67.0)	01 (14.3)	05 (100)	01 (100)
	R	65 (36.9)	39 (33.1)	06 (85.7)	00	00
Cefotaxime	S	108 (61.4)	70 (59.3)	01 (14.3)	NT	NT
	R	66 (37.5)	48 (40.7)	06 (85.7)	NT	NT
Ceftazidime	S	89 (50.6)	78 (66.9)	01 (14.3)	NT	NT
	R	87 (49.4)	40 (33.1)	06 (85.7)	NT	NT
Ceftriaxone	S	94 (53.4)	64 (54.2)	03 (42.9)	NT	NT
	R	82 (46.6)	54 (45.8)	04 (57.1)	NT	NT
Clindamycin	S	118 (67.0)	61 (51.7)	04 (57.1)	NT	NT
	R	58 (33.0)	57 (48.3)	03 (42.3)	NT	NT
Ciprofloxacin	S	72 (41.0)	62 (52.5)	00	NT	NT
	R	104 (59.0)	56 (47.5)	07 (100)	NT	NT
Cephalexin	S	22 (12.5)	52 (44.1)	00	NT	NT
	R	154 (87.5)	66 (55.9)	07 (100)	NT	NT
Erythromycin	S	60 (34.1)	72 (61.0)	00	05 (100)	01 (100)
	R	116 (65.9)	46 (39.0)	07 (100)	00	00
Gentamycin	S	54 (30.7)	68 (57.6)	00	05 (100)	01 (100)
	R	122 (69.3)	50 (42.4)	07 (100)	00	00
Norfloxacin	S	52 (30.0)	47 39.8)	00	NT	NT
	R	124 (70.0)	71 (60.2)	07 (100)	NT	NT
Ofloxacin	S	119 (67.6)	92 (78.0)	1 (14.3)	NT	NT
	R	57 (32.4)	26 (22.0)	06 (85.7)	NT	NT
Oxacillin	S	102 (58.0)	25 (75.4)	1 (14.3)	NT	NT
	R	74 (42.0)	25 (21.2)	06 (85.7)	NT	NT
Penicillin	S	19 (10.8)	42 (35.6)	00	05 (100)	01(100)
	R	157 (89.2)	76 (64.4)	07 (100)	00	00

NT indicates antibiotics not tested S - Sensitive, R - Resistant n - indicates number of isolates
Figures in parenthesis indicate percentages

Table 7. Antimicrobial susceptibility pattern of gram negative isolates.

Drugs		Klebsiella sps. (n=232)	E.coli (n=92)	Acineto-bacter sps. (n=54)	Pseudo-monas aeruginosa (n=42)	Entero-bacter cloacae (n=30)	Citro-bacter freundii (n=21)	Alkaligene faecalis (n=03)
Ampicillin	R	218 (94.0)	71 (77.2)	42 (77.8)	35 (83.3)	28 (93.3)	19 (90.5)	00
	S	14 (6.0)	21 (22.8)	12 (22.2)	07 (16.7)	02 (6.7)	2 (9.5)	3 (100)
Amikacin	R	114 (49.1)	30 (32.6)	16 (29.6)	20 (47.6)	11 (36.7)	9 (42.9)	00
	S	118 (50.9)	62 (67.4)	38 (70.4)	22 (52.4)	19 (63.3)	12 (57.1)	3 (100)
Cefotaxime	R	152 (65.5)	60 (65.2)	41 (75.9)	34 (80.9)	24 (80.0)	14 (66.7)	00
	S	80 (34.5)	32 (34.8)	13 (24.1)	08 (19.1)	06 (20.0)	7 (33.3)	3 (100)
Ceftazidime	R	142 (61.2)	48 (52.2)	28 (51.9)	21 (50.0)	21 (70.0)	14 (66.7)	00
	S	90 (38.8)	44 (47.8)	26 (48.1)	21 (50.0)	09 (30.0)	7 (33.3)	3 (100)
Ceftriaxone	R	170 (73.3)	70 (76.1)	32 (59.3)	24 (57.1)	17 (56.7)	11 (52.3)	00
	S	60 (26.7)	22 (23.9)	22 (40.7)	18 (42.9)	13 (43.3)	10 (47.7)	3 (100)
Cefuroxine	R	193 (83.2)	60 (65.2)	35 (64.8)	26 (61.9)	23 (76.7)	17 (81.0)	00
	S	39 (16.8)	32 (34.8)	19 (35.2)	16 (38.1)	07 (23.3)	4 (19.0)	100
Ciprofloxacin	R	146 (62.9)	50 (54.3)	21 (38.9)	32 (76.2)	20 (66.7)	13 (61.9)	00
	S	86 (37.1)	42 (45.7)	33 (61.1)	10 (23.8)	10 (33.3)	8 (38.1)	3 (100)
Erythromycin	R	185 (79.7)	59 (64.1)	33 (61.1)	34 (80.9)	22 (73.3)	14 (66.7)	00
	S	47 (20.3)	33 (35.9)	21 (38.9)	08 (19.1)	08 (26.7)	7 (33.3)	3 (100)
Gentamycin	R	193 (83.2)	44 (47.8)	39 (72.2)	31 (73.8)	17 (56.7)	15 (71.4)	00
	S	39 (16.8)	48 (52.2)	15 (27.8)	11 (26.2)	13 (43.3)	6 (28.6)	3 (100)
Imipenem	R	0	0	0	0	0	0	00
	S	232 (100)	92 (100)	54 (100)	42 (100)	30 (100)	21 (100)	3 (100)
Norflaxacin	R	138 (59.5)	57 (62.0)	34 (62.0)	37 (88.1)	24 (57.1)	17 (88.0)	00
	S	94 (40.5)	35 (38.0)	22 (37.0)	05 (11.9)	06 (20.0)	04 (19.0)	3 (100)
Ofloxacin	R	124 (53.4)	37 (40.2)	12 (22.2)	14 (33.3)	17 (56.7)	05 (23.8)	00
	S	108 (46.6)	55 (59.8)	42 (77.8)	28 (66.7)	13 (43.3)	16 (76.2)	3 (100)
Piperacillin	R	162 (69.8)	45 (48.9)	41 (75.9)	15 (35.7)	12 (40.0)	11 (52.3)	00
	S	70 (30.2)	47 (51.1)	13 (24.1)	27 (64.3)	18 (60.0)	10 (47.0)	3 (100)

n= number of isolates, S= Sensitive, R= Resistant, Figures in the parenthesis indicate percentage.

Antibiotic sensitivity pattern

Table 6 gives the antimicrobial susceptibility pattern of gram positive isolates while Table 7 gives the antimicrobial susceptibility pattern of gram negative isolates. This information enables the clinician to administer appropriate antibiotic

Discussion

Neonatal septicemia is one of the major causes of neonatal morbidity and mortality in India. The incidence and microbial profile of neonatal septicemia vary from place to place. Various perinatal and maternal risk factors may predispose the neonate to development of septicemia. Most of these risk factors may be prevented, thereby reducing the incidence of neonatal septicemia.

Isolation of infective organisms is the gold standard test for diagnosis and is helpful in the management

of neonatal septicemia. Optimal time for observation of culture is yet a dilemma and precious time may be wasted by the long culture observation that needs optimization in practice.

In the present study, the incidence of neonatal septicemia is high (877/1647; 53.2%) which is at par with the various studies[1,4,5]. Refusal of feeds (76.5%), lethargy (72.4%), irritability (61.5%), hypothermia (44.8%), and respiratory distress syndrome (26.7%) were the common clinical symptoms. Many babies had more than one symptom. The clinical features are in concurrence with other studies [1,6,7].

Maternal risk factors like poor socioeconomic status, preterm delivery, anemia, pregnancy with hypertension, PROM, urinary tract infection, genital infection, maternal fever, prolonged labor and multiple vaginal examinations (>3) were seen in 73% cases in the present study. Neonatal septicemia was high in low socioeconomic group (58.3%), teenage pregnancy (32.7%), and in home delivered babies (67%). Our findings, corroborate with other studies[1,3,7-9]. Incidence of positive culture was high in vaginal delivery (Table 3).

In our study early onset septicemia (within 7 days of birth) was observed in 73% and late onset septicemia in 27% of neonates (Table 4). Other studies by Tallur et al[1], report 83.4% and 16.5%, Kuruvilla et al[4] 22.9% and 77.1%, Ayengar et al[8] 73 % and 27% for early and late onset septicemia respectively. Kuruvilla et al's[4] study group comprised of babies delivered at their institution and treated with prophylactic antibiotics. All babies referred to our neonatal center with suspected septicemia were included in our study which explains the high incidence of early onset septicemia.

Klebsiella (26.9%) was the most common infective organism followed by Staphylococcus aureus (20%), CONS (13.4%), candida species (10.9%), E.coli (10.5%) and acinetobacter species (6.1%). Others also observed the same [4-8]. In our study E.coli, Staphylococcus aureus, and CONS were isolated in early onset septicemia and CONS. Staphylococcus aureus, and klebsiella in late onset septicemia. Most of these babies resulted from instrumental delivery and LSCS as observed by Tallur et al [1] and others [2,4,5,8].

In the present study 80.1% of the babies were delivered in hospital and 19.9% at home by untrained persons. Incidence of early onset septicemia was high (67%) in home vaginal delivered babies, with E.coli (26.9%), Staphylococcus aureus (21.9%), klebsiella (16.4%) and streptococci (12.8%) infections. The high vaginal swab culture of mothers of babies with septicemia showed the same organism in blood culture of babies indicating vertical transmission as also observed by other authors[3,8-10]. Klebsiella species (29.8%), Staphylococcus aureus, CONS (13.7%), and candida species (13.2%) were organisms isolated in hospital delivered babies and E.coli, Staphylococcus aureus (21.9%) and klebsiella (16.4%) were organisms isolated in home delivered babies [1,2,4,5,7,11]. Candida species was isolated in our study, as ours is a referral center and babies had already been treated with antibiotics elsewhere before admission, resulting in emergence of resistant organisms and candida species.

The culture observation is usually done for 7 days. In the present study culture observation by day 4 detected 99.5% cases of neonatal septicemia. This emphasizes the discontinuation of culture observation after 4 days, thus saving time and cost incurred in waiting and in delayed changing of treatment. However we could not get any reference which attempted similar optimization of culture observation time.

The neonatal risk factors also contributed to early onset septicemia in our study. Male babies were more prone to neonatal septicemia (58.5%) as was also observed by Parashar et al[6]. Low birth weight was a risk factor for early onset septicemia in our study as is also reported by others.

Majority of the gram negative and gram positive organisms isolated in the present study were resistant to one or more antibiotics. This is in concurrence with studies of other authors[1,4,6,8]. Resistant bacteria are emerging world wide as a real threat to the favorable outcome of common infections in community and hospital settings. The accretion and spread of antibiotic resistance determinants among gram negative bacteria at all the points where some clinical isolates are resistant to all standard therapies highlight both the vulnerability of our present armament. arium as well as the looming prospect of a postantibiotic era. The antibiotic susceptibility pattern in the present study shows higher prevalence of resistant organisms. Both klebsiella sps and

Staphylococcus aureus showed alarmingly high resistance to all groups of antibiotics (Tables 6 and 7). This is probably due to emergence of new variant of the existing strain as a result of mutations or may be plasmid borne. Majority of enterococci sps were multidrug resistant.

Neonatal mortality in present study was 16.5% in culture positive cases. Other studies have reported 16-20% mortality [1,4].

Conclusion

Blood culture is the gold standard in diagnosis and treatment of neonatal septicemia. A culture observation for a period of 4 days can detect most of the infective organisms.

The prevention of perinatal risk factors by good antenatal services, promotion of institutional delivery, prevention of meconium aspiration, minimal pelvic examinations during labor, avoidance of routine antibiotic prophylaxis and good asepsis. Prompt observation for signs of neonatal septicemia in babies born to mothers with risk factors would minimize the incidence of neonatal septicemia and reduce neonatal morbidity and mortality.

Acknoweldgement

M. R. Medical College, Gulbarga, Sangameshwar Hospital, Gulbarga, K.B.N. Institute of Medical College, Gulbarga, Government Hospital, Gulbarga, and S. S. Institute of Medical College and Research Centre, Davangere provided clinical material and Gulbarga University, Gulbarga, provided facilities for the study.

Reference

1. Tallur SS, Kasturi AV, Nadgir SD et al. Clinico-bacteriological study of neonatal septicemia in Hubli. Indian J Pediatr 2000;67:169-74.
2. Chugh K, Agarwal BB, Kaul VK et al. Bacteriological profile of neonatal septicemia. Indian J Pediatr 1988;55:961-5.
3. Bawa KS, Mathai S. Newer concepts and management of neonatal sepsis. MJA FI 2002;58:138-42.
4. Kuruvilla KA, Pillai S, Jesudason M et al. Bacterial profile of sepsis in a neonatal unit in south India. Indian Pediatr 1998;35:851-6.
5. Mondal GP, Raghavan M, Bhat BV et al. Neonatal septicemia among inborn and outborn babies in a referral hospital. Indian J Pediatr 1991;58:529-33.
6. Parashar A, Ajaykumar. Clinical approach to neonatal sepsis. Pediatrics Today 2001;4:493-9.
7. Agarwal R, Sarkar N, Deorari AK et al. Sepsis in newborn. Indian J Pediatr 2001;69:1143-7.
8. Ayengar V, Madhulika, Vani SN. Neonatal sepsis due to vertical transmission from maternal genital tract. Indian J Pediatr 1991;58:661-4.
9. Mishra JN, Rai MG, Chakraborthy S et al. Study of neonatal septicemia. Indian J Pediatr 1985;22:281-5.
10. Monif GRG. Maternal risk factors for perinatal septicemia due to the enterobacteriae. Am J Perinatol.2000;17:19-22.
11. Mehrotra N, Kumar A M, Chansoria M et al. Neonatal sepsis: correlation of maternal and neonatal factors to positive bacterial cultures. Indian J Pediatr 1985;52:275-80.
12. Bhakoo ON, Singh M. Prenatal risk factors in neonatal bacterial sepsis. Indian J Pediatr 1988;55:941-6.