Study of the Prevalence of Neonatal Septicaemia with Antibiotic Susceptibility in a Large Tertiary Care Hospital

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ABSTRACT

Introduction: *Invasion of the blood stream by microorganisms constitutes one of the most serious situations in infectious disease and as a result, timely detection and identification of blood borne pathogens is one of the most important functions of the microbiology laboratory. Positive blood cultures may help provide clinical diagnosis, as well as a specific etiological diagnosis.*

Neonatal septicemia constitutes an important cause of morbidity and mortality amongst neonates in India. However, with presently available antimicrobial agents, neonatal septicemia may be treated successfully. Early diagnosis and proper management of neonatal septicemia can bring down the morbidity and mortality substantially. Hence, the present study was undertaken to study the bacteriological profile of neonatal septicemia cases and their antimicrobial sensitivity pattern for planning strategy in the management of these cases.

Materials and Methods: *This retrospective study was carried out in the CNBC and MYH, department of microbiology and paediatrics, M.G.M. medical college and M.Y. hospital, Indore, from January to December in 1000 blood cultures. Identification of organism was done as per standard methods like gram's staining, cultural characteristics, motility and biochemical reactions.*

Results: *In our study done on 1000 neonatal blood cultures, we found 42.2 % cultures were positive, in which 51.3 % were males and 48.7 % were female neonates. We found 52.8 % were Early onset septicaemia (EOS) (<2 days) and 47.2 % were late onset septicemia (LOS) (>2 days). Among 1000 neonates 543 were institutional delivered (inborn) and 457 were out born referred from other hospitals; 64.7 % were term, 35.3 % were preterm, 80.1 % were normal deliveries and 19.9 % were LSCS.*

Key words: *Septicaemia, Blood culture, CoNS, MRSA, EOS, LOS*

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INTRODUCTION

Invasion of the blood stream by microorganisms constitutes one of the most serious situations in infectious disease and as a result, timely detection and identification of blood borne pathogens is one of the most important functions of the microbiology laboratory. Positive blood cultures may help provide clinical diagnosis, as well as a specific etiological diagnosis.

Clinical presentation ranges from benign transient bacteraemia with little or no symptoms to fulminate septic shock with high mortality. Transient bacteraemia may follow manipulation of or surgery in infected or colonized areas. Intermittent bacteraemia is usually seen secondary to abscesses. Continuous bacteraemia is associated with endocarditic and other intravascular infections, but may occur in the early stages of thyroid fever or brucellosis.

Neonatal septicemia constitutes an important cause of morbidity and mortality amongst neonates in India. However, with presently available antimicrobial agents, neonatal septicemia may be treated successfully. Early diagnosis and proper management of neonatal septicemia can bring down the morbidity and mortality substantially. Hence, the present study was undertaken to study the bacteriological profile of neonatal septicemia cases and their antimicrobial sensitivity pattern for planning strategy in the management of these cases.

Bacteremia may be classified by its site of origin, primary bacteremia arises from an endovascular source such as an infected cardiac valve of an infected intravenous catheter, whereas secondary bacteremia arises from an infected extra vascular source, such as the lung in patients with pneumonia, a case in which the source of bacteremia remains undefined is termed bacteremia of unknown origin. Classification in this manner has important clinical consequences because it determines the appropriate therapy and prognosis. For example, a secondary bacteremia from an infected focus, such as an abscess, may require surgical therapy in addition to antimicrobials to achieve cure to the infection. Bacteremias of unknown origin generally have a poorer prognosis than primary or secondary bacteremia.

In the neonatal age group, group B streptococcus, Escherichia coli, Listeria monoctogenes, enteroviruses, and Herpes simplex virus are the pathogens most commonly associated with sepsis. In order children, Streptococcus pneumoniae, Neisseria meningitides, and Staphylococcus aureus (methicillin-sensitive or resistant) are more common.[10]

Among the causes of neonatal sepsis in infants, group B streptococcus is the most common, although

intrapartum antibiotic prophylaxis has greatly decreased the incidence of this infection. Gram negative enteric organisms acquired from the maternal birth canal, in particular Escherichia coli, all other common causes of neonatal sepsis. Although rare, Listeria monocytogenes is also an important pathogen, and is resistant to cephalosporin antibiotics.

The pathogenesis of bacteremia depends in part on the infecting pathogen, the portal of initial entry, and the immune status of the patients. In general, however, bacteremia occurs because of disruption of normal skin or mucosal barriers to bacterial invasion in the bloodstream. Such disruption may occur via trauma, burns, or ischemia giving rise to breaks in the skin that allow access to the microvasculature; via an antecedent viral infection that disrupts the epithelial lining (e.g. influenza virus involving the upper respiratory tract) and allows resident flora to invade the blood stream via capillaries; or iatrogenic disruptions, such as surgery, instrumentation, or placement of an indwelling device. Alternatively, a focal bacterial infection (e.g. bacterial pneumonia) may lead to bacteremia via local inflammation, edema, and tissue destruction that disrupts nearby vascular structures and allows bloodstream invasion. [7]

Once bacteremia occurs, the patient's immune system attempts to control infection via antibiotics, which opsonize organisms complement mediated killing, as well as by phagocytosis. In addition, filtering mechanism in the lymphatics and large vascular beds in the liver and spleen may sequester organisms and allow their destruction. If however, these defenses are unsuccessful, two major complications may ensue: metastatic infection and septic shock.

Invasion of the blood stream may result in spread of organisms throughout the body, causing seeding of multiple sites and leading to widely disseminated infection. For example, bacteremia that is due to streptococcus pneumoniae may lead to infection of the meninges, resulting in pneumococcal meningitis – a catastrophic infection with mortality as high as 25%, even with optimal treatment. Other infections associated with a period of bacteremia as a part of the disease process include salmonellosis, infective endocarditic and acute hematogenous osteomyelitis. Staphylococcus aureus is particularly likely to cause metastatic infections or abscess formation as a consequence of bacteremia; S. aureus bacteremia may lead to endocarditic, osteomyelitis, septic arthritis, hepatic abscess, or pyomyositis.

Sepsis and septic shock were once thought to be more likely to cause septic shock than those cause by gram positive organisms, the risk of sepsis, severe bacteremia, in both cases a bacterial membrane component (lipopolysaccharide; LPS), also known as endotoxin, in case of gram-negative organisms; lipoteichoic acid peptidoglycan in the case of gram-positive organisms), interacts with macrophages and causes release of tumor necrosis factor (TNF), interlukin-1 (IL-1), IL-6, and other pro-inflammatory cytokines, increasing endothelial activation, vascular permeability, blood flow and recruitment of normally counter regulated by anti-inflammatory mediators to prevent a destructive systemic inflammatory reaction. In sepsis, and septic shock, however, an imbalance in regulation leads to an unopposed pro-inflammatory state, leading to micro vascular abnormalities and endothelial injury. In turn, these derangements lead to decreased tissue perfusion, complement activation, and disseminated intravascular coagulation (DIC), which cause multi organ dysfunction, eventually leading to septic shock and death.

Infants with late-onset disease are often less severely ill, on presentation than infants with early-onset disease and the disease is often less fulminant.[9]

Other neonatal pathogens, including escherichia coli, and listeria monocytogenes may cause illness that is clinically indistinguishable from that due to GBS

MATERIAL AND METHODS

This prospective study was carried out in the CNBC and MYH, department of microbiology and paediatrics, M.G.M. medical college and M.Y. hospital, Indore, from January 2008 to December 2008 in 1000 blood cultures.

Nosocomial infection was considered to be present, if onset of infection was found after 48 hours of birth. Supportive evidence of risk factors such as fever, prematurity, low birth weight, birth asphyxia, foul smelling liquor and prolonged rupture of membranes, antibiotic usage was taken into consideration.

Inclusive criteria:

- All babies who were either inborn or out born with clinical symptoms and signs of septicemia were included in the study who presented in the duration from January 2008 to December 2008.

Exclusive criteria:

- All babies with age more than 28 days were excluded from the study.

METHODS

The babies who were brought to the NICU of CNBC and M.Y. hospital, Indore underwent routine clinical checkup and other relevant data regarding detailed history of days, gender, gestational age, maternal factors, and antibiotics were noted. Also mode of delivery, inborn or out born status was noted.

Identification of organism was done as per standard methods like gram's staining, cultural characteristics, motility and biochemical reactions (Mackie and McCartney present method microbiology 14th New York).

If no growth obtained after subculture on day 4 the culture were reported as sterile. Colonies were identified by size, colour, consistency, hemolysis, lactose fermentation, pigmentation, etc. Even a single count of colony was taken as positive culture.

The gram stain and microscopic evaluation of cultured bacteria were used with colony morphology to decide which identification steps are needed and to exclude contaminants from further processing.

After 24 hours of incubation, colonies were identified as per standard protocol. ATCC strain of staphylococci 25923 and E. coli 25922 were taken as controls.

Further identification of bacteria was done by biochemical tests like catalase, coagulse, bile-esculine sugar fermentation, optochin, bacitracin sensitivity, citrate utilization, urease, oxidaes, indole, methyl red, VP, ONPG, TSI, PPA, etc. Antibiotic sensitivity testing was done according to CLSI guidelines.

RESULTS

In our study done on 1000 neonatal blood cultures, we found 42.2% cultures were positive, in which 51.3% were males and 48.7% were female neonates, then we divide the septicemia according to the time of onset. We found 52.8% were EOS (>2 days) and 47.2% were late onset septicemia (>2 days).

Among 1000 neonates 543 were institutional delivered (inborn) and 457 were outborn referred from other hospitals; 64.7% were term, 35.3% were preterm, 80.1% were normal deliveries and 19.9% were LSCS.

Mathur M, Shah H et al (1991), in their study found the incidence of septicemia to be 24.88%.[3] This low blood culture isolation rate in this study might be due to several reasons e.g. administration of the antibiotics before blood collection either to the mother or to the baby or the possibility of infection with anaerobes, which cannot be ruled out. Moreover, negative blood cultures do not exclude sepsis. Cases with negative blood cultures have been reported with fatal illness and post-mortem evidence of infection.

Incidence of septicemia in the present study, corroborates with the studies done by Mondal GP et al (1991), Vaidya U et al (1991), Kurien Anil Kuruvilla et al (1998), Ojukwn, Juliana et al (2005) and Murthy DS et al (2007).[6.]

In the study done by Nawshad Uddin Ahmed ASM et al (2002), found of the 86 blood culture positive cases, 26% were early and 45% were late onset septicemia, showing higher rate of nosocomial septicemia.[5]

Present study results do not corroborate with the studies done by Nawshad Uddin Ahmed el al (2002) and kurien Anil Kuruvilla et al (1998), as most of the babies in our hospital are institutional births and maximum deliveries are normal, hence chances of early onset septicemia is very high.

In the present study, among 1000 neonates, 543 were institutional deliveries and 457 were out born referred from other hospitals, thus showing an increased number of inborn neonates in our study.

Our study results do not corroborate with the study done by Ojukwu, Juliana et al (2005), as our institution has maximum normal institutional deliveries.

In the present study, in 1000 blood cultures, 64.7% neonates were term and 35.3% were preterm. 27.6% were term and 14.6% were preterm babies in positive blood culture, although preterm neonates carry 3 – 10 times more risk for sepsis than full term.

Among 1000 cultures; 80.1% were normal deliveries and 19.9% were LSCS deliveries. Of the 801 normal delivery cases, 346 (43%) were positive, 385 (48%) were sterile and 70 (8.70%) were contaminants. Thus explaining the higher rate of sepsis in normal delivery; as well as inborn and in early onset septicemia. There were 199 neonates born through LSCS. 77 (38.69%) were positive, 104 (52.2%) were sterile and 18 (9%) were contaminants. In case of LSCS, there are a higher number of sterile cases.

In the present study, of the positive blood cultures (422), there were 345 (81.75%) normal deliveries and 77 (18.5%) were delivered by cesarean section.

Results of present study corroborates with the study done by Nawshad Ahmed et al (2002) showing normal delivery predominance over LSCS and instrumental deliveries.

In the present study, among 422 positive blood cultures, gram positive cocci were found in 285 cases and 128 were gram negative bacilli. Among gram positive cocci, the most prevalent organism was staphylococcus aureus (209) and others were CoNS (47). Enterococcus species (15) and streptococcus species (14).

Among gram negative bacilli (128) the major organisms were E.coli (52) and Klebsiella species (52). Others were enterobacter (11), pseudomonas aeruginosa (6), polymicrobial septicemia were reported in only 7 patients, out of which 4 were with CoNS. Only 2 cases of candida albicans were reported in our study (0.2 %).

In our study, in staphylococcus aureus (209), 169 (80.86%) were resistant to methicillin, which is very high; it may be because of prolonged hospitalization, intake of broad spectrum antibiotics and nasal carriage in healthcare workers. These MRSA strains were multidrug resistant.

Sensitivity for vancomycin was 100%, we did not find any case of VRSA. Good sensitivity was seen with netilmycin (82.84%) and Amikacin (77.51%). Moderately sensitivity to gentamycin (42.01%). Cefotaxime (25.44%) and ciprofloxacin (20.71%) were found sensitive. Ampicillin (5.32%) was least sensitive.

In EOS septicemia the commonest organism was S. aureus (46.70%) followed by Klebsiella (14.10%), E.coli (13.22%) and then CoNS (10.57%).

In LOS septicemia, again staphylococcus aureus (52.82%) was the commonest organism (103) followed by CoNS (11.79%), E.coli (11.28%), and Klebsiella (10.26%).

Candida was found only in 2 cases of EOS. 6 cases of pseudomonas aeruginosa were seen in our study,

3 were seen in EOS and 3 were seen in LOS. Clindamycin was found to be resistant to staphylococci species.

In all gram negative bacilli (17), Meropenem was found to be sensitive in 100% cases. All cases of pseudomonas, Piperacillin was found to be resistant.

In 20 health care workers, we found 4 workers positive for MRSA (20%). So, keeping a watch on healthcare personnel, we could decrease the prevalence of hospital acquired infection by MRSA.[8]

In the study done by Nawshad Uddin Ahmen ASM et al (2002) found 87.10% Gram negative bacilli in their study. Among gram negative bacilli, klebsiella was predomiant (38.5%) and rest were enterobacter, which corroborates with our study. Of the gram positive staphylococcus aureus was the predominant isolate (79%).

In the study done by Mathur M (1990-91) there were 87.10% gram negative bacilli. Klebsiella and Enterobacter predominate among gram negative organisms. [3]

In the present study, maximum sensitivity for all organisms was found for Amikacin (68.96%), Netilmycin (63.98%), Gentamycin (41%), Cefotaxime (33.89%), Ciprofloxacin (33.65%), Ampicillin (15.17%).

DISCUSSION

Brill reported the first case of bacteremia (due to bacillus pyocyaneus, now pseudomonas aeruginosa) in 1899. Ten years later fewer than 40 cases had been reported worldwide, with less than 30 additional cases in the years following that. Between 1950 and 2003, the mortality rate due to septicemia increased almost 40-fold, making it the 10th leading cause of death in the United States.

Literature available from the western world has established coagulase negative staphylococci (CoNS) as the most common organisms associated with late onset nosocomial septicemia in neonates, responsible for more than 50% of the cases. CoNS are amongst the commonest microorganisms found colonizing the skin and mucous membrane of neonates and are considered the most common blood culture contaminants. Large numbers of patients with false positive blood cultures are unnecessarily treated with antimicrobial agents, often vancomycin. Clinicians always face this difficulty while dealing with a septicemia child, whether a culture growing. CoNS represent true infection or contamination with skin flora. Only way to solve this dilemma is to obtain repeat cultures and demonstrate the presence of same organisms.

Hence the present study was undertaken with the primary aim of establishing the significance of CoNS isolated from blood culture obtained from neonates with clinically suspected late onset-septicemia.

CoNS are the major bacterial agents causing late onset nosocomial neonatal sepsis. Despite their low virulence, they have emerged as important agents because of the large population of premature and debilitated infants. Another group reported a rise from 25% to 68.8% in CoNS septicemia in neonates between 1975 – 1982 at their hospital.[4] Data from a tertiary hospital in India for the year 2001 – 2002 revealed that CoNS were the commonest gram positive bacteria isolated from cases of neonatal septicemia. At the same time CoNS are the most frequent blood culture contaminant and their presence in the single blood culture that is obtained from sick neonates in ICU may not indicate that the infant is actually having bacteremia.

In present study we strictly denied the laboratory criteria for labeling CoNS isolate as "significant". Over all isolation rate of CoNS was 22.7% (52 / 338) from of cases of late neonatal septicemia. Though only 13 / 52 (25%) of CoNS were found to be significant, remaining 39 / 52 isolated CoNS were either isolated from a single sample or were different species from both samples and showed different AST pattern. Indian studies have reported incidence of CoNS in late onset neonatal septicemia, varies from 2.8 to 24%. Since blood loss from repeated phlebotomy is a major clinical problem for these tiny infants, only a single set of blood culture is usually obtained per clinical episode. Hence validity of CoNS recovered from blood of sick neonates remains doubtful in most of these studies. Using double specimen protocol we have found 3/4th of CoNS recovered from neonates who were clinically suspected of having late onset septicemia, to be probable contaminants.

Due to technical difficulties in obtaining two blood samples in very sick neonates we could not only get single sample in 322 cases, and isolated 36 (21.3%) CoNS. They noticed similar isolation rates in both subject groups (22.7 vs. 24.3%).

In this study, E. cloacae have been isolated as the leading cause of sepsis. Forty percent of the cultures were bacteriologically positive out of which 36% were pathogenic and 4% were contaminants. Among the pathogens isolated, gram-negative bacilli predominated (88.4%) and all were members of the family enterobacteriaceae except 3 isolates, which were non-fermenters. The gram-negative bacteria preponderance, specifically enterobacteriaceae has been reported by various authors as the cause of neonatal septicemia. Chugh et al and Gupta et al reported Klebsiella to be the number one causative organism.[1] But in other studies E.coli was found to be the predominant agent.[2] E. cloacae were found to be maximum in the present study followed by Klebsiella. This organism has been reported to be isolated in varying percentages ranging from 1.5 to 14.6 by various authors. Present study shows a higher percentage in comparison to the result reported by above authors. Kuruvilla isolated E. cloacae in significant numbers from late onset sepsis.[2] But there was no significant difference in bacteriology between EOS and LOS in the present study. In the present study gram-positive isolates are very few accounting to only 11.6%. Acinetobacter spp. and coagulase negative staphylococci each accounted for only 6.9 % of all pathogenic isolates

in comparison to Mondal who had isolated 15.2% and 21.2% of the above organism's respectively.[4]

E. Cloacae septicemia should be emphasized and taken into account for its rising incidence. Moreover E. cloacae affect the most vulnerable age group i.e. neonates and its growing resistance to conventional and even newer antibiotics is a serious cause for concern. Thus, its containment and prevention needs special consideration.

SUMMARY

The present study of 1000 neonates regarding bacteriological profile, risk factors in neonatal septicemia reveals that neonatal septicemia is an important cause of death in India.

1. Infection rate in our nursery was 42.2%. The commonest organism isolated was staphylococcus aureus, followed by CoNS, E.coli and Klebeiella.
2. Neonatal mortality rate in M.Y. Hospital and Chacha Nehru Children's Hospital was 30 – 33 per 1000 live births.
3. Contamination rate was 8.8% which can be lowered by using aseptic method of blood collection and good laboratory techniques. Contamination of more than 3 % is generally considered high and may indicate educational opportunities.
4. In the present study, early onset septicemia and late onset septicemia incidence was found to be nearly equal.
5. Majority of the neonates included in our study were term, hence we found higher incidence of septicemia in term neonates, although this should have been higher in preterm neonates.
6. We could find maternal factors (viz. PROM, foul smelling liquor, twin gestation, breech presentation, etc.) in only 28% of the cases.
7. In our nursery, most organisms causing septicemia was staphylococcus aureus.
8. 80% of the staphylococcus aureus were found to be methicillin resistant staphylococcus aureus.
9. Vencomycin gave 100% sensitivity for staphylococcus aureus and Ampicillin gave only 5% sensitivity for staphylococcus aureus. Most of the staphylococcus aureus in present study were resistant to penicillin.
10. Other antibiotics to which staphylococcus aureus were sensitive were Netilmycin, Amikacin and Gentamycin. Newer drugs like clindamycin and Pipercillin were also resistant to staphylococcus aureus.
11. In gram positive organisms, commonest organisms were staphylococcus aureus, CoNS, streptococcus species and Enterococci.
12. In gram negative organisms, commonest organisms were E.coli, Klebsiella, Enterobacter and Pseudomonas.
13. 0.2% of the infections were caused by Candida albicans.
14. In present study, we found 20% of MRSA in resident doctors. A regular check of MRSA in resident doctors can reduce the nosocomial infection.
15. The number of MRSA are increasing may be because of instrumentation, increased use of antimicrobial agents, breaks in aseptic techniques, lack of hand hygiene and immunocompromised patients.
16. If MRSA is more frequently isolated the healthcare providers would change the empirical therapy. They should maintain good hand hygiene, when hands are soiled, hand washing with soap is a must, when hands are not soiled, they can use alcohol based hand-rubs.
17. To confirm the diagnosis of CoNS septicemia, two bloods with positive cultures for CoNS are mandatory.
18. Multiple antibiotic resistances are characteristics of hospital strain of CoNS being skin commensal, they are by far the commonest contaminants of blood culture.
19. Interpretation of blood cultures results need better understanding between clinicians and microbiologists.

CONCLUSION

1. There should be an antibiotic policy laid down in ICU setup, so as to reduce the antibiotic resistance.
2. There is a need for automation in blood culture to speed up results and give better antibiotic susceptibility.
3. Blood collection with complete aseptic precautions is of utmost importance for better results.
4. Mixing and recycling of antibiotics can reduce the antibiotic resistance.
5. For mild superficial lesions, systemic antibiotics should not be given. Topical application of drugs not used systemically as bacitracin, chlorhexidine or mupirocin may be sufficient.
6. The study as carried out for a shorter duration on a smaller population hence this study should be continued on an on – going basis to better understand the pattern of bacteremia and their antibiotic sensitivity pattern.
7. Hand washing between patient contacts is essential to decrease the nosocomial spread of staphylococcus, spread by fomites is rare.
8. Regular swabs from nursery and from healthcare workers will help in monitoring the spread of MRSA.
9. The reduced the prevalence of MRSA the regular surveillance of hospital acquired infection, monitoring of antibiotic sensitivity pattern and formulation of definite antibiotic policy may be helpful.
10. Studies done in other setups like private hospitals and institutions where facilities differ should be compared, so as to get a better picture of septicemia in neonates.

11. Awareness about medical insurance policies should be brought in general population so that they can afford timely investigations and proper treatment.

Conflict of Interest: None

Table 1: Incidence of infection in our NICU (CNBC + MYH) (N = 1000)

Particular	No.	%
Sterile blood cultures	490	49.00
Contaminated blood cultures	88	8.80
Growth seen in blood cultures	422	42.2 %

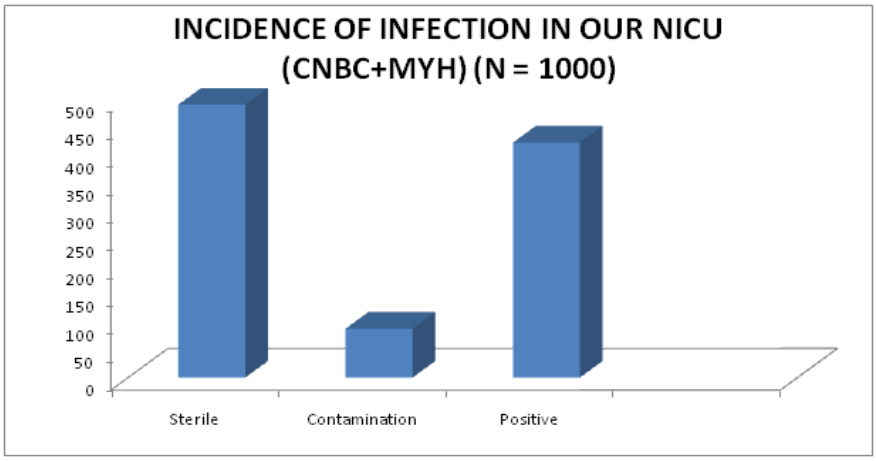

Table 2: Gender wise distribution of Neonates (N = 1000)

Gender	No.	%
Male	513	51.3
Female	487	48.7

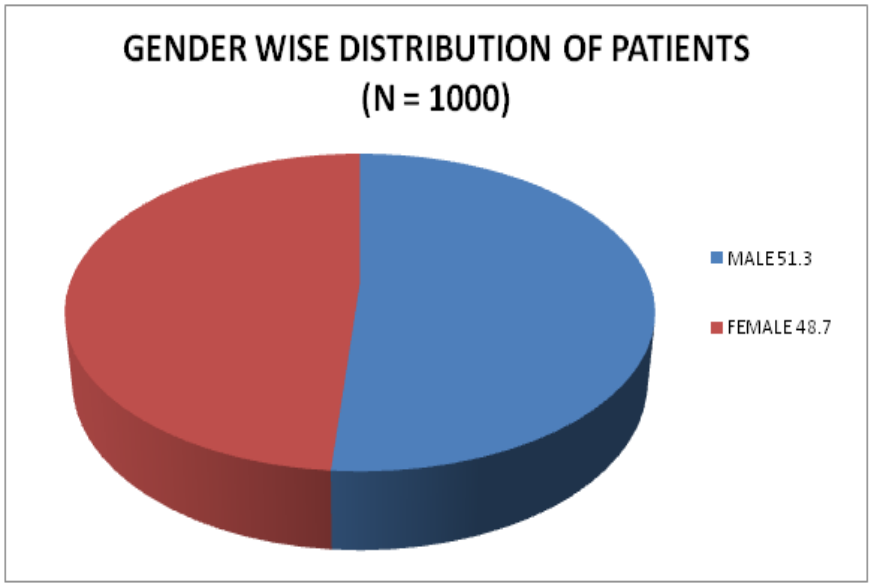

Table 3(a): Distribution of Patients According to Onset of septicemia (No = 1000)

Onset of Septicemia	No.	%
EOS (< 2 days)	528	52.8
LOS (> 2 days and less than 28 days)	472	47.2

Table 3(b): Distribution of Patients According to Onset of septicemia (No = 422)

Onset of Septicemia	No.	%
EOS (< 2 days)	228	54.02
LOS (> 2 days and less than 28 days)	194	45.98

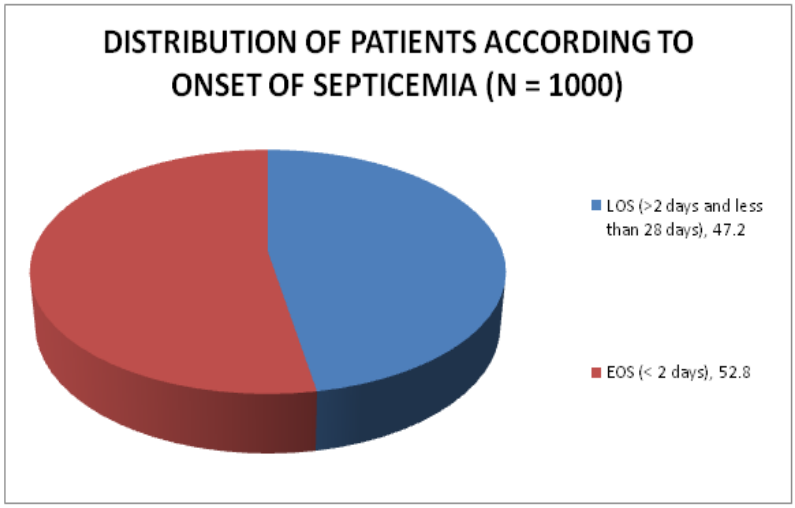

Table 4: Institutional delivery (inborn) / Out born Status (N = 1000)

Inborn / Out born	No.	%
Inborn	543	54.3
Out born	457	45.7

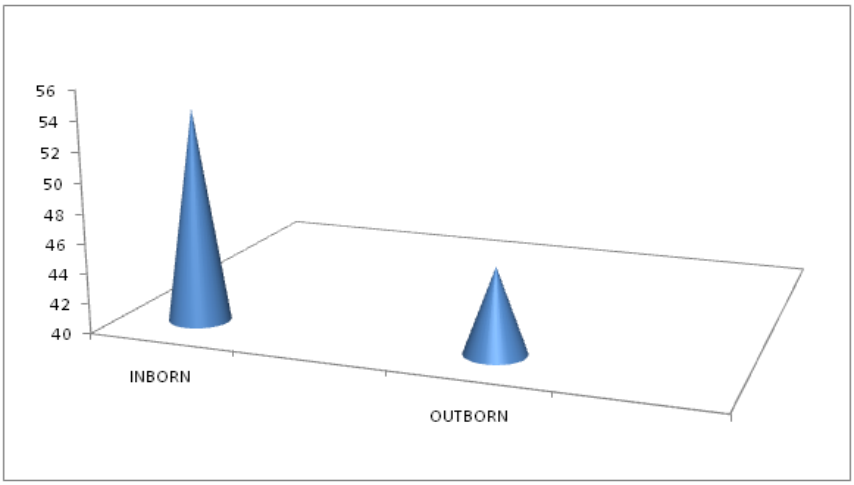

Table 5: Term / preterm (N = 1000)

Term / Preterm	No.	%
Term	647	64.7
preterm	353	35.3

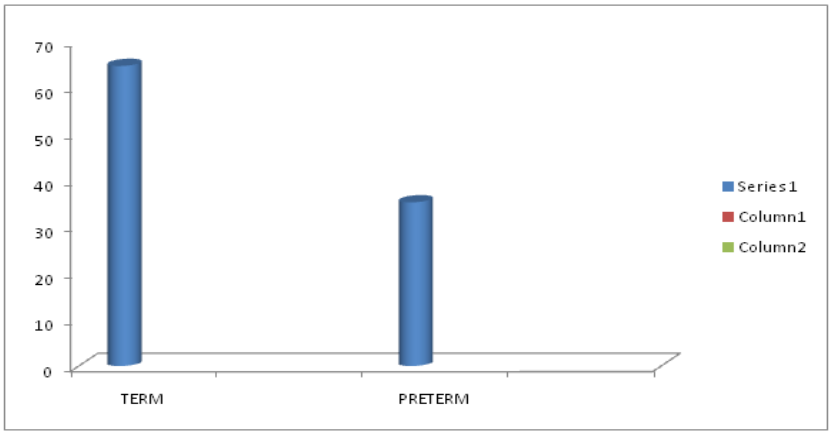

Table 6: Organism wise distribution (N = 422)

Organism	No.	%
Gram Positive Cocci (N = 285)		
• Staphylococcus aureus	209	73.33
• CoNS	47	14.49
• Enterococcus species	45	5.26
• Streptococcus species	14	4.91
Gram Negative Bacilli (N = 128)		
• E.coli	52	40.62
• Klebsiella species	52	40.62
• Enterobacter	11	8.60
• Pseudomonas aeruginosa	6	4.68
• Non-fermenters	5	3.90
• Citrobacter	1	0.78
• Proteus species	1	0.78
Mixed (N = 7) polymicrobial (2 species)	7 / 1000	0.70
Fungi (Candida albicans) (N = 2)	2 / 1000	0.20

Table 7: Overall Antibiotics Sensitivity Pattern of Organisms Isolated (N = 422)

Antibiotic	Sensitivity	%	Resistance	%
Ampicillin	64	15.17	356	84.36
Amikacin	291	68.96	259	61.37
Cefotaxime	143	33.89	277	65.64
Gentamycin	173	41.00	247	58.53
Netilmycin	270	63.98	250	59.24
Ciprofloxacin	142	33.65	278	65.88
Vancomycin (N=285) only in staphylococci and streptococci	285	100.0	0	0.0
Erythromycin (N=285) only in gram positive cocci	93	32.63	190	66.67
Clindamycin (N=42)	29	69.05	13	30.95
Meropenem (N=17)	17	100.00	0	0.00
Piperacillin (N=06) only in pseudomonas species	0	0.00	6	100.00

Table 8: EOS and LOS in Relation to Organism (N = 422)

Organism	EOS (N = 227)		LOS (N = 195)	
	No.	%	No.	%
E.Coli	30	13.22	22	11.28
Klebsiella	32	14.10	20	10.26
S. aureus	106	46.70	103	52.82
Proteus	1	0.44	0	0.00
Streptococcus species	8	3.52	6	3.08
CoNS	24	10.57	23	11.79
Enterococci	8	3.52	7	3.59
Enterobacter	7	3.08	4	2.05
Non-fermenter	2	0.88	3	1.54
Candida	2	0.88	0	0.00
Pseudomonas	3	1.32	3	1.54
Citrobacter	1	0.44	0	0.00
Mixed	3	1.32	4	2.05

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