Incidence of culture proven neonatal sepsis, pattern of antibiotic sensitivity and clinical course in neonatal intensive care unit in tertiary care center in North India

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ABSTRACT

Background: Neonatal sepsis is a major cause of neonatal mortality, accounts for nearly half of all the neonatal deaths in our country. The incidence of neonatal septicemia ranges from 1 to 10 per 1000 live births. In our country the incidence of culture proven neonatal sepsis is 8.6 per 1000 live births, intramural data. Antibiotics are rapidly losing their effectiveness, with some early reports going so far to suggest that we are approaching a post-antibiotic era. Aims of this study was to find out the incidence of culture proven neonatal sepsis and to analyze data collected for mortality and morbidity in culture proven neonatal sepsis and antibiotic sensitivity pattern in culture proven neonatal sepsis at Neonatal Intensive Care Unit of Santokha Durlabhji Memorial Hospital (SDMH), Jaipur.

Methods: The study included 129 newborn fulfilling the inclusion criteria, admitted into NICU of SDMH, Jaipur from 01st January 2013 to 31st December 2013, were investigated using various hematological and biochemical test e.g. CBC, Serum CRP. Blood culture and sensitivity, CSF examination includes cell counts, gram staining, biochemistry, culture and sensitivity etc.

Results: Overall 722 cases admitted in NICU during the period of one-year 2013. Out of which 129 cases had blood culture proven neonatal sepsis (17.87%), 14.88% cases in P.C.U. and 21.79% cases in I.P.U. had positive blood culture sepsis with statistically significant difference (p value 0.016, <0.05).

Conclusions: Antibiotic resistance is an emerging problem requires justified use of antibiotics.

Keywords: Antibiotic resistance, Blood culture and sensitivity, Mortality, Sepsis

INTRODUCTION

Infections are an important cause of neonatal morbidity and mortality worldwide. Neonatal infections among low-birth-weight infants are associated with significant risk of neurologic abnormalities, developmental and functional delays.¹

Although most neonatal infections are of maternal or community origin, an increasing proportion are acquired in the nursery. Advances in newborn intensive care have permitted the survival of low-birthweight and sick infants and simultaneously have created risks for neonatal infections, which are themselves a significant cause of mortality in these infants.² Reported infection rates in the
Clinical antibiotic rapid antimicrobial subsequent agent factors.

Hypothermia CNS diarrhea, Gastrointestinal in tachypnea, temperature.

Common spread newborn, morbidity sepsis septicemia sepsis accounted significant have among per neonatal.

Antibiotic era fluid, shock.

Therefore in conjunction with the presence of risk factors and clinical signs of sepsis. Identification of a bacterial infection may be made by isolating etiological agent from a body fluid that is usually sterile (blood, CSF, joint fluid, urine).

In recent years, the subject of the emergence and subsequent increase in the incidence of resistance to antimicrobial agents has become a serious threat. Reports from all around the world suggest that antibiotics are rapidly losing their effectiveness, with some early reports going so far to suggest that we are approaching a post-antibiotic era.

Aim and objectives were to find the incidence of neonatal sepsis in NICU admissions in our hospital. Antibiotic sensitivity pattern in our NICU.

METHODS

The present study was planned to find out the incidence of culture proven neonatal sepsis and to analyze data collected for mortality and morbidity in culture proven neonatal sepsis and antibiotic sensitivity pattern in culture proven neonatal sepsis at SDMH, Jaipur. Study design was cross-sectional type of observational study. Study place was Neonatal intensive care unit (NICU) of Santokba Durlabhji Memorial Hospital cum Medical Research Institute (SDMH) Jaipur, Rajasthan is a 20 bedded level III unit well equipped to handle complications in a newborn. Study period was 01st January 2013 to 31st December 2013 Study Population was 129 newborns fulfilling the inclusion criteria, admitted into Neonatal Intensive Care Unit of SDMH, Jaipur were included in the study.

Inclusion criteria

- All babies born inside/outside our hospital and admitted in NICU at SDMH, Jaipur with Neonates who had clinical features suggestive of neonatal septicemias such as refusal to feed, dullness, fever, seizure, respiratory distress, excessive irritability, vomiting, abdominal distension, jaundice, bleeding or shock were included in the study.

Exclusion criteria

- All newborns with negative blood culture profile.
- Newborns with major congenital malformations.

A detailed antenatal history was taken from the attendant by interview method for any risk factor such as prolonged rupture of membranes, APH, maternal intrapartum fever, birth asphyxia, foul smelling liquor, prematurity, low birth weight etc. and a thorough physical examination was conducted at the time of admission.

A proper parental consent was taken prior to enrolling the newborn in the study group. Gestational age assessment was done by maternal menstrual history, prenatal ultrasonography and postnatal maturational examination.

After detailed antenatal history and complete physical examination all these newborns included in the study were investigated using various hematological and biochemical tests. CBC, Serum CRP, Blood culture and sensitivity, CSF examination includes cell counts, gram staining, biochemistry, culture and sensitivity and other investigation like chest X-ray, gastric aspirate, metabolic profile (Serum Ca, Mg, blood sugar levels) etc were done.

Data analysis

Data analysis was done with the help of distribution of cases on the basis of age, sex, clinical presentation, blood
reports and Biochemical reports. The statistical test used was Chi square test (p value).

RESULTS

Figure 1: Neonatal sepsis 2013.

Table 1: Distribution of blood culture confirmed cases among IPU/PCU discussion.

| Distribution            | P.C.U. (N=410) | I.P.U. (N=312) |
|-------------------------|----------------|----------------|
| Culture positive sepsis | 61             | 68             |
| Culture negative sepsis | 349            | 244            |

Table 2: Culture and Sensitivity pattern in I.P.U.(n=68) Year 2013.

| Antibiotics                  | Klebsiella pneumonia | Staphylococcus spp. | Acinetobacter | Enterobacter cloacae | Candida spp. | Others | Total |
|-----------------------------|----------------------|---------------------|---------------|------------------------|--------------|--------|-------|
| Amikacin                    | 9/68 (13.23%)        | 16/68(23.53%)       | 4/68(5.89%)   | 4/68(5.89%)            | 25/68 (36.76%) | 10/68 (14.70%) | n=68  |
| Amphotericin B              | 2/9(22.22%)          | 0/4(0.00%)          | 1/4(25.00%)   | 2/4(50.00%)            | 5/21 (23.80%) |        |
| Ampicillin sulbactum        | 1/3(33.33%)          | 0/2(0.00%)          | 0/1(0.00%)    | 1/1(100%)              | 2/7(28.57%)   |        |
| Azithromycin                | 0/6(0.00%)           | 0/2(0.00%)          | 0/3(0.00%)    | 0/3(0.00%)             | 0/1(0.00%)    | 0/1(0.00%) |
| Cefepime                    | 4/9(44.44%)          | 0/4(0.00%)          | 1/4(25.00%)   | 3/4(75.00%)            | 8/21(38.09%)  |        |
| Ceftriaxzone                | 0/3(0.00%)           | 0/2(0.00%)          | 0/1(0.00%)    | 1/1(100%)              | 1/7(14.28%)   |        |
| Ciprofloxacin               | 1/4(25.00%)          | 0/4(0.00%)          | 2/3(66.67%)   | 3/6(50.00%)            | 6/17(35.29%)  |        |
| Clindamycin                 | 4/6(66.67%)          | 4/6(66.67%)         | 4/6(66.67%)   | 4/6(66.67%)            | 4/6(66.67%)   |        |
| Erythromycin                | 0/4(0.00%)           | 0/2(0.00%)          | 0/6(0.00%)    | 0/6(0.00%)             | 0/6(0.00%)    |        |
| Fluconazole                 | 21/25 (84.00%)       | 23/25(92.00%)       | 23/25(92.00%) | 21/25(84.00%)          | 21/25(84.00%) |        |
| Gentamicin                  | 1/9(11.11%)          | 4/4(100%)           | 1/4(25.00%)   | 0/4(0.00%)             | 2/4(50.00%)   | 8/25(32.00%) |
| Imipenem                    | 3/9(33.33%)          | 0/4(0.00%)          | 1/4(25.00%)   | 3/4(75.00%)            | 7/21(33.33%)  |        |
| Levofloxacin                | 7/9(77.78%)          | 0/4(0.00%)          | 1/4(25.00%)   | 3/6(50.00%)            | 13/27(48.15%) |        |
| Linezolid                   | 5/6(83.33%)          | 0/4(0.00%)          | 2/4(50.00%)   | 1/2(50.00%)            | 6/8(75.00%)   |        |
| Meropenem                   | 4/9(44.44%)          | 0/4(0.00%)          | 1/4(25.00%)   | 4/4(100%)              | 9/21(42.86%)  |        |
| Moxifloxacin                | 3/4(75.00%)          | 3/4(75.00%)         | 3/4(75.00%)   | 3/4(75.00%)            | 3/4(75.00%)   |        |
| Nitrofurantoin              | 4/6(66.67%)          | 0/2(0.00%)          | 0/6(0.00%)    | 0/2(0.00%)             | 4/6(66.67%)   |        |
| Oxacillin                   | 3/5(60.00%)          | 3/5(60.00%)         | 3/5(60.00%)   | 3/5(60.00%)            | 3/5(60.00%)   |        |
| Piperacillin tazobactum     | 1/9(11.11%)          | 0/3(0.00%)          | 0/4(0.00%)    | 2/4(50.00%)            | 3/20(15.00%)  |        |
| Quinapristone dalfistrate   | 2/2(100%)            | 1/1(100%)           | 3/3(100%)     | 1/1(100%)              | 3/3(100%)     |        |
| Tetracycline                | 3/3(100%)            | 4/4(100%)           | 0/2(0.00%)    | 0/1(0.00%)             | 1/3(66.67%)   | 8/13(61.54%) |
| Tigecycline                 | 9/9(100%)            | 5/6(83.33%)         | 3/4(75.00%)   | 4/4(100%)              | 5/6(83.33%)   | 26/29(89.65%) |
| Tobramycin                  | 1/3(33.33%)          | 1/2(50.00%)         | 1/1(100%)     | 3/6(50.00%)            | 3/6(50.00%)   |        |
| Vancomycin                  | 5/6(83.33%)          | 1/2(50.00%)         | 6/8(75.00%)   | 6/8(75.00%)            | 6/8(75.00%)   |        |
| Voriconazole                | 25/25(100%)          | 25/25(100%)         | 25/25(100%)   | 25/25(100%)            | 25/25(100%)   |        |

Figure 1 shows:
- 722 neonates admitted in N.I.C.U. in the year 2013
- 129 (18%) neonates had blood culture proven sepsis
- 88 (P.C.U. 34, I.P.U. 54) were males
- 41 (P.C.U. 27, I.P.U. 14) were females
Table 3: Culture and sensitivity pattern in P.C.U. (n=61) year 2013.

| Culture and sensitivity pattern in P.C.U. (n=61) | Klebsiella pneumonia | Staphylococcus spp. | Acinetobacter | Pseudomonas | Candida spp. | Others | Total |
|-------------------------------------------------|----------------------|---------------------|---------------|-------------|--------------|--------|-------|
| 8/61 (13.11%) | 12/61 (19.67%) | 5/61 (8.20%) | 2/61 (3.28%) | 26/61 (42.62%) | 8/61 (13.11%) | n=61 |
| Amikacin | 0/8 (0.00%) | 0/5 (0.00%) | 1/2 (50.00%) | 3/3 (100%) | 4/18 (22.22%) |
| Amphotericin B | 0/2 (0.00%) | 0/3 (0.00%) | 0/1 (0.00%) | 0/2 (0.00%) | 0/8 (0.00%) |
| Azithromycin | 0/6 (0.00%) | 0/2 (0.00%) | 0/1 (0.00%) | 3/3 (100%) | 3/12 (25.0%) |
| Cefazolin | 1/8 (12.50%) | 0/5 (0.00%) | 2/2 (100%) | 3/3 (100%) | 6/18 (33.33%) |
| Cefepime | 1/8 (12.50%) | 0/5 (0.00%) | 2/2 (100%) | 3/3 (100%) | 6/18 (33.33%) |
| Ciprofloxacin | 0/8 (100%) | 0/9 (0.00%) | 0/5 (0.00%) | 2/2 (100%) | 2/4 (50.00%) |
| Clindamycin | 2/9 (22.22%) | 2/9 (22.22%) | 2/9 (22.22%) | 2/9 (22.22%) | 2/9 (22.22%) |
| Etrapenem | 7/8 (87.50%) | 0/9 (0.00%) | 0/5 (0.00%) | 2/2 (100%) | 9/26 (34.61%) |
| Erythromycin | 2/9 (22.22%) | 2/9 (22.22%) | 2/9 (22.22%) | 2/9 (22.22%) | 2/9 (22.22%) |
| Gentamicin | 0/8 (0.00%) | 0/5 (0.00%) | 0/2 (0.00%) | 3/3 (100%) | 5/27 (18.52%) |
| Imipenem | 0/2 (0.00%) | 0/3 (0.00%) | 2/2 (100%) | 2/3 (66.67%) | 4/18 (22.22%) |
| Levofloxacin | 0/2 (0.00%) | 0/3 (0.00%) | 0/1 (0.00%) | 2/2 (100%) | 2/8 (25.0%) |
| Linezolid | 0/2 (0.00%) | 0/3 (0.00%) | 2/2 (100%) | 3/3 (100%) | 6/18 (33.33%) |
| Meropenem | 0/2 (0.00%) | 0/3 (0.00%) | 2/2 (100%) | 3/3 (100%) | 6/18 (33.33%) |
| Moxifloxacin | 0/9 (100%) | 0/3 (0.00%) | 2/2 (100%) | 2/2 (100%) | 3/7 (42.86%) |
| Nitrofurantoin | 0/3 (0.00%) | 0/3 (0.00%) | 2/2 (100%) | 2/2 (100%) | 9/12 (75.0%) |
| Oxacillin | 0/9 (0.00%) | 0/9 (0.00%) | 0/5 (0.00%) | 2/2 (100%) | 3/3 (100%) |
| Piperacillin tazobactum | 0/8 (0.00%) | 0/3 (0.00%) | 2/2 (100%) | 3/3 (100%) | 5/16 (31.25%) |
| Tetracycline | 7/8 (87.50%) | 0/9 (0.00%) | 0/5 (0.00%) | 2/2 (100%) | 9/26 (34.61%) |
| Tigecycline | 7/8 (87.50%) | 0/9 (0.00%) | 0/5 (0.00%) | 2/2 (100%) | 9/26 (34.61%) |
| Tobramycin | 0/2 (0.00%) | 0/3 (0.00%) | 2/2 (100%) | 2/2 (100%) | 5/9 (55.56%) |
| Vancomycin | 0/8 (100%) | 0/6 (100%) | 0/3 (0.00%) | 2/2 (100%) | 9/12 (75.0%) |
| Voriconazole | 22/22 (100%) | 22/22 (100%) | 22/22 (100%) | 22/22 (100%) | 22/22 (100%) |

Table 1 shows:
- The chi square statistics is 5.7762
- p value is 0.016244
- This result is significant at p<0.05

Table 3 shows that among total 61 culture proven cases in P.C.U, Candida spp. (26 cases) > Staphylococcus spp. (12 cases) > Klebsiella spp. (8 cases) are more common. Candida spp. shows maximum sensitivity to voriconazole (100%) > amphotericin B (86.36%) while Staphylococcus spp. shows maximum sensitivity to tigecycline (100%), tetracycline (100%), nitrofurantoin (100%) > linezolid (77.78%). Klebsiella spp. shows maximum sensitivity to ciprofloxacin (100%) > levofloxacin (87.50%) > tigecycline (87.50%).

Table 4 shows that among total 61 culture proven cases in P.C.U, Candida spp. (26 cases, 42.62%) > Staphylococcus spp. (12 cases, 19.67%) > Klebsiella spp. (8 cases, 13.11%) are more common. Among total 68 culture proven cases in I.P.U, Candida spp. (25 cases, 36.76%) > Staphylococcus spp. (16 cases, 23.53%) > Klebsiella spp. (9 cases, 13.23%) are more common. Table 5 shows that overall sensitivity pattern in P.C.U shows maximum sensitivity to voriconazole (100%) > amphotericin B (86.36%) > fluconazole (81.82%) for fungal infection.
while bacterial infection shows maximum sensitivity to tigecycline (89.28%) > linezolid (80%) > tetracycline (76.47%). Table 6 shows that overall sensitivity pattern in I.P.U. shows maximum sensitivity to voriconazole (100%) > amphotericin B (92%) > fluconazole (84%) for fungal infection while bacterial infection shows maximum sensitivity to tigecycline (89.65%) > linezolid (75%) > vancomycin (75.00%).

Table 4: Distribution of blood culture isolates from I.P.U. and P.C.U.

| Organisms                  | P.C.U.    | I.P.U.    | p value |
|----------------------------|-----------|-----------|---------|
|                            | No. of isolates(n=61) | No. of isolates(n=68) |         |
| Klebsiella pneumoniae      | 8/61(13.11%) | 9/68(13.23%) | 0.984   |
| Staphylococcus spp.       | 12/61(19.67%) | 16/68(23.53%) | 0.596   |
| Acinetobacter             | 5/61(8.20%) | 4/68(5.89%) | 0.606   |
| Pseudomonas               | 2/61(3.28%) | 0/0(00.00%) | 0.132   |
| Enterobacter cloacae      | 0/0(00.00%) | 4/68(5.89%) | 0.054   |
| Candida spp.              | 26/61(42.62%) | 25/68(36.76%) | 0.497   |
| Others                    | 8/61(13.11%) | 10/68(14.70%) | 0.795   |
| Total                     | n=61      | n=68      |         |

Table 5: Overall antibiotic sensitivity pattern of pathogens in P.C.U.

| Antibiotics    | Total (n=61) |
|----------------|-------------|
| Amikacin       | 4/18(22.22%)|
| Amphotericin B | 19/22(86.36%)|
| Ampicillin B   | 0/8(00.00%) |
| Ampicillin sulbactam | 2/7(28.57%)|
| Azithromycin   | 3/12(25.00%)|
| Cefazolin      | 0/2(00.00%) |
| Cefepime       | 6/18(33.33%)|
| Ceftriazone    | 2/8(25.00%) |
| Ciprofloxacin  | 12/28(42.86%)|
| Clindamycin    | 2/9(22.22%) |
| Etrapenem      | 2/2(100%)   |
| Erythromycin   | 2/10(20.00%)|
| Fluconazole    | 18/22(81.82%)|
| Gentamicin     | 5/27(18.52%)|
| Imipenem       | 4/18(22.22%)|
| Levofloxacin   | 9/26(34.61%)|
| Linezolid      | 8/10(80.00%)|
| Meropenem      | 6/18(33.33%)|
| Moxifloxacin   | 2/7(28.57%) |
| Nitrofurantoin | 9/12(75.00%)|
| Oxacillin      | 0/9(00.00%) |
| Piperacillin tazobactum | 5/16(31.25%)|
| Tetracycline   | 13/17(76.47%)|
| Tigecycline    | 25/28(89.28%)|
| Tobramycin     | 5/9(55.56%) |
| Vancomycin     | 6/9(66.67%) |
| Voriconazole   | 22/22(100%) |

Table 6 shows that antibiotics and intravenous fluid given to majority of neonates (66/68, 97.05%, both). Oxygen was used in 75% cases (51/68) and phototherapy was given to 48.52% cases (33/68) in I.P.U. while in P.C.U. antibiotics were used in 100% cases (61/61), intravenous fluid was given in 96.72% cases (59/61), Oxygen was used in 90.16% cases (55/61) and phototherapy was given to 73.77% cases (45/61).

Table 6: Overall antibiotic sensitivity pattern of pathogens in I.P.U.

| Antibiotic     | Total (n=68) |
|----------------|-------------|
| Amikacin       | 5/21(23.80%)|
| Amphotericin B | 23/25(92.00%)|
| Ampicillin     | 0/1(00.00%) |
| Ampicillin sulbactam | 2/7(28.57%)|
| Azithromycin   | 0/14(00.00%)|
| Cefazolin      | 7/21(33.33%)|
| Cefepime       | 8/21(38.09%)|
| Ceftriazone    | 1/7(14.28%) |
| Ciprofloxacin  | 6/17(35.29%)|
| Clindamycin    | 4/6(66.67%) |
| Erythromycin   | 0/6(00.00%) |
| Fluconazole    | 21/25(84.00%)|
| Gentamicin     | 8/25(32.00%)|
| Imipenem       | 7/21(33.33%)|
| Levofloxacin   | 13/27(48.15%)|
| Linezolid      | 6/8(75.00%) |
| Meropenem      | 9/21(42.86%)|
| Moxifloxacin   | 3/4(75.00%) |
| Nitrofurantoin | 4/8(50.00%) |
| Oxacillin      | 3/5(60.00%) |
| Piperacillin tazobactum | 3/20(15.00%)|
| Tetracycline   | 8/13(61.54%)|
| Tigecycline    | 26/29(89.65%)|
| Tobramycin     | 3/6(50.00%) |
| Vancomycin     | 6/8(75.00%) |
| Voriconazole   | 25/25(100%) |
Table 7: Indicators of conditions of care.

| Therapy given                  | P.C.U. |                  | L.P.U. |                  | p value |
|--------------------------------|--------|------------------|--------|------------------|---------|
|                                | Number of infants (n=61) | %      | Number of infants (n=68) | %      |         |
| I/V Fluids                    | 59     | 96.72            | 66     | 97.05            | 0.942   |
| Antibiotics                   | 61     | 100              | 66     | 97.05            | 0.177   |
| Oxygen                        | 55     | 90.16            | 51     | 75               | 0.0247  |
| Phototherapy                  | 45     | 73.77            | 33     | 48.52            | 0.0034  |
| Assisted ventilation          | 19     | 31.14            | 23     | 33.82            | 0.746   |
| Blood/plasma transfusion      | 20     | 32.78            | 25     | 36.76            | 0.636   |

Table 8: Indicators of conditions of care.

| Outcome                      | P.C.U. |                  | L.P.U. |                  | p value |
|------------------------------|--------|------------------|--------|------------------|---------|
|                              | Number of infants (n=61) | %      | Number of infants (n=68) | %      |         |
| Recovered                    | 38     | 62.29            | 45     | 66.17            | 0.646   |
| Discharged on request        | 7      | 11.47            | 8      | 11.76            | 0.959   |
| Left against medical advice  | 10     | 16.39            | 10     | 14.70            | 0.791   |
| Expired                      | 6      | 9.83             | 4      | 5.88             | 0.402   |
| Referred                     | 0      | 0.00             | 1      | 1.47             | 0.342   |

Table 7 shows that in P.C.U., out of 61 cases of blood culture proven neonatal sepsis, 38 cases (62.29%) were recovered and discharged in stable condition. 7 cases (11.47%) discharged on request. 10 cases left against medical advice (16.39%) and 6 cases expired (9.83%). In L.P.U., out of 68 cases of blood culture proven neonatal sepsis, 45 cases (66.17%) were recovered and discharged in stable condition. 8 cases (11.46%) discharged on request. 10 cases left against medical advice (14.70%) and 4 cases expired (5.88%).

DISCUSSION

The aim of this research was to study the incidence of blood culture proven neonatal sepsis at Santokha Durlabhji Hospital Jaipur in the year 2013. Antimicrobial susceptibility of the isolated microorganisms from different sources was tested to evaluate the role of antibiotic prophylaxis and treatment in the dynamics of the problem.

There are several reasons why neonatal septicemia has to be set apart from those at other ages. First, the early signs are vague and nonspecific and, if not actually overlooked altogether, are rarely accorded significance so that the diagnosis is too often made late. Secondly, host defense is naturally not at an advanced stage of competence early in life, especially in preterm whose blood brain barrier is fragile and more permeable. Finally the infecting organisms are many and predominantly gram negative. This cross-sectional type of observational study conducted on newborns admitted in the neonatal intensive care unit at Santokha Durlabhji Memorial Hospital cum Medical Research Institute, Jaipur, over a period of one year from January 2013 to December 2013. For the purpose of analysis of data collected following study group were formed:

- Premature care unit (P.C.U.): Neonates admitted who are born at SDM Hospital
- Intensive premature care unit (I.P.U.): Neonates admitted who are born outside SDM Hospital.

Incidence of neonatal septicemia

There were around 1900 deliveries taken place at Santokha Durlabhji Memorial Hospital in the year 2013. Neonates (n=410) admitted in P.C.U. with some clinical manifestations. Neonatal sepsis suspected in around 150 admitted neonates but only 61 neonates had blood culture proven sepsis. Calculated from total deliveries neonatal sepsis rate was 32.1 per 1000 live birth.

A study published in the journal of pediatrics also had similar rate of sepsis. The incidence of suspected neonatal sepsis was 36.6% but only 14.9% have blood culture proven neonatal sepsis in P.C.U. which was lesser than a study (22%) conducted in tertiary care hospital at Gangtok, Sikkim and in study (19.2%) conducted at govt. medical college and hospital Chandigarh. In I.P.U. 312 neonates had been admitted in the year 2013 out of which 68 neonates had positive blood culture. The incidence of blood culture proven neonatal sepsis was 21.8%, which is close to study (22%) conducted at tertiary care hospital at Gangtok, Sikkim.
Table 1 shows significant difference in blood culture proven cases among P.C.U. and I.P.U (p value 0.016244, <0.05). The difference between two units could be due to better care in labour room and proper post-natal handling (using gloves, apron, gown, hand rubs etc.) for neonates delivered at SDM Hospital.

In total (Figure 1) 722 neonates had been admitted in neonatal intensive care unit during the year 2013 and 129 neonates had positive blood culture. The incidence of blood culture proven sepsis was 17.86% which is close to study (19.2%) conducted at govt. medical college and hospital Chandigarh.13

**Bacterial/ fungal isolates**

Table 2 and Table 3 describes percentage of bacterial and fungal isolates in blood cultures and pattern of antibiotic sensitivity. Among bacteria gram negative organisms (24.81%, 32/129) were more common than gram positive organisms (21.71%, 28/129) which can be compared with many studies done in different parts of India, all were suggestive of gram-negative organism predominance over gram positive organisms.12,13

National neonatal perinatal database report 2002-2003 also suggestive of gram negative organisms predominated over gram positive organisms.8 Staphylococcus spp were the most prevalent gram positive bacteria in this study which was comparable to the study done in a tertiary hospital of Africa.14

Among gram negative bacteria Klebsiella pneumoniae being the most common isolate (Table 4). A study conducted over the etiology and antimicrobial resistance of the neonatal sepsis at a tertiary care centre in eastern India also showed comparable results.15 The incidence of Acinetobacter baumannii was 6.98% in present study. A constant and significant rise in the incidence of Acinetobacter spp was observed in a retrospective study of bacterial isolates from cases of neonatal septicemia over a period of 5 years at the Govt. Medical College and Hospital, Chandigarh.13 Blood culture proven fungal septicemia constituted 39.53% of cases in neonatal intensive care unit in the year 2013. Among fungi, candida albicans was the major pathogen. A study published in Indian journal of pediatrics also showed candida albicans as a major pathogen among fungi.16 However, overall incidence of fungal septicemia was low (6.8%) in that study.16

**Pattern of antibiotic sensitivity**

Majority of organisms isolated were resistant to commonly used antibiotics.

**Sensitivity percentages**

- Amikacin (23.08%)
- Gentamicin (25%)
- Piperacillin tazobactam (22.22%)

A study published in NJIRM also suggestive of increasing resistance to commonly used antibiotics.15 Among fungi maximum sensitivity was seen by Voriconazole (100% sensitive in 47 cases) followed by amphotericin B (89.36%) and then fluconazole (82.98%). Among bacteria maximum sensitivity was shown by Tigecycline (89.47%) followed by Linezolid (77.78%) and then Vancomycin (70.59%), Tetracycline (70%), Meropenem (38.46%). Pattern of antibiotic sensitivity was slightly differed in P.C.U./I.P.U. blood culture isolates (Table 5 and Table 6).

NNPD 2002-2003 report showed antibiotics were used in 12.9% of cases whereas in present study antibiotics were used in all cases.6 This difference was due to data collected in present study include blood culture proven neonatal cases only. Similarly, oxygen therapy (8.2%), phototherapy (5.7%), I/V fluids (10.9%), assisted ventilation (2.2%), blood/plasma transfusion (2.2%) was given to small proportion of population as compared to present study.

In I.P.U. (Table 7) antibiotics and intravenous fluid given to majority of neonates (66/68, 97.05%, both). Oxygen was used in 75% cases (51/68) and phototherapy was given to 48.52% cases (33/68). Assisted ventilation was provided to 33.82% cases (23/68) and plasma/blood transfusion given to 36.76% cases (25/68).

NNPD 2002-2003 report showed that the most common therapeutic intervention used for admitted babies was the administration of antibiotics (84.2%) followed by intravenous fluid administration (82%) and oxygen administration (45.3%). Assisted ventilation was given to 23.6% cases while 32.9% received phototherapy. Blood/plasma transfusion given to 22.7% cases.6

Antibiotics were significantly less used (p value 0.002347, <0.05) in NNPD report.6 This difference may be due to more cases of sick neonates (blood culture proven cases only) in present study. Similarly the proportion of modality of treatment in NNPD report was less as only culture proven cases are included in present study.

**Outcome**

In P.C.U. (Table 8) out of 61 cases of blood culture proven neonatal sepsis-38 cases (62.29%) were recovered and discharged in stable condition. 7 cases (11.47%) discharged on request. 10 cases left against medical advice (16.39%) and 6 cases expired (9.83%). NNPD report 2002-2003 showed out of 145623 cases 140572 cases (96.5%) were recovered and discharged in stable condition. 1232 cases (0.09%) were left against medical advice 7365 cases expired (5%).6
Although mortality was high in present study (9.83%) as compared to NNPD report (5%) but these results were not statistically significant (p value 0.0867, >0.05).

In I.P.U. (Table 8) out of 68 cases of blood culture proven sepsis 45 cases (66.17%) were recovered and discharged in stable condition. 8 cases (11.76%) discharged on request. 10 cases (14.70%) left against medical advice. 4 cases (5.88%) were expired and 1 case was referred to other hospital.

NNPD report 2002-2003 showed 7638 cases (69.3%) were recovered and discharged in stable condition. 76 cases (0.7%) left against medical advice. 1860 cases (16.9%) expired and 1447 (13.1%) cases referred. Mortality rates were lower in present study (5.88%) as compared to NNPD report (16.9%). Results were statistically significant with p value 0.016 (<0.05).

CONCLUSION

Overall 722 cases admitted in NICU during the period of one-year 2013. Out of which 129 cases had blood culture proven neonatal sepsis (17.87%), 14.88% cases in P.C.U. and 21.79% cases in I.P.U. had positive blood culture sepsis with statistically significant difference (p value 0.016, <0.05). Majority of cases were candida sepsis (51/129, 39.53%) followed by gram negative organisms (32/129, 24.81%), gram positive organisms (28/129, 21.70%) and others (18/129, 13.95%). Among candida species, candida albicans was the most common strain. Candida spp. sensitive to Voriconazole (100%, 47/47), Amphotericin B (89.36%, 42/47) and Fluconazole (82.98%, 39/47). Among gram negative organisms Klebsiella pneumonia was the most common followed by Acinetobacter. Gram negative organisms were resistant to Amikacin, Meropenem, Piperacillin-tazobactam and sensitive to Ciprofloxacin, Levofloxacin and Tigecycline. Among gram positive organism’s staphylococcus spp. were the most common. Resistant to Ciprofloxacin (7.69%, 1/13), Levofloxacin (7.69%, 1/13), Clindamycin (46.15%, 6/13), Gentamicin (46.15%, 6/13). Sensitive to Tigecycline (93.33%, 14/15), Linezolid (80.00%, 12/15) and Vancomycin (78.57%, 11/14). Antibiotic resistance is an emerging problem requires justified use of antibiotics.

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REFERENCES

1. Vohr BR, Wright LL, Dusick AM, Mele L, Verter J, Steichen JJ, et al. Neurodevelopmental and functional outcomes of extremely low birth weight infants in the National Institute of Child Health and Human Development Neonatal Research Network, 1993-1994. Pediatrics. 2000;105(6):1216-26.

2. Zafar N, Wallace CM, Kieffer P, Schroeder P, Schootman M, Hamvas A. Improving survival of vulnerable infants increases neonatal intensive care unit nosocomial infection rate. Arch Pediatr Adolesc Med. 2001;155(10):1098-104.

3. Moore DL. Nosocomial infections in newborn nurseries and neonatal intensive care units. In: Mayhall CG, editor. Hospital epidemiology and Infection control. 3rd ed. Philadelphia: Lippincott, Williams & Wilkins; 2004:852-883.

4. Rupp M. Nosocomial Bloodstream Infections. In: Mayhall CG, editors. Hospital epidemiology and infection control, 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2004:253-265.

5. Namdeo UK, Singh HP, Rajput VJ, Kushwaha JS. Hematological indices for early diagnosis of neonatal sepsis. Indian Pediatr. 1985;22(4):287-92.

6. National Neonatal Perinatal Database 2002-2003. NNPD Network. www.newbornwhoc.org/pdf/HRRC-Report-2002-03.pdf. Accessed Mar. 28, 2012.

7. McIntosh N, Stenson B. The newborn. In: McIntosh N, Helms PJ, Smyth RL, Logan S, editors. Forfar and Arneil’s Textbook of Pediatrics. 7th ed. Edinburgh: Churchill Livingstone; 2008:320-324.

8. Stoll BJ. Infections of Neonatal Infant. In: Kliegman RM, Stanton BF, Schor NF, St. Geme JW, Behrman RE, editors. Nelson Textbook of Paediatrics. 19th ed. Philadelphia: Elsevier, a division of Reed Elsevier India Private Limited; 2012:629-644.

9. Schelonka RL, Freij BJ, Mccracken GH. Bacterial and Fungal Infections. In: MacDonald MG, Seshia MMK, Mullett MD, Avery GB, editors. Avery’s neonatology: pathophysiology management of the newborn. 6th ed. Lippincott Williams & Wilkins; 2014:1235-1239.

10. Cohen ML. Epidemiology of drug resistance: implications for a post- antimicrobial era. Sci. 1992;257(5073):1050-5.

11. Lukacs SL, Schrag SJ. Clinical Sepsis in neonates and young infants, United States, 1988-2006. J Pediatr. 2012;160(6):960-965.

12. Tserring DC, Chanchal L, Pal R, Kar S. Bacteriological Profile of septicaemia and the risk factors in neonates and infants in Sikkim. J Glob Infect Dis. 2011;3(1):42-5.

13. Agnihotri N, Kaitha N, Gupta V. Antimicrobial susceptibility of isolates from Neonatal Septicemia. Jpn J Infect Dis. 2004;57(6):273-5.

14. Aletayeb SMH, Khosravi AD, Dehdashtian M, Kompani F, Mortazavi SM, Aramesh MR.
Identification of bacterial agents and antimicrobial susceptibility of neonatal sepsis: A 54-month study in a tertiary hospital. Afr J Microbiol Res. 2011;5(5):528-31.

15. Vishwanathan R, Singh K, Mukherjee S, Mukherjee R, Das P, Basu S. Aetiology and antimicrobial resistance of neonatal sepsis at a tertiary care centre in Eastern India: a 3-year study. Indian J Pediatr. 2011;78(4):409-12.

16. Kamath S, Mallaya S, Shenoy S. Nosocomial infections in neonatal intensive care units: profile, risk factors assessment and antibiogram. Indian J Pediatr. 2010;77(1):37-3.

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