Risk factors for neonatal sepsis in paediatric ward at Khartoum North Teaching Hospital, Sudan

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Abstract

Infections are a frequent and important cause of neonatal morbidity and mortality. It was found that neonatal deaths account for a third of global child mortality and those infections are a major cause of neonatal mortality. Objectives: The aim of this study is to determine the common risk factors associated with neonatal sepsis and its relation to site and mode of delivery, birth weight, gestational age, onset of sepsis and the causative organisms in paediatric ward at Khartoum North Teaching Hospital. Methods: A cross-sectional prospective hospital based study was conducted on 120 neonates presented with neonatal sepsis who had been admitted to Khartoum North Teaching Hospital general pediatrics ward from January 2013 to of July 2013. History and physical examination were carried out, samples of blood were taken for blood culture and full blood count. Data was analyzed using the Statistical Package for Social Sciences (SPSS). Results: One hundred twenty neonates were studied. Sepsis was confirmed by clinical and laboratory measures. Sixty-seven (55.8%) neonates were males and 53(44.2%) were females. Fourteen (11.7%) were preterm, 99 (82.5%) were full term and 7(5.80%) were post dated. Early onset sepsis was detected in 79 (65.8%) neonates while late onset sepsis was detected in 41 (34.2%) neonate. The common risk factors were being delivered in the hospital 88(73.3%), history of fever or infection during pregnancy in 53(44.2%), low birth weight (LBW) 39(32.5%), neonatal resuscitation 33(27.5%), and prolonged rupture of membranes 21(17.5%). Conclusion: The common risk factors for neonatal sepsis in paediatric ward at Khartoum North Teaching Hospital were being delivered in hospital, history of fever or infection during pregnancy, low birth weight, neonatal resuscitation and prolonged rupture of membranes.

Keywords: neonatal sepsis, risk factors, Sudan

INTRODUCTION

Infections are a frequent and important cause of neonatal morbidity and mortality (Stoll et al., 2007). It was found that neonatal deaths account for a third of global child mortality and those infections are a major cause of neonatal mortality (Lawn et al., 2004). The incidence of sepsis varies from one center to another, but it ranges from 1-4 in 1000 live birth in most centers (Henrik, 1998). The incidence of bacterial septicemia in developing countries reaches 10-50 per 1000 live births (Gomella, 2004). The mortality of neonatal septicemia varies between 13-45%, Infection accounts for 10-20% of infant mortality (Cole and Cloherty, 1988). Moreover most babies who die from sepsis die within the first 14 days of life, (Mcintosh and Stenson, 2008). World Health
Organization (WHO) estimates that globally there are about 5 million neonatal deaths per year, ninety eight percent of them are occurring in developing countries in the first week of life (perinatal mortality) (WHO, 1996). Neonatal mortality for developed countries is in the region of five while in Asia is about 34, in Africa about 42, and in Latin America and the Caribbean about 17 per 1000 live birth (Costello et al., 2001).

Neonatal sepsis can be defined as the presence of positive cultures, whether in the blood, CSF, or urine associated with systemic clinical signs of infection such as fever, temperature instability, poor feeding and respiratory distress. Neonatal sepsis may be classified according to the time of onset of the disease, early onset and late onset (Vergnano et al., 2005). The distinction has clinical relevance, as early onset sepsis is mainly due to bacteria acquired before and during delivery, and late onset sepsis is due to bacteria acquired after delivery (Noccomial or community sources). Early onset sepsis often presents as a fulminant, multi-system illness within 72 hours of delivery and is mainly due to bacteria acquired before and during delivery whereas late onset sepsis is due to bacteria acquired after delivery (Nosocomial or community sources) and can present as either a fulminant or a smoldering infection. Early onset sepsis presents with prominent respiratory signs while late onset sepsis has more varied presentations (Kaftan et al., 1998).

The source of infection in early onset sepsis (birth to 5 days) is trans-placental or ascending transmission and the major risk factors are maternal infection and prolonged rupture of membranes (Soman, 1985). Maternal genital flora such as group B streptococci (GBS) and Escherichia coli (E. coli) responsible for the majority of cases and may ascend through the birth canal to the amniotic fluid either through intact amniotic membranes or, more commonly, after rupture of membranes (Kaufman, 2004), and the major risk factors are prolonged rupture of membranes (PROM), prematurity, septic or traumatic delivery, fetal anoxia, maternal infection especially urinary tract infection, maternal poverty, preeclampsia, cardiac disease, diabetes mellitus. In late onset (5 to 30 days) it is nosocomial and the risk factors are intravascular catheters, endo-tracheal intubation, assisted ventilation, surgery, and contact with hand of colonized personnel, contact with contaminated equipment. In Late late (more than 30 days) it is nosocomial and the risk factors are indwelling intravascular devices, extreme prematurity, broncho-pulmonary dysplasia, short gut syndrome, complex congenital malformation (Baltimore, 2002).

Intrapartum antibiotics are used to reduce vertical transmission of group B streptococci (GBS), as well as lessen neonatal morbidity after preterm rupture of membranes. After the introduction of selective intrapartum antibiotic prophylaxis to prevent perinatal transmission of GBS, rates of early-onset neonatal GBS infection in the United States declined from 1.7 cases per 1,000 live births to 0.6 per 1,000. Intrapartum chemoprophylaxis does not reduce the rates of late-onset GBS disease (Stoll, 2007). Hand washing has been shown to be effective ever since the 19th century and several guidelines are available (Boyce and Pittet, 2002). Health personnels require education, continuous reminding, and feedback if compliance is to be maintained (Chandra and Milind, 2001). Minimizing invasive procedures has also shown an impact in reducing nosocomial infections (Hansen, 2003). The most effective intervention in reducing the risk of neonatal infection globally is exclusive breast feeding (Narayanan et al., 1983).

It possible to save most cases of neonatal sepsis if diagnosed early and treated aggressively with antibiotics and good supportive care. However if early signs or risk factors are missed mortality increases. Residual neurological damage occurs in 15 to 30 % of neonates with septic meningitis. Mortality from neonatal sepsis may be as high as 50% for infants who are not treated. Infection is a major cause of fatality during the first month of life, contributing to 13 to 15% of all neonatal deaths. Low birth weight neonate and gram negative infection are associated with adverse outcome (Kermorvant-Duchemin et al., 2008).

Subjects and Methods

A cross-sectional prospective hospital based study was conducted at the Khartoum North Teaching Hospital paediatrics ward during the period of January 2013 to July 2013. It includes 120 neonates who admitted to general pediatrics ward from emergency room with diagnosis of early onset sepsis (0-7 days of age) and late onset sepsis (7-28 days of age). Verbal informed consent was obtained from their parents. Then the Author took a detailed history and conduct clinical examination of the neonates. The diagnosis of neonatal sepsis established by the consultant of the unit and investigated for bacterial etiologic agents, blood culture and full blood count. The data was collected through interview questionnaire prepared for this study and data analysis was done by using statistical package of social science (SPPS).

RESULTS

The males were 67 (55.8%) whereas females were 53 (44.2%). The male: female ratio (1.26: 1) (Figure 1). 99 (82.5%) were term neonates, 14 (11.7%) were preterm and 7 (5.8%) were post dated (Figure 2). 81 (67.5%) weighing more than 2.5 kg, while the 39 (32.5%) ranging from 1.5 to 2.5 kg. (Figure 3). The vast majority 96 (80%) of the mothers were between 20 to 40 years, 18 (15%) were less than 20years, and 6 (5%) were more than
40 years. Among 120 mothers their neonates included in this study 87 (72.5%) has regular antenatal care, 22 (18.3%) has irregular antenatal care, and 11 (9.2%) has no antenatal care at all.

A history of maternal fever or infection during pregnancy was positive in 53 (44.2%) of the mothers and negative in 67 (55.2%) (Figure 4). Regarding site of delivery 88 (73.3%) of the neonates were outcome of normal vaginal delivery, 21 (17.5%) were outcome of emergency caesarian section, 12 (10%) were outcome of elective caesarian section and 6 (5%) were outcome of assisted vaginal delivery (Table 1).

Regarding the duration of the rupture membranes 84 (70%) of the mothers has duration of less than 18 hours, 21 (17.5%) has duration of more than 18 hours and the rest under-went caesarian section before rupture of membranes (Table 2). Seventy three (60.8%) of mothers had a duration of labor less than 24 hours and 21 (17.5%)
had a duration of more than 24 hours.

Among all neonates 87 (72.5%) of the neonates didn’t need resuscitation after delivery while 33 (27.5%) of them needed resuscitation. Fifty five (45.8%) neonates admitted within the 1st 3 days of age and 65 (54.2%) of them admitted after the age of 3 days (Table 3). In this study the early onset sepsis was found in 78 (65%) and the late onset sepsis was found in 42 (35%).

Regarding the laboratory investigations a blood culture was positive in 81 (67.5%) and negative in 39 (32.5%). The most common isolated organisms were E coli 39 (48.2%), staphylococcus aureus 23 (28.3%), and GBS 19

Figure 4. Maternal fever or infection during pregnancy n = 120

Figure 5. Site of delivery of the study group n = 120

Table 1. Distribution of mode of delivery among the study group n = 120

<table>
<thead>
<tr>
<th>Mode of delivery</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal vaginal delivery</td>
<td>81</td>
<td>67.5</td>
</tr>
<tr>
<td>Assisted vaginal delivery</td>
<td>6</td>
<td>5.0</td>
</tr>
<tr>
<td>Elective caesarian section</td>
<td>12</td>
<td>10.0</td>
</tr>
<tr>
<td>Emergency caesarian section</td>
<td>21</td>
<td>17.5</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 2. Shows the duration of Rupture of membranes in the study group n = 120

<table>
<thead>
<tr>
<th>Rupture of membranes</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 24</td>
<td>84</td>
<td>80.0</td>
</tr>
<tr>
<td>&gt; 24</td>
<td>21</td>
<td>20.0</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Among 120 neonates included in this study, early onset sepsis was more common 79 (65.8%) than late onset sepsis 41(34.2%). This result is similar to study done by Demissie Shitaye in Ethiopia (Shitaye, 2008) which showed a total of 298 (98.7%) neonates from 302 presented with early onset sepsis and only 4 (1.3%) presented with late-onset sepsis.

The deaths were highly associated with early onset sepsis 86.2% from all deaths and it was higher than in late onset sepsis (13.8%). A higher mortality rate among early onset was found in other studies e.g. Jumah in Al-Basrah (Jumah and Hassan, 2007), Rodriguez in Mexico (Rodriguez et al., 2003) and Schuchat A in Georgia (Schuchat et al., 2002). On the other hand there were some studies showed that the mortality rate is higher in late onset sepsis Dawadu in Saudi Arabia (Dawadu et al., 1997): (Stoll et al., 2002).

There was a difference in the frequency of death between both sexes. The mortality rate among the males was 26.8% while in females was 20.7%. A similar result was obtained in Obi et al. (1999 suggesting the possibility of sex linked factors in host susceptibility. But there was no statistical significant difference of death between both sexes was obtained by Koutouby A in Dubai (Koutouby et al., 1999), Rodriguez in Mexico (Rodriguez et al., 2003).

In this study there was significant association between home delivery and increment in neonatal death (p-value 0.002). 15 (46.9%) neonates out of 32 neonates outcome of home delivery and this account 51.7% from the all deaths, in comparison with hospital delivery 14 (15.9%) out of 88 neonates outcome of hospital delivery and account 48.3% from all deaths. Similar results were reported by Jumah in Al-Basrah (Jumah et al., 2007), Wax JR in USA (Wax et al., 2010) and Susan Mayor in London (Susan, 2010). The difference may be caused by a lower rate of medical intervention, access to neonatal resuscitation and different causative organisms.

This study revealed that low birth weight LBW was significantly associated with death in neonates with sepsis (p-value 0.040). The mortality rate in the neonates weighing from 1.5kg to 2.5kg was (38.5%) and in the neonates of more than 2.5 kg was (17.3%). This result was similar to many previous studies carried in

### DISCUSSION

(23.5%) (Fig.6). The total White blood cells were in the normal rang in 92 (76.7%), high in 19 (15.8%) and low in 9 (7.5%).

Overall 80 (66.7%) neonates were discharged in a good condition, 29 (24.1%) died, and 11 (9.2%) discharged against medical advice. The deaths were highly associated with early onset sepsis as 25 (86.2%) neonates from all deaths in comparison to 4 (13.8%) with late onset sepsis. Fourteen preterm neonates included in this study 5 of them died with mortality rate of 35.7%, while the mortality rate among the term neonates in this study was 24.2% and 0 (0%) in post date neonates. In 39 of neonates weighing from 1.5 to 2.5 kg (LBW less than 2.5 kg) the mortality rate was 38.5%, on the other hand the mortality rate among the neonates weighing more than 2.5 kg was 17.3%

### Table 3. Age on admission per day in the study group n = 120

<table>
<thead>
<tr>
<th>Age on admission (days)</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3</td>
<td>55</td>
<td>45.8</td>
</tr>
<tr>
<td>&gt; 3</td>
<td>65</td>
<td>54.2</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### Figure 6. Isolated organism in the study group n = 120
different countries whether developing or developed e.g. Dawodu A in Saudi Arabia, Jumah in Al-Basrah and Rodriguez M in Mexico. This may be explained by the fact that these neonates need prolonged hospitalization which increases risk of nosocomial infection or related to inherent immunological deficiency.

Among the 120 neonates included in this study, 81 (67.5%) was positive for blood culture. This was higher in comparison to the study done in Ethiopia by Demissie Shitaye in Ethiopia in which 302 neonates investigated for sepsis, 135 (44.7%) were positive for blood culture. The mortality was higher in neonates whose blood cultures were positive. A gram negative E. coli was found to be the most fatal organisms in this study (p-value 0.00). It was the causative organism in 19 (65.5%) of the deaths, GBS 7 (24.1%), staph aureus 1 (3.4%) while 2 (6.8%) deaths had a negative blood culture. Similar results were obtained by many studies in Saudi Arabia by Asinidi A (Asinidi et al., 1999), in Dubai by Koutouby and in Mexico by Rodriguez. All these studies showed a higher incidence of gram negative micro-organisms among neonates with sepsis who died compared to those who survived.

CONCLUSION

The most common risk factors that increase the incidence of neonatal sepsis were hospital delivery, prematurity, low birth weight (LBW), prolonged rupture of membranes and fever or infection during pregnancy. Early onset sepsis was more common than late onset one. The most common organism isolated from Blood cultures was Gram negative E. coli. The mortality was significantly associated with early onset sepsis, home delivery (p-value 0.002), LBW (p-value 0.04) and E coli sepsis (p-value 0.002). The mortality rate in this study was 24.1%.

RECOMMENDATIONS

Sick neonates should be admitted in separate neonatal ward. Diagnosis and management of maternal infection during pregnancy helps to decrease the risk of early onset sepsis and preterm deliveries.

Treatment of chorio-amnionitis and intrapartum prophylaxis antibiotics for premature and/or prolonged rupture of membranes decreased the neonatal sepsis dramatically.

Restriction of vaginal examination during labor, hands washing, and minimal manipulations of neonate post delivery.

Early diagnosis of neonatal sepsis and aggressive management can decrease the neonatal mortality and morbidity.

Unified protocol for treatment of neonatal sepsis, and the empirical treatment should cover both Gram negative and positive organisms.

Application of infection control programs.

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