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### FACTORS INFLUENCING NEONATAL SEPTICAEMIA IN MAIDUGURI, NORTH-EASTERN NIGERIA

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#### ABSTRACT

**BACKGROUND:** Neonatal septicaemia is a leading cause of morbidity and mortality worldwide, especially in the tropics. The risk factors vary, and the clinical features of neonatal septicaemia may be vague and nonspecific, therefore a high index of suspicion is vital to early diagnosis and treatment. The aetiological agents and their antibiotic sensitivity pattern have continued to change (in the same centre over time), hence the need to have undertaken this study.

**AIMS AND OBJECTIVES:** The primary objective of the study was to determine the risk factors influencing the aetiology of neonatal septicaemia at the University of Maiduguri Teaching Hospital.

**PATIENTS AND METHODS:** The study was prospective and all the newborn that had clinical diagnosis of septicaemia were consecutively enrolled and admitted to the Special Care Baby Unit of the Department of Paediatrics of University of Maiduguri Teaching Hospital (UMTH). The patients were appropriately investigated including blood cultures, cerebrospinal fluid cultures and urine culture among others.

**RESULTS:** One hundred and ten neonates were studied, of these 46(42.0%) had positive blood culture, while 64 (58.0%) were blood culture negative. Eighteen (39.1%) of the septicaemic neonates were inborn, while 28 (60.9%) were out born. The incidence of neonatal septicaemia among babies delivered at UMTH was 5.9/1000 live births and the male to female ratio among septicaemic neonates was 1.9:1. The common risk factors for NNS were prolonged rupture of membrane (PROM), prematurity and low socio-economic status of parents among others. Fever was the commonest clinical feature at presentation (87%), others include: poor feeding (64 %), excessive crying (33%), tachypnoea, hepatomegaly were some of the common examination findings. *Staphylococcus aureus* 16(69.6%) and *Streptococcus pyogenes* 5(21.8%) were the predominant Gram positive organisms isolated while *Escherichia coli* 9(39.1%) and *Klebsiella Pneumoniae* 7(30.4%) were the predominant Gram negative organisms isolated.

**CONCLUSION:** Mortality was high in infection associated with Gram negative organisms and in the presence of conditions/complications like urinary tract infections, tetanus and meningitis.

### LES FACTEURS QUI INFLUENCENT SEPTICEMIE NEONATALE A MAIDUGURI AU NORD - EST DU NIGERIA

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#### RESUME

**CONTEXTE :** Septicémie néonatale est une cause majeure de morbidité et de mortalité dans le monde entier, en particulier dans les tropiques. Les facteurs de risques varient, et les caractéristiques cliniques de septicémie néonatale peuvent être vague et non spécifiques, pas conséquent, un indice élevé de suspicion est important pour le diagnostic et le traitement précoce. Les agents étiologiques et leur modèles sensibles aux antibiotiques ont continué à changer (dans le même centre finalement), d'où la nécessité d'avoir entrepris cette étude.

**OBJECTIF :** L'objectif principal de l'étude était pour déterminer les facteurs de risques qui influencent l'étiologie de septicémie néonatale à l'hôpital d'enseignement universitaire de Maiduguri.

**PATIENTS ET METHODES :** L'étude était éventuelle et tous les nouveaux-nés qui ont eu le diagnostic clinique de septicémie ont été inscrits consécutivement et ils ont été admis à l'unité de soins spéciaux de bébé du Département de Pédiatrie de l'hôpital d'enseignement universitaire de Maiduguri (UMTH). Les patients ont été examinés correctement y compris l'hémoculture, la culture liquide céphalorachidienne et la culture d'urine parmi d'autres.

**RESULTATS :** Cent dix nouveau-nés ont été étudiés, de ceux-ci, 46 (42,0%) ont eu l'hémoculture positif, alors que 64 (58,0%) étaient négatif à l'hémoculture. Dix-huit (39,1%) des nouveaux-nés septiciémiens étaient innés, alors que 28 (60,9%) étaient hors nés. L'incidence de septicémie néonatale chez les bébés mis au monde à UMTH était 5,9/1000 naissances vivantes et le ratio male -

févélle parmi les nouveau - néssépticémiques étáit 1, 9 :1. Les factéurs des risques communs pour NNS étáient membrane de rupture prolongée (PROM) prématurité et de faible statut socio - éconómique des parents parmi d'autres. La fièvre étáit la caractéristique clinique le plus commun lors de la présentation (87%) d'autres comprennent : une mauvaise alimentation (64%), pleure excessif (33%), tachypnée, hépatomégalie étáient des résultats de l'examen commun. *Staphylococcus aureus* 16 (69,6%) et *Streptococcus pyogenes* 5 (21,8%) étáient les organismes Gram positifs prédominant isolés alors que *Escherichia Coli* 9 (39,1%) et *Klebsiella Pneumoniae* 7 (30, 4%) étáient les organismes Gram négatifs prédominant isolés.

**CONCLUSION :** La mortalité á été élevé dans l'infection associé aux organismes Gram négatifs et en présence des conditions /complications comme les infections des voies urinaires, le tééanos et la méningite.

## INTRODUCTION

Infections are common problems of the newborn especially children in the developing countries.(1) Severe bacterial infections such as neonatal septicaemia constitute a major cause of morbidity and mortality in the newborn, accounting for 15 to 40% of neonatal morbidity. (1, 2) It is one of the commonest causes of admissions into the neonatal intensive care units of developing countries.(3) The incidence of neonatal septicaemia varies widely between the developed world and developing countries and also varies from one nursery to another.(1) The characteristics of neonates studied also influences the incidence. For example the prevalence rate is 3-10 fold higher in preterm than in full term neonates.(1) Also, the incidence is higher in low birth weight (LBW), (4, 5) than normal weight babies, and in males than females.(6, 7) Other factors are the levels of obstetric and nursery care available, the presence of predisposing factors like lack of good water supply, poor socio economic status, delivery at home or unhygienic environment.(8-10) The common risk factors for NNS in the developed world include prematurity and peripartum colonization of the birth canal by group B  $\beta$ -haemolytic streptococcus (GBS).(7) In one study from South-Western Nigeria, common risk factors were lack of good obstetric care, poor nursery practices, low socio economic status, poor housing conditions, poor personal hygiene, delivery at home/unhygienic environment, prematurity and complications of labour.(7) and most of these are preventable. The factors that influence the likelihood of neonatal infections can be classified into three groups ; Maternal, Neonatal and Environmental.(7,8)

The incidence of neonatal septicaemia in developed countries of Europe and North America ranges between .95/1000 live birth to 3/1000 live birth.(11) Unlike the values reported from developed countries, the reports from Nigeria like other developing countries are higher, ranging from 5.5/1000 live births to 35/1000 live births. (12-14)

The burden of aetiologic organisms causing NNS varies from place to place, and over time, even in the same centre or region.(1,3,6) It is therefore important to maintain local vigilance, so as to detect shifts in pattern early enough to intervene effectively.

This prospective study aimed to determine the risk factors, the characteristics and outcome of neonates with diagnosis of neonatal septicaemia at UMTH, Maiduguri North-Eastern region of Nigeria. Similar prospective study has not been carried out to determine the risk factors that influences the aetiology of neonatal septicaemia in this North-Eastern region so the need to conduct such study.

## PATIENTS AND METHODS

This was a prospective study conducted on patients admitted into the Special Care Baby Unit (SCBU) over a period of twelve months from January 1<sup>st</sup> to December 31<sup>st</sup> 2012. Total of one hundred and ten (110) patients who met the inclusion criteria were studied.

Ethical clearance was obtained from the Research and Ethics Committee of the University of Maiduguri Teaching Hospital and informed consent was obtained from the parents or the patients care giver. The babies were consecutively recruited from both the in-born and out-born units of the SCBU who presented with risk factors and features and/or diagnosis of neonatal septicaemia. All patients who met the set criteria were evaluated at admission; parameters such age, sex, maternal age, maternal education, place of antenatal care and delivery, cord care, symptoms such fever, poor feeding, respiratory difficulty and convulsion among others were recorded on to the study proforma.

Samples including blood, urine, cerebrospinal fluid, umbilical swab and other septic foci were appropriately taken for cultures before antibiotics were commenced on the patients.

All data were entered into SPSS version 16.0 (SPSS Inc. Chicago. USA. Soft ware) and analysed. Tables were used for data presentation and association were tested using Chi-square and Fishers exact test where appropriate, while statistical significance were set at  $p < 0.05$ .

## RESULTS

Forty two (38.2%) of the 110 neonates were inborn and 68 (61.8%) were out born and the age of the neonates at admission ranged from 0-28 days with a mean of  $5.33 \pm 5.29$  days. Forty nine (44.5%) presented within the first 72 hours of life, while 61(55.5%) presented after 72hrs of life. Eighteen (16.4%) of the newborn were preterm while 92 (83.6%) were full term. The mean gestational age was  $38.03 \pm 2.30$  weeks and the range was between 30-43 weeks.

The weight at admission ranged between 1150gm - 4300gm with a mean weight of  $2842.27 \pm 734.23$ g. Forty six (41.8%) of the newborns that were studied had blood culture proven septicaemia, of whom 18(39.0%) were inborn and 28(61.0%) were out born. The remaining 64(58.2%) had negative blood culture.

Table I. Shows the distribution of the neonates in relation to place of delivery and frequency of septicaemia.

TABLE I: PLACE OF DELIVERY AND FREQUENCY OF NEONATAL SEPTICAEMIA

Place of delivery	No of neonates in each group	No of culture proven septicaemia (%)
UMTH	42	18(42.9)*
Gen Hospital	14	2(14.3)
PHC	2	0(0.0)
Private Hospital	10	6(60.0)
Home	42	20(47.6)
Total	110	46(42.0)

\* Of this 10 mothers had ANC in UMTH; the rest had no ANC but only came in during labour.

Table II shows factors that may influence the risks of neonates to come down with neonatal septicaemia. These includes mode of delivery, characteristics of liquor mode of umbilical cord care.

Table III. Shows the relationship between parental socio economic class and neonatal septicaemia.

TABLE II: MODE OF DELIVERY, CHARACTER OF LIQUOR AND CORD CARE IN RELATION TO NEONATAL SEPTICAEMIA

Factors	Number of neonates in the group	No of neonates with culture proven septicaemia (%)	$\chi^2$	p-value
<b>Mode of delivery</b>				
SVD	95	41(43.2)	5.081	0.279
Breech	2	0(0.0)		
Vacuum	1	0(0.0)		
Forceps	3	0(0.0)		
C/S	9	5(55.6)		
<b>Liquor Character</b>				
Clear	92	36(39.1)	6.236	0.182
Cloudy liquor	6	2(33.3)		
meconium stained	4	2(50.0)		
Foul smelling	4	4(100.0)		
blood stained	4	2(50.0)		
<b>Cord care</b>				
Methylated spirit	52	23(44.2)	8.960	0.255
Warm old rag	5	2(40.0)		
Cow dung use	5	4(80.0)		
Charcoal	12	4(33.3)		
Warm compression	11	6(54.5)		
Tooth paste	22	5(22.7)		
Dettol	2	1(50.0)		
Soap	1	1(100.0)		

TABLE III: PARENTAL SOCIO-ECONOMIC CLASS AND FREQUENCY OF NEONATAL SEPTICAEMIA

Socio-economic class	Number of neonates in group	No of neonates with culture proven septicaemia (%)	$\chi^2$	p-value
I	7	4(57.1)		
II	7	1(14.3)		
III	25	9(36.0)	3.920	0.417
IV	26	13(50.0)		
V	45	19(42.2)		
<b>Total</b>	<b>110</b>	<b>46(42.0)</b>		

Table IV. shows various factors (gestational age, prolonged rupture of membrane, age at admission, weight at birth and sex) in relation to the occurrence of neonatal septicaemia.

Ten (55.6%) of the 18 preterm newborns that were screened had blood culture proven septicaemia. There were ninety two term neonates (gestational age  $\geq$  37

TABLE IV: RISK FACTORS IN RELATION TO NEONATES WITH SEPTICAEMIA

Factors	Number of neonates	No of neonates with culture proven septicaemia (%)	$\chi^2$	p-value
<b>Gestational age</b>				
Preterm	18	10(55.6)	1.669	0.196
Term	92	36(39.1)		
<b>PROM</b>				
YES	21	14(66.7)	6.587	0.010*
NO	89	32(36.0)		
<b>Weight</b>				
LBW	30	16(53.3)	2.248	0.134
NBW	80	30(37.5)		
<b>Sex</b>				
Male	73	32(43.8)	0.363	0.547
Female	37	14(37.8)		

\*Statistical significance set at  $p < 0.05$

weeks), 36 (39.1%) of whom had blood culture proven neonatal septicaemia. One of the babies born at  $\geq$ 37 weeks was post term ( $\chi^2 = 1.669$ ,  $p = 0.196$ ). Septicaemia was significantly more likely to occur following PROM ( $\chi^2 = 6.587$ ,  $p = 0.01$ ). Preterm delivery, low birth weight and gender however, were not significantly associated with septicaemia.

#### ISOLATES IDENTIFIED ON BLOOD CULTURE STUDIES

The proportion of organisms isolated includes 23 (50%) Gram positive and the remaining half 23 (50%) were Gram negative. Out of the Gram positive organisms, *Staphylococcus aureus* accounted for 16 (69.6%) of the isolates, *Streptococcus pyogenes* accounted for 5 (21.8%), while *Staphylococcus epidermidis* and *Streptococcus pneumoniae* responsible for one isolate each. The Gram negative organisms consisted of *Escherichia coli* 9 isolates (39.2%), *Klebsiella pneumoniae* 7 (30.5%) while *Coliforms* 5 isolates (21.7%) and *Haemophilus influenzae* and *Salmonella spp* responsible for one isolates each.

#### OUTCOME OF BABIES

Of the 110 neonates studied, 46 (42.0%) neonates were blood culture proven septicaemia. Thirteen (28.00%) of the 46 neonates with positive blood culture died, while 20(31.3%) neonates out of 64 with blood culture negative septicaemia died. The overall mortality among neonates studied was 33(30.0%). ( $\chi^2 = 0.860$ ,  $P = 0.804$ ). Two (9.09%) of the 22 neonates with early onset septicaemia died while 11 (45.93%) of the 24 neonates with late onset neonatal septicaemia died. There was statistically significant difference ( $\chi^2 = 4.420$ ,  $P = 0.035$ ). Ten (31.25%) of the 32 male neonates with blood culture positive septicaemia died compared to 3 (21.43%) of the 14 females neonates with positive blood culture. ( $\chi^2 = 0.270$ ,  $P = 0.605$ ).

Four (40.00%) of the 10 preterm neonates died compared to 9 (25.00%) of the 36 full term neonates. ( $\chi^2 = 0.460$ ,  $P = 0.499$ ). Six (37.50%) of the 16 low birth weight (LBW) neonates died compared to 7(23.33%) of the 30 normal birth weight babies. ( $\chi^2 = 0.560$ ,  $P = 0.454$ ).

The overall mortality rate was 28.3%. Mortality was high among male than female, also higher among preterm low birth weight than term normal birth weight neonates. Though it was not statistically significant ( $\chi^2 = 1.190$ ,  $p = 0.274$ )

## DISCUSSION

This study has revealed that neonatal septicaemia is an important cause of morbidity and mortality among neonates admitted at our centre, supporting the finding in previous studies.(13,16) The incidence of neonatal septicaemia of 5.9/1000 live births in this study is quite high compared to incidences reported from developed countries, (11) and some earlier studies in Nigeria,(10) the possible reason for such differences while in the developed countries, pregnant mothers are well informed, easy access to antenatal care delivery often at low cost, but lower than other reports,(13, 17) because these studies were also from lower resource setting like Nigeria.

Factors responsible for neonatal septicaemia were not different from other studies reported in Nigeria,(14) and elsewhere.(18) Maternal risk factors such as fever and prolonged rupture of membrane (PROM) which were common in this study have been reported by some workers.(18) Another important risk factor includes parental socio-economic status, majority of the neonates with septicaemia in this study were from low socio-economic (class IV and V), (18) and most of the other factors were also found in this category of social class. In this study neonatal septicaemia was seen more common among those that were delivered at home, which was also reported in other parts of Nigeria. (7) All the bacterial isolates in this study were mono microbial, and have been implicated previously in neonatal septicaemia.(7,19) The predominant organisms includes *Staphylococcus aureus*, *Streptococcus pyogenes* among the Gram positive agents and *Escherichia coli*, *Klebsiella pneumoniae* among the Gram negative agents in this study, had been reported by other workers in Nigeria.(7,19) Other organisms were *Staphylococcus epidemidis* and *Streptococcus pneumoniae* among the Gram positive bacteria and *Coliforms*, *Haemophilus influenzae* and *Salmonella spp* among the remaining Gram negatives. However there were equal proportion of both Gram positive and Gram negative organisms in this study which differs with findings in previous report from the same centre done over ten years earlier which showed Gram positive as predominant organisms.(13) The reason probably, the earlier report was a retrospective study with so many flaws as oppose to the present study which is prospective study and precaution were taken to adhere strictly the inclusion criteria set for the study.

Also, in this study, among the Gram negative organisms, *Escherichia coli* was commoner than *Klebsiella Pneumoniae*. This differ from earlier report by Ambe *et al* (13) in which *Klebsiella spp* was the predominant Gram negative pathogen. This affirms the well-known phenomenon of a periodic changes in the pattern of bacterial pathogens of neonatal septicaemia in a given environment over time, but differs from report from other centres in Nigeria.(14, 18)

The six deaths from early onset (EONNS) were due to Gram negative bacteria, out these, 4 were preterm low birth weight neonates, other two were term neonates. This is in keeping with a report from a centre in Nigeria.(10) Two had severe birth asphyxia and *E. coli* infection, one

had meningitis due *E. coli*, and one had meningitis due *Haemophilus influenzae*. There were two normal birth weight babies with the EOS that died; one had severe birth asphyxia with *coliforms* septicaemia and one with meningitis due to *Klebsiella* infections.

Late onset neonatal septicaemia (LONNS) were responsible for seven death. Five cases of tetanus, out of which 3 cases were due to *staphylococcus aureus* septicaemia, one case due *Klebsiella* septicaemia and one case due to *Streptococcus pyogenes*. There was a case of preterm with *streptococcus pyogenes* UTI and another preterm with *E. coli* UTI. The overall mortality in this study was 13/46 (28.3%) which high. However, it was lower than the mortality reported elsewhere in Nigeria.(13,19) Possibly the high index of suspicion, concerted effort on the side of the health care team and vigilance on ensuring use of good quality and highly potent drugs in the treatment of index cases might likely explain the low mortality rate in our study report.

## CONCLUSION

There is unacceptable high burden of neonatal septicaemia in the region. The common risk factors identified in the study includes lack of antenatal care services, maternal illnesses such as maternal fever, antepartum haemorrhages, eclampsia, home delivery and poor cord such as use of hot compression, use of charcoal and application of cow dung and application of Maclean(tooth paste). Prematurity and prolong rupture of amniotic membrane beyond 18hrs were highly associated neonatal septicaemia. The common organisms responsible for neonatal septicaemia identified in this study include *Staphylococcus aureus*, *Streptococcus pneumoniae* among the Gram positive organisms and *Escherichia coli* and *Klebsiella pneumoniae* among the Gram negatives. Mortality was 28.3% in this study and was high among the neonates with Gram negative septicaemia. Mass education of pregnant mother at utilization of health care facility for booking, regular antenatal care, safe delivery and good cord care practices will reduce un wanted morbidity and mortality.

## LIMITATION

Due to cost of financing of the research work we could not afford to repeat the blood culture, which could have been necessary in accordance with scientific standard.

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**CONTRIBUTORS:** Pius S conceive the research and with other authors collected and analyze the data, wrote the draft and critical review of the final article.

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