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*Review*

# A review of bacterial isolates in blood cultures of children with suspected septicemia in a Nigerian tertiary Hospital

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**Septicaemia is a common condition in children with a resultant high morbidity and mortality. The gold standard for diagnosis of septicemia is the isolation of bacteria agents from blood cultures. To determine the common etiology of septicemia in children and their antibiotic susceptibility pattern, a retrospective study with a review of blood culture reports of paediatric patients aged 0 - 15 years, suspected of septicemia, from October 2006 to October 2008 in the Medical Microbiology department of Aminu Kano Teaching Hospital, Kano, Nigeria was carried out. Out of a total of 3840 blood culture samples, only 18.2% was culture positive. Gram–negative and gram–positive bacteria constituted 69.3 and 30.7%, respectively. The most prevalent bacterial isolates were *Escherichia coli* (44.3%) and *Staphylococcus aureus* (30.7%). *E. coli* were sensitive to Ceftriaxone, Ciprofloxacin, Gentamycin and Clavulinate – Amoxyl. The commonest bacterial isolate from blood culture of children with suspected septicemia in Kano was *E. coli*. The most sensitive and preferable among the tested antibiotics was Ceftriaxone. Rational use of antibiotics with regular antibiotic susceptibility surveillance studies is recommended to maintain high antibiotic therapeutic profile.**

**Key words**: Blood cultures, bacterial isolates, antibiotic sensitivity, children.

## INTRODUCTION

Septicemia, a symptomatic bacteraemia, is a common condition in children with a resultant high morbidity and mortality (Odugbemi et al., 1994; Ogunleye et al., 2005). Children with septicemia present with fever, difficulty in breathing, tachycardia, malaise, refusal of feeds or lethargy. It is a medical emergency that requires urgent rational antibiotics therapy. The gold standard for diagnosis of septicaemia is the isolation of bacterial agent from blood culture (Iregbu et al., 2006). Neonatal blood culture positive rates ranging from 25 – 55% have been documented in previous studies carried out within Nigeria (Iregbu et al., 2006; Martins et al., 2005). In Nigeria, the outcome of treatment of neonatal septicemia has remained poor, with reports of mortality of 33 to 41% from two tertiary hospitals in the country (Adeleke et al., 2006; Martin et al., 2005; Mokuola et al., 2002).

As neonatal septicemia is a life threatening emergency, the knowledge of epidemiological and antimicrobial susceptibility pattern of common pathogens in a given area helps to inform the choice of antibiotics. Predominance of either the gram- positive or gram- negative bacterial isolates is influenced by geographical location and changes in time; so also is the antibiotic susceptibility pattern influenced by location and time. Some bacteria commonly isolated include *Escherichia coli*, *Klebsiella pneumonia*, *Enterobacter* species, *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

The determination of the bacterial profile and their antibiotic sensitivity pattern will guide in the infection control and rational use of antibiotic in this locality. The pattern of bacterial isolates in children with clinical diagnosis of septicaemia seen at Aminu Kano Teaching hospital in the North –western Nigeria is reported in this study.

## MATERIALS AND METHODS

The present retrospective study was on pediatric age group less

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**Table 1.** Distribution of blood culture bacterial isolates in three age groups in Oct. 2006 – Oct. 2008 in Aminu Kano Teaching Hospital. Kano.

| Bacteria | Age group | | | |
|---|---|---|---|---|
| | Group A (neonates) (%) | Group B (> 28/7, 12/12) (%) | Group C (1 < 15 yrs) (%) | Total (%) |
| *Escherichia coli* | 180 (55.1) | 70(40.2) | 60(30.0) | 310 (44.3) |
| *Staphylococcus aureus* | 90 (27.6) | 60 (34.5) | 50 (25.0) | 200(28.6) |
| *Klebsiella* spp | 40(12.3) | 30(17.3) | 30(15.0) | 100(14.3) |
| *Proteus* spp | 14(4.4) | 6(3.5) | 15 (7.5) | 35(5.0) |
| *Salmonella* spp | - | 2(1.1) | 28(14.0) | 30(4.3) |
| *Streptococcus pneumonia* | 1(0.3) | 2 (1.1) | 7(3.5) | 10 (1.4) |
| *Pseudomonas aeruginosa* | - | 3(1.7) | 5(2.5) | 8(1.1) |
| *Enterococcus* spp | 1(0.3) | 1(0.6) | 3 (1.5) | 5(0.7) |
| *Haemophilus influenza* | - | - | (2(1.0) | 2(0.3) |
| Total Isolates | 326(25.7) | 174(17.4) | 200(12.7) | 700(18.2) |
| Sterile (negative) cultures | 944(74.3) | 826(82.6) | 1370(87.3) | 3140(81.8) |
| Total cultures | 1270 (33.1 | 1000 (26.0) | 1570 (40.9) | 3840 |

than 15 years, with septicemia and their antibiotic sensitivity pattern from 2006 to 2008 in Aminu Kano Teaching Hospital.

Blood samples were collected following thorough cleaning of the venous site with 70% alcohol and subsequently followed by providone iodine. The rubber cap of each of the culture broths bottles was immediately cleaned with 70% alcohol. The used needle was replaced with a new needle and then, the venous blood was injected into Brain heart Infusion and Sodium thioglycolate broths in the ratio of one part of blood to five parts of the broth. The blood samples were categorized into different age – groups of the individual patients; A, B and C (0 to 28 days, > 28 days to <1 year and 1 year to < 15 years, respectively). The blood culture broths were immediately sent to the laboratory, where they were incubated at 37°C for 7 days. Three sub-cultures were made at 24, 72 h and on the $7^{th}$ day on MacConkey, Blood and Chocolate agar media and incubated in appropriate temperature and atmospheres according to standard procedures (Murray et al., 2003). Organisms isolated were identified by conventional methods (Murray et al., 2003). Antibiotic susceptibility tests were done against locally available antibiotics by using disk diffusion method in accordance with the National Committee for Clinical Laboratory Standards (NCCLS) (now, Clinical Laboratory Standard Institute (CLSI)) criteria and similarly interpreted (NCCLS, 2003). Controlled strains; *S. aureus* ATTC 25923, *E. coli* ATTC 25922 and *P. aeruginosa* ATTC 27853 were used.

The results were analysed using Statistical Package for the Social Sciences (SPSS) 11.0 statistical software; chi – square ($X^2$) was used to compare associations between proportions and p-values < 0.05 were considered significant at 95% confidence limit. Formal approval was obtained from the hospital ethical committee.

## RESULTS

A total of 3840 blood culture samples were collected, among which 700 (18.2%) were culture positive. Gram-negative bacteria were 69.3% of the total isolates and gram-positive were 30.7%. The commonest bacterial isolates were *E. coli* (44.3%), *S. aureus* (28.6%) and *Klebsiella* species (14.3%). Gram–negative and gram – positive bacteria were in the ratio of about 2:1 (Table 1).

Bacterial isolates according to age groups; A (neonates), B (> 28 days to < 1 year) and C (1 year to <15 years) were 25.7, 17.4 and 12.7%, respectively. *E. coli* predominated in all the three age groups by 55.1, 40.2 and 30.0% in groups A, B and C respectively. This was followed by *S. aureus* accounting for 27.6, 34.5 and 25.0% in groups A, B and C respectively. The least prevalent isolate was *Haemophilus influenza* found only in age group C and accounted for only 1% of isolates in this age group (Table 1).

*E. coli* was sensitive to Ceftriaxone, Ciprofloxacin, Gentamycin and Clavulinate+Amoxyl by 90, 90, 80 and 80%, respectively. 90% of *S. aureus* was sensitive to Cefuroxime, while 90, 90 and 85% were sensitive to Ceftriaxone, Clindamycin and Clavulinate+ Amoxyl, respectively (Table 2).

## DISCUSSION

The rate (18.2%) of bacterial isolation in the blood culture of children in this study was relatively low compared to some previous studies done in Nigeria, namely; Calabar (44.9%) (Martins et al., 2005), Ilorin (30.8%) (Mokuola et al., 2002) and Ife (55%) (Ako-Nai et al., 1999). India (Madhu et al., 2002) recorded a relatively low rate (22.9%) of positive blood cultures among children. In the present study, a 25.7% rate of bacterial isolation was from group A (neonates), while 17.4 and 12.7% were from blood cultures of group B (age > 28 days to < 1 year) and group C (age 1 year to < 15 years), respectively. The 25.7% rate of bacterial isolation among neonates in the study was similar to a 22% isolation rate in a previous study done in Abuja, Nigeria (Iregbu et al., 2006). The higher incidence of septicemia in neonates compared to other pediatric age groups may be related to immaturity of the immune system.

**Table 2.** Bacterial isolates and antibiotic sensitivity pattern among study population in Aminu Kano teaching hospital 2006 – 2008.

| Drugs | Bacterial isolates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***E. coli* 310 (%)** | ***S. aureus* 200 (%)** | ***Klebsiella* spp. 100 (%)** | ***Proteus* spp35 (%)** | ***P. argueinosa* 8(%)** | ***Salmonella* spp. 30 (%)** | ***S. pneumonia* 10(%)** | ***Enterococcus* spp. 5 (%)** | ***H. influenza* 2 (%)** |
| *PEN. | - | - | - | - | - | - | 5(50) | 3(60) | - |
| AMP. | 155(50) | - | 45(45) | 21(60) | 1(13) | 21(70) | 5(50) | - | 2(100) |
| CHLO | 40(12.9) | 100(50) | 42(42) | 10(29) | 1(13) | 24(80) | 6(60) | 2(40) | 2(100) |
| ERYTH. | - | 100(50) | - | - | - | - | 6(60) | 1(20) | 2(100) |
| GENT. | 248(80) | 160(80) | 49(49) | 23(65) | 4(50) | 24(80) | 7(70) | 4(80) | 2(100) |
| CIPRO. | 279(90) | - | 70(70) | 28(80) | 27(90) | 9(90) | 3(60) | 3(60) | 2(100) |
| CEFTR. | 279(90) | 160(80) | - | 21(60) | - | 27(90) | 8(80) | - | 2(100) |
| CEFTA. | 279(90) | - | 70(70) | - | 8(100) | -- | - | - | - |
| CEFU | - | 180(90) | 56(56) | - | - | 24(80) | 8(80) | 4(80) | 2(100) |
| CLAV+ AMOX. | 248(80) | 170(85) | 70(70) | 20(57) | 5(63) | 24(80) | 8(80) | 4(80) | 2(100) |
| CLIND. | - | 180(90) | - | - | - | - | - | - | - |
| COTR. | 155(50) | - | - | 16(45) | 1(13) | 17(55) | 4(40) | 1(20) | 1(50) |
| CLOX. | - | 140(70) | - | - | - | - | - | - | - |

*PEN=Penicillin; AMP=Ampicillin; CHLO=Chloramphenicol; ERYTH = Erythromycin; GENT = Gentamycin; CIPRO = Ciprofloxacin; CEFTR = Ceftriaxone; CEFT = Ceftazidime; CEFU = Cefuroxime; CLAV+ AMOX = Clavulinate+Amoxycillin; COTR = Cotrimoxazole; CLOX = Cloxacillin

***E. coli = Escherichia coli; S. aureus = Staphylococcus aureus; P. aeruginosa = Pseudomonas aeruginosa; S. pneumonia = Streptococcus pneumonia; H. influenza = Haemophilus influenza;* spp = species.

It was reported that there was a total of 69.3% of gram-negative bacteria isolation, with predominance of *E. coli* (44.3%) . Similarly, prevalence of gram–negative bacterial etiology of septicemia in children has been recorded by several other Nigeria authors (Martins et al., 2005; Iregbu et al., 2006) reporting from eastern Nigeria and central Nigeria, respectively. On the other hand, some Nigerian authors had recorded preponderance of *S. aureus* as bacterial cause of septicemia in neonates (Adeleke et al., 2006; Ako-Nai et al., 1999) reporting from northern Nigeria and western Nigeria, respectively. Thus, pre-dominance of either the gram- positive or gram-negative bacteria isolates is influenced by geographical location and changes in time.

Gentamycin, a relatively cheap and an easily available antibiotic, is 70.7% effective against the gram-negative bacilli (GNB) and 76.7% effective against the gram-positive cocci (GPC) in the study. This is similar to a study done in Calabar, claiming 80% effectiveness (Martins et al., 2005). Gentamycin is routinely used syner gistically with a beta-lactam antibiotic or vancomycin for empirical therapy in infective endocarditis (Madhu et al., 2002). Ciprofloxacin is 82.9% effective across all the bacterial isolates tested *in vitro* in the study. Ciprofloxacin is not routinely recommended for pediatric use except in special cases where the benefits out – weigh the short term risk of joint toxicity, such as in cystic fibrosis (Adolf, 2000).

The present study revealed that Ceftriaxone can be used as a drug of choice for empirical treatment of septicemia in children in Kano. Ceftriaxone is 81.4% effective across all the bacterial isolates tested *in vitro* in this study. This finding is similar to a previous work (Adeleke and Belonwu, 2006) done with Ceftriaxone having about 96.0% effectiveness across all tested bacterial isolates. Ceftriaxone, a third generation cephalosporin, is generally very well tolerated in children. Prolonged use of Ceftriaxone has been associated with the formation of gall-bladder sludge, which usually resolves after drug therapy is discontinued. The superior broad activity of this agent against enterobacteriacea has recently been challenged by Extended Spectrum Beta-lactamase enzyme (ESBL) plasmid mediated resistance as a consequence of point mutations in the TEM or SHV genes, representing a widening threat to the utility of these agents (Adolf, 2000).

A rational use of antibiotics especially in this tender age group in order to achieve a relative high level antibiotic activity against the offending bacterial organisms was recommended.

In conclusion, *E. coli* is the commonest bacterial isolate responsible for septicemia in all the pediatric groups. Finally, in the absence of antibiotic susceptibility report, Ceftriaxone should be considered as a first choice of reliable antibiotics for empirical treatment of septicemia in this age group in Kano community and environs.

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