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**ORIGINAL ARTICLE**

# Bacteremic Infants and Children in Basrah with Its Antibiotics Susceptibility

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**ABSTRACT**
*Bacteremia in infants and children is a life threatening emergency and any delay in treatment may result in death. Blood cultures are used to detect the pathogenic microorganisms in bacteremic patients. Therefore, this study was aimed to detect the different species of bacteria which cause bacteremia in infants and children, to determine the sources of infection and to determine the susceptibility of isolates to different antimicrobial drugs. Patients admitted to Basrah General Hospital were included in this study. Blood samples from 170 patients were collected during the period from January 2010 to March 2011. The patient's age, sex, and source of infection were recorded. Different samples of bacteremia were established according to the standard guidelines.Blood culture results from the 170 blood samples were obtained. The blood samples came from infants and children ranging in age from one day old to five years old. Of the 170 blood samples, 150 (88.2%) were positive for bacteremia and 20 (11.8%) showed no cultural growth. The 150 blood samples that were positive for bacteremia were further categorized according to the species of bacteria isolated from the samples. The most frequently isolates were Klebsiella pneumoniae (34.6%), Staphylococcus aureus (18%), Escherichia coli (17.3%), Staphylococcus epidermidis (14%) and Streptococcus viridans (4%). Klebsiella Pneumoniae showed the highest susceptibility to colistin sulphate (88.5%). Staphylococcus aureus and Escherichia coli showed the highest susceptibility to gentamycin with percentages of 88.9% and 80.8% respectively. Miscellaneous sites (36.7%), the gastro-intestinal tract (GIT) (32%), and respiratory tract (22%) were the main sources of infection.Several Gram-negative and Gram-positive species of bacteria were isolated as the causes of bacteremia. The GIT was the main source of infection. Although many of the bacteria showed high antimicrobial resistance, colistin sulphate showed effectiveness against Gram-negative bacteria and ampicillin and gentamycin showed effectiveness against Gram-positive bacteria.*
***Keywords**: Bacteremia, Infant, antimicrobial*

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## INTRODUCTION

Bacteremia is a common problem in infants and young children and it is a common reason for their hospitalization [1]. Bacteremia represents a risk to children because it may lead to focal infections, including meningitis. Though this likely occurs less frequently with *Streptococcus pneumoniae* than with other organisms causing bacteremia, meningitis carries a risk of permanent neurologic sequelae. A positive blood culture in a bacteremic patient can likely improve care by quickly mandating follow-up and further investigations [2].

Diagnosis of sepsis in infants and children is difficult. Knowledge of pathogens causing infections in young infants is essential for designing community-based management strategies [3]. Septicemia is a common cause of morbidity and mortality in neonates and children. Numerous risk factors have been identified both in the neonates and children that make them susceptible to infections [4]. Blood cultures are frequently obtained from infants and children to determine the bacterial etiology of focal infections or to document bacteremia in pediatric patients with fevers and suspected sepsis [5]. Detailed studies on the etiology and antibiotic resistance of infants and children with bacteremia in Basrah are unavailable. Therefore, this study was carried out in Basrah, in the south of Iraq. The objectives of this study were to detect the different species of bacteria that cause bacteremia in infants and children, to determine the sources of infection and to determine the susceptibility of isolates to different antimicrobial drugs.

## PATIENTS AND METHODS

This cross-sectional study involved 170 pediatric patients (neonates, infants and children) admitted to Basrah General Hospital between January 2010 and March 2011. The patients included in this study were those with symptoms suggestive of bacteremia and who were not on antibiotic therapies. Signs and symptoms of sepsis included: temperature instability, feeding difficulties, respiratory distress, jaundice, convulsions, and autonomic disturbances. Verbal consent from their parents was obtained. The patient's age, sex, and source of infection were recorded besides to the miscellaneous source such as (multi-abscess, catheter sites, etc) .Tissue sources of bacteremia were established according to the guidelines mentioned by Setia et al., and Fineglod and Baron [6,7]. Blood cultures were obtained by veni-puncture following skin disinfection with an iodine compound. Four milliliters of blood were obtained. Two milliliters were inoculated immediately into 10 ml of brain heart infusion broth and two milliliters were inoculated into 10 ml of thioglycollate liquid medium for anaerobic incubation. The blood culture bottles were initially subcultured on one chocolate agar, two blood agar plates and two MacConkey agar plates after 24 hours of incubation at 37°C. One blood agar and one MacConkey were incubated aerobically and the other media incubated into 5-10% $CO_2$.

After 24 hours of incubation, the positive cultures (i.e., showed growth) were examined and the negative cultures (i.e., showed no growth) were further incubated for 72 hours [7,8]. Identification of bacterial isolates was based on Gram reaction, colonial morphology, biochemical tests and some special treatment of identification methods according to Finegold and Baron; Lennette et al. [7, 9]. The Kirby-Bauer disc diffusion method was used to test the antimicrobial susceptibility of the bacterial isolates. The guidelines of the Clinical and Laboratory Standards Institute were used to categorize the bacterial isolates as resistant, intermediate susceptible, or susceptible to the antimicrobials [10].

**Statistical analysis:**

Statistical analysis was done using Microsoft Excel 2007 and its graphic program software. ANOVA, single factor using Microsoft Excel 2007 was used for analysis of different parameters. A difference was considered significant when the *P* value was less than or equal to 0.05.

## RESULTS

Isolation of bacteria and age groups:

Between January 2010 and March 2011, a total of 170 blood cultures were examined for the presence of bacteria. Of these, 150 cultures (88.2%) were positive (i.e., showed growth), and 20 cultures (11.8%) were negative (i.e., showed no growth) (Table 1, Table 2). Among the positive cultures, the following bacterial species were detected, *K. pneumoniae* (34.6%), *Staph. aureus* (18.0%), *E. coli* (17.3%), *Staph. epidermidis* (14.0%), *St. viridans* (4.0%), *Ps. aeruginosa* (2.7%), *Salm. typhi* (2.7%), *St. faecalis* (2.0%), *St. agalactiae* (2.0%), *Candida albicanis* (1.3%), *St. pneumoniae* (0.7%) and *Proteus spp*. (0.7%). Distribution of bacteremia according to age groups is shown in (Table 2), of these 150 positive blood cultures; 84 (56%) was grouped from first day of birth to 28 day and 46 (31%) from day 29 to 12 months and 20 (13%) from 12 months to 5 year of age respectively.

Table 3 shows the distribution of organisms in relation to the source of infection. Gastro-intestinal tract (GIT) (32.0%), the respiratory tract (22.0%) and miscellaneous sites (36.7%) were the main source of infection among the positive cultures. Analysis by ANOVA single factor resulted in significant differences between sources of infection variables (*P*-value 0.02). In comparison, Table 4 has shown the profile of bacteremia in relation to different age groups and the source of infection. Although patients in the age group ranging from one day old to 28 day old were more susceptible to bacteremia infection through the GIT, miscellaneous and respiratory tract entry compared to patients in the age groups ranging from one year old to five years old. There were no significant differences showed by analysis of data using ANOVA single factor test and the *p*-value was (0.15).

Antimicrobial Susceptibility:

Bacterial isolates were tested to characterize their susceptibility to different antimicrobial agents. Gram-negative bacteria were more susceptible to colistin sulphate, gentamycin, chloramphenicol and carbanicillin. Gram-positive bacteria were more susceptible to gentamycin, chloramphenicol, ampiclox, ampicillin and carbenicillin (Table 5). *K. Pneumonia*, which represented 34.6% of isolates, had higher susceptibility to colistin sulphate (88.5%) and lower susceptibility to Ampicillin and cloxacillin (1.9%). *Staph. aureus,* which represented 18.0% of isolates, had higher susceptibility to gentamycin (88.9%) and to ampicillin (81.5%). It had lower susceptibility to colistin sulphate (7.4%). *E. coli* was highly susceptible to gentamycin (80.8%) and colistin sulphate (69.2%). It was less susceptible to ampicillin (3.8%) and ampiclox (3.8%) (Table 5).

Table 1: Frequency of organisms causing bacteremia

| Organisms | No. of isolates | Percentage |
|---|---|---|
| Gram-positive bacteria | | |
| *Staphylococcus aureus* | 27 | 18.0 |
| *Staphylococcus epidermidis* | 21 | 14.0 |
| *Streptococcus viridians* | 6 | 4.0 |
| *Streptococcus faecalis* | 3 | 2.0 |
| *Streptococcus agalactiae* | 3 | 2.0 |
| *Streptococcus pneumoniae* | 1 | 0.7 |
| Gram-negative bacteria | | |
| *Klebsiella pneumoniae* | 52 | 34.6 |
| *Escherichia coli* | 26 | 17.3 |
| *Pseudomonas aeruginosa* | 4 | 2.7 |
| *Salmonella typhi* | 4 | 2.7 |
| *Proteus SPP.* | 1 | 0.7 |
| Yeast | | |
| *Candida albicanis* | 2 | 1.3 |
| Total | 150 | 88.2 |
| Total cultures with no isolates | 20 | 11.8 |
| Total examined | 170 | 100% |

Table 2. Distribution of bacteremia according to age groups.

| Variable | Age | | | Total |
|---|---|---|---|---|
| | From birth to ≤ day 28 | Day 29 to ≤ 12 months | >12 months | |
| Number of patient | 93 | 53 | 24 | 170 |
| +ve blood culture | 84 (56%) | 46 (31%) | 20 (13%) | 150 (88.2%) |
| -ve blood culture | 9 (45%) | 7 (35%) | 4 (20%) | 20 (11.8%) |

Table 3: Distribution of organisms in relation to the sources of infection

| Organisms | Total | Sources of infection | | | | | |
|---|---|---|---|---|---|---|---|
| | | Skin (No.%) | Umbilicus (No.%) | Respiratory tract (No.%) | GIT (No.%) | Miscellaneous site (No.%) | Urinary tract (No.%) |
| Gram- positive | | | | | | | |
| bacteria | 27 | 6(22.22) | 0(0.0) | 8(29.63) | 3(11.11) | 10(37.04) | 0(0.0) |
| *Staph. aureus* | 21 | 1(4.76) | 0(0.0) | 5(23.81) | 9(42.86) | 6(28.57) | 0(0.0) |
| *Staph. epidermidis* | 6 | 0(0.0) | 0(0.0) | 1(16.67) | 5(83.33) | 0(0.0) | 0(0.0) |
| *St. Viridians* | 3 | 0(0.0) | 0(0.0) | 0(0.0) | 3(100.0) | 0(0.0) | 0(0.0) |
| *St. faecalis* | 3 | 0(0.0) | 0(0.0) | 0(0.0) | 3(100.0) | 0(0.0) | 0(0.0) |
| *St. agalactiae* | 1 | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 1(100.0) | 0(0.0) |
| *St. pneumonia* | | | | | | | |
| Gram-Negative | 52 | 0(0.0) | 0(0.0) | 19(36.54) | 9(17.31) | 24(46.15) | 0(0.0) |
| bacteria | 26 | 1(3.85) | 1(3.85) | 0(0.0) | 12(46.15) | 12(46.15) | 0(0.0) |
| *K. pneumonia* | 4 | 1(25.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 3(75.0) |
| *E. coli* | 4 | 0(0.0) | 0(0.0) | 0(0.0) | 4(100.0) | 0(0.0) | 0(0.0) |
| *Ps. aeruginosa* | 1 | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 1(100.0) | 0(0.0) |
| *Salm. typhi* | | | | | | | |
| *Proteus SPP.* | 2 | 0(0.0) | 1(50.0) | 0(0.0) | 0(0.0) | 1(50.0) | 0(0.0) |
| Yeast | | | | | | | |
| *Cand. albicanis* | | | | | | | |

Significant difference and *P*-Value was (0.02)

Table 4. Site of isolates in relation to age of patients.

| Variable | From birth to ≤ day 28 | Day 29 to ≤ 12 months | 12 months and above | Total % |
|---|---|---|---|---|
| GIT | 27 | 15 | 6 | 48 32% |
| RTI | 18 | 10 | 5 | 33 22% |
| Skin | 5 | 3 | 1 | 9 |

| | | | | |
|---|---|---|---|---|
| | | | | 6% |
| UTI | 2 | 0 | 1 | 3<br>2% |
| Umbilicus | 1 | 1 | 0 | 2<br>1.3% |
| Miscellaneous | 31 | 17 | 7 | 55<br>36.7% |
| Total | 84 | 46 | 20 | 150 |

Significant difference and *P*-Value was (0.15)

Table 5: Susceptibility of bacterial isolates to antimicrobial agents

| Organisms | Total | No. of isolates susceptible to (%) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (CT)* | (C)* | (AMP)* | (AX)* | (GM)* | (CL)* | CB)* | (OB)* | (E)* | (PG)* | (CS)* |
| *K. pneumonia* | 52 | 46 (88.5) | 19 (36.5) | 1 (1.9) | 2 (3.8) | 35 (67.3) | 9 (17.3) | 12 (23.0) | 1 (1.9) | 8 (15.4) | 0 (0.0) | 11 (21.1) |
| *Staph. aureus* | 27 | 2 (7.4) | 18 (66.7) | 22 (81.5) | 20 (74.1) | 24 (88.9) | 14 (51.8) | 16 (59.2) | 5 (18.5) | 6 (22.2) | 6 (22.2) | 6 (22.2) |
| *E. coli* | 26 | 18 (69.2) | 8 (30.8) | 1 (3.8) | 1 (3.8) | 21 (80.8) | 2 (7.7) | 10 (38.5) | 4 (15.4) | 3 (11.5) | 0 (0.0) | 6 (23.1) |
| *Staph. epidermidis* | 21 | 3 (14.3) | 9 (42.8) | 5 (23.8) | 5 (23.8) | 15 (71.4) | 5 (23.8) | 12 (57.1) | 6 (28.6) | 8 (38.1) | 3 (14.3) | 2 (9.5) |
| *Strep. Viridians* | 6 | N** | 4 (66.6) | 3 (50.0) | 1 (20.0) | 3 (50.0) | N | 5 (83.3) | 1 (20.0) | 4 (66.6) | 4 (66.6) | 1 (20.0) |
| *Ps. aeruginosa* | 4 | 4 (100.0) | 2 (50.0) | 2 (50.0) | N | 0 (0.0) | N | 2 (50.0) | N | 0 (0.0) | 0 (0.0) | 4 (100) |
| *Salm. typhi* | 4 | N | 4 (100.0) | 0 (0.0) | N | 4 (100.0) | N | 0 (0.0) | N | N | 1 (25.0) | N |
| *St. faecalis* | 3 | 0 (0.0) | 2 (66.7) | 2 (66.7) | 2 (66.7) | 1 (33.3) | 0 (0.0) | 1 (33.3) | 1 (33.3) | 2 (66.7) | 1 (33.3) | N |
| *St. agalactiae* | 3 | N | 3 (100.0) | 0 (0.0) | N | 3 (100.0) | N | 3 (100) | N | 3 (100) | 3 (100) | N |
| *St. pneumonia* | 1 | N | 1 (100.0) | 1 (100.0) | 0 (0.0) | 1 (100.0) | 0 (0.0) | N | 0 (0.0) | 1 (100) | 1 (100) | N |
| *Proteus SPP.* | 1 | 1 (100.0) | 1 (100.0) | 0 (0.0) | 0 (0.0) | 1 (100.0) | 1 (100.0) | N | N | N | N | 1 (100) |
| Total | 148 | 74 (50.0) | 71 (47.9) | 37 (25.0) | 31 (20.9) | 108 (72.9) | 31 (20.9) | 61 (41.2) | 18 (12.1) | 35 (23.6) | 19 (12.8) | 31 (20.9) |

*(CT) colistin sulphate, (C) Chloramphenicol, (AMP) Ampicillin, (AX) Ampiclox, (GM) Gentamycin, (CL) Cephalexin, (CB) Carbenicillin, (OB) Cloxacillin, (E) Erythromycin, (PG) Penicillin, (CS) Cefotoxime sodium. **N= Not done

## DISCUSSION

The objective of this study was to isolate clinically important pathogens from bacteremic infants and children. Blood culturing is the most important investigative procedure for the management of sepsis. In this study, we processed a total of 170 blood cultures, 150 (88.2%) were positive and 20 (11.8%) showed no growth. Gram-negative septicemia was encountered in 59.3% of the culture positive cases. The results of this study showed that Gram-negative infections (59.3%) were more prevalent than Gram-positive infections (40.7%). This finding is consistent with previous reports [11-14]. The other blood cultures which were reported as negative for bacterial growth might be due to several reasons, like administration of antibiotics before blood collection, anaerobic bacteraemia or viral infections.

The rate of septicaemia was more frequent in neonate with a percentage (56%) and that might be due to associated problems such as low birth weight, neonatal jaundice and respiratory distress which were less frequently seen in infant and children [13].

In contrast to prior studies [5], we considered the growth of *Staphylococcus epidermidis* to be indicative of its presence in the patient as opposed to being a contaminant. This organism has been increasingly recognized as an important pathogen in infants and children [15-17].

Different tissues can be sources of bacteremia. Other researches had identified the urinary tract and the lungs as the most common sources of bacteremia in elderly patients [4,6]. In general it had been considered that the genitourinary tract, respiratory tract, miscellaneous sites, abscesses and gastro-intestinal tract were the most common portals of entry for bacteremia[7, 9]. This study showed that the miscellaneous sites (36.7%) and gastro-intestinal tract (32%) was the main source of bacteremia followed by and the respiratory tract (22%) .These findings were in agreement with criteria and results mentioned by Denise et. al. [18]. Although Gomez et al. [19] has reported that the urinary tract might be a source of bacteremia in infants; this may be because their study focused on the isolation of *E. coli* from urine cultures and blood cultures. It was noticed that the age group category from one day old to one year old showed a higher prevalence of bacteremia than the other age group category. These findings may be because premature, low-birth-weight infants are more susceptible to infection than full-term infants with a normal birth weight [20]. Also, premature infants staying in the hospital may be exposed to more infectious materials than full-term infants who did not have to stay in the hospital as long [21]. A maternally spread organisms or transmission by unhygienic practices in health facilities or at home might be another exposed [21].

It is a life-threatening emergency when infants and children have bacteremia and any delay in treatment may result in their death [22]. In this study, we tried to understand the distribution of antimicrobial resistance for bacterial isolates. Gram-negative bacteria were more susceptible to colistin sulphate, gentamycin, chloramphenicol and carbenicillin. The Gram-positive bacteria were more susceptible to gentamycin, chloramphenicol, ampiclox, ampicillin and carbenicillin. The most frequently isolated pathogen (i.e., *K. pneumonia,* which represented 34.6% of the total isolates) had a higher susceptibility to colistin sulphate (88.5%) and gentamycin (67.3%). It had a lower susceptibility to ampicillin (1.9%), cloxacillin (1.9%), and ampiclox (3.8%). These findings were in agreement with Viswanathan et al [14]. *Staph. aureus* represented 18.0% of the total isolates and had a higher susceptibility to gentamycin (88.9%), ampicillin (81.5%), ampiclox (74.1%) and chloramphenicol (66.7%). It had a lower susceptibility to colistin sulphate (7.4%). *E. coli* had a higher susceptibility to gentamycin (80.8%) and colistin sulphate (69.2%). It had a lower susceptible to ampicillin (3.8%), ampiclox (3.8%) and cephaloxin (7.7%). These results were in agreement with other reports [14,21].

In conclusion, this study has attempted to give a better idea about the most causative agents of bacteremia in neonates and children. This study has shown that *K. pneumoniae*, *Staph. aureus*, *E. coli*, *Staph. epidermidis*, and *St. viridans* were the major causes of infection. Also, we identified that the source of infection can be through the miscellaneous, gastro-intestinal tract sites and the respiratory tract. The miscellaneous was the most common source of infection. Also, we observed a high degree of antimicrobial resistance which calls for an urgent evaluation and development of antimicrobial agents.

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