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Age-Specific Bacteriological Profile of Pediatric Septicemia; A Population- Based Study

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Abstract

Background

Septicemia is a life-threatening condition particularly among pediatric population. Early initiating a proper empiric antimicrobial treatment prior to definite isolation of the pathogen through blood culture has pivotal role in reducing further mortality and morbidity. The aim of this study was to evaluate the epidemiological properties of a distinct Iranian population by patients' age and gender throughout the year.

Materials and Methods

As a retrospective study between March 2013 and March 2017, all consecutive patients referred to the Hazrat Masumeh hospital of Qom-Iran with suspicious of septicemia were reviewed. Patients with prior history of antibiotic consumption as well as patients over 6 years of age were excluded; incomplete hospital records were also excluded from further evaluations. Prespecified data-extraction forms were used to collect data including characteristics of patients and the results of antibiogram.

Results

Total of 378 patients were enrolled in this study and 200 of them were boys (52.91%). Escherichia coli (11.6%) and Klebsiella (9.5%) were the most common isolated pathogens (Gram-negative) after coagulase-negatives. *Escherichia coli*, *Citrobacter* (Gram-negative), and *Staph. Aureus* (Gram-positive) were the most common pathogens among age group of 0-1 year. Winter had the greatest outbreak of bacteremia (29.1%) and the autumn had the least incidence (21.4%). The least and the most antimicrobial resistance were associated with Imipenem (1.8%) and Ampicillin (78.78%), respectively.

Conclusion

Escherichia coli and Klebsiella were the most common isolated bacteria in patients suspected to bacteremia in our region. Imipenem and Ampicillin had the least and the most antimicrobial resistance in our population, respectively.

Key Words: Antimicrobial drug resistance, Blood culture, Children, Iran, Septicemia.

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1- INTRODUCTION

Septicemia is a sever disease which can be, particularly in pediatric population, a life-threatening condition (1). In this context, detecting the involved microorganisms through patients' blood stream would be of great diagnostic values (2). Blood culture is a laboratory test of choice which provides outstanding information in this regard. Nevertheless, this approach deals with an impediment of being time-consuming procedure as well as the probability of observing false results due to blood contamination (2). Epidemiological studies, therefore, have a pivotal role to help clinicians in making decision on individual patients by providing impressive information by which an empiric treatment is established (3). Support this statement, epidemiological studies around the world proposed various bacteriological profile with particular antimicrobial resistance (3, 4). Thus, in this study, we aimed to reconsider the population-based information on pediatric blood cultures and their antibiogram yielded from patients suspected to septicemia throughout the year by season, patients' age and gender.

2- MATERIALS AND METHODS

2-1. Study design and population

Between March 2013 and March 2017 in HazratMasumeh hospital of Qom city-Iran, hospital records of all consecutive patients suspected to bacteremia, for whom blood culture had carried out, were reviewed in the form of a retrospective study. Data on patients' demographic and laboratory results including blood culture and the results of antibiogram were extracted by seasonal time series, patients' age and gender.

2-2. Measuring tools

An antibiogram is the result of an antibiotic sensitivity test. Microbiological procedures were performed using standard guidelines (5). Briefly, blood samples were collected by experienced medical staffs and immediately were sent to the laboratory. Then samples were inoculated into brain heart infusion (BHI) medium. After that, the medium was diluted 1:10 and was incubated an overnight. Eventually, samples were cultured onto blood agar. Samples were considered contaminated if either *Staphylococcus (Staph.) Epidermidis*, *Staph. Saprophyticus*, coagulase-negative *Staphylococci*, mix or yeast growth as well as gram positive or negative inconsistent with patients' symptoms was seen.

2-3. Ethical consideration

Local ethical committee approved and supervised the study proposal. Patients' information was kept confidential to consent with the principle of anonymity.

2-4. Exclusion criteria

Patients with a history of receiving antibiotics through a week prior to admission as well as patients over 6 years of age were excluded from the study. Furthermore, hospital records with incomplete data were excluded from further investigations.

2-5. Statistical analysis

Collected data were analyzed using SPSS version 24.0 for windows (SPSS INC., Chicago, IL). Significance level of < 0.05 was considered.

3- RESULTS

A total of 378 patients in various age groups were enrolled in this retrospective study. Participants were categorized in different age groups of neonate (n=109, 28.83%), 0-1 year (n=107, 28.3%) for age spectrum of neonate to one year, 1-2 years (n=76, 20.1%), 2-3 years (n=51, 13.49%), 3-4 years (n=13, 3.43%), 4-5 years (n=13, 3.43%), and 5-6 years (n=9, 2.38%). Two-hundred patients were boys (52.91%) and

178 were girls (47.08%) (**Figure.1**). Microbiological results indicated that the frequency of isolated bacteria in order from highest include *Staphylococcus (Staph.) Epidermidis* (35.4%, Gram-positive), *Staph. Saprophyticus* (14.8%, Gram-positive), *Escerichia coli* (11.6%, Gram-negative), *Klebsiella* (9.5%, Gram-negative), *Pseudomonas* (4.5%, Gram-negative), and *Staph. Aureus* (2.9%, Gram-positive), the most common of which were *Escherichia coli*, and *Klebsiella* after excluding coagulase-negatives (**Figure.2**).

Analysis for age-specific distribution of cultured bacteria showed that the most commonly isolated bacteria in neonates were *Escerichia coli* and *Klebsiella*, after coagulase-negatives; among age group of 0-1 year, *Escerichia coli*, *Citrobacter* (Gram-negative), and *Staph. Aureus* were the most common and in age group of 1-2 years, *Pseudomonas* and *Klebsiella* species were the most commonly cultured bacteria (**Table.1**). Seasonal variations also witnessed in distribution of pathogens (**Table.2**). Accordingly, winter was recognized as the time of the most referring of patients with bacteremia (29.1%) and the autumn was recognized as the least (21.4%) ($P < 0.05$). It was also witnessed that through the summer, *Escerichia coli* and *Pseudomonas* were the most common pathogens; while *Klebsiella* and *Serachia* were the most common during winter ($P<0.05$). *Staph. Aureus* had the same incidence rate throughout the year ($P>0.05$).

According to antibiogram evaluations, 26 resistances out of 135 cases (19.25%) were recorded for Ceftazidime. Although, resistance rate of Ceftriaxone, vancomycin, Imipenem, Gentamicin, ampicillin and Cefotaxime were recorded 15.56%, 38.32%, 1.8%, 13.33%, 78.78%, and 10.24, respectively (**Figure.3**).

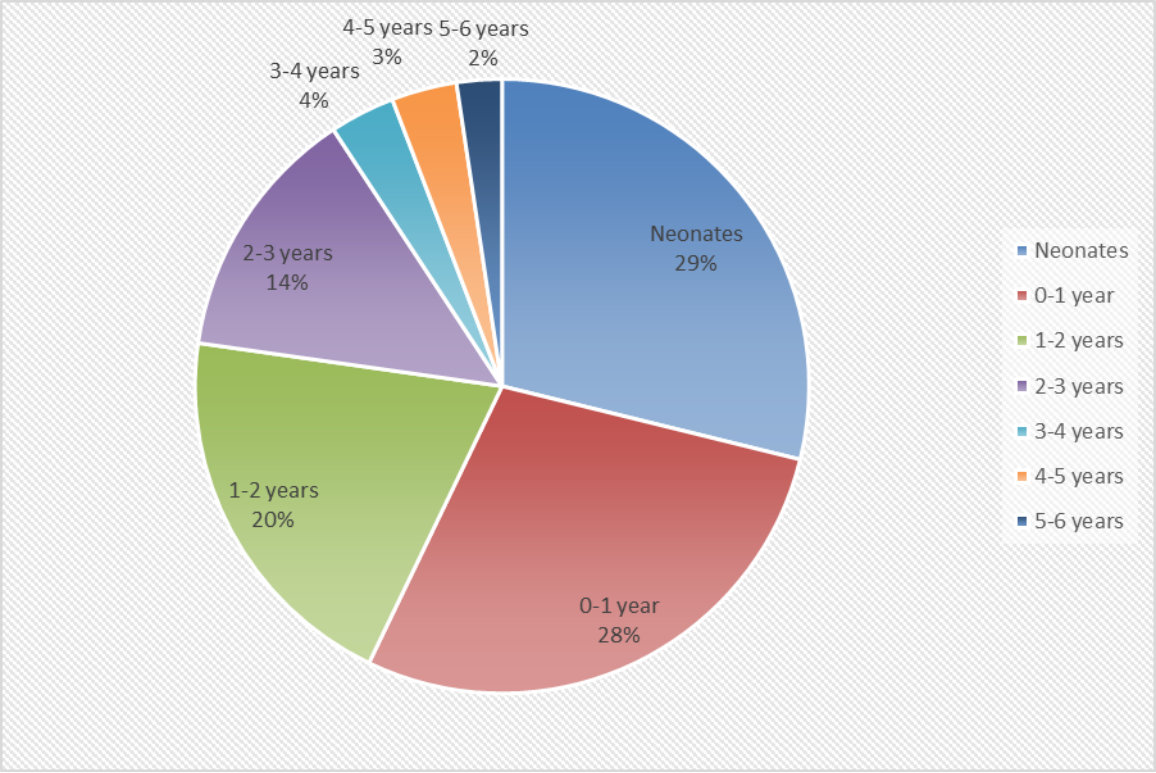

Fig.1: Age distribution of the patients.

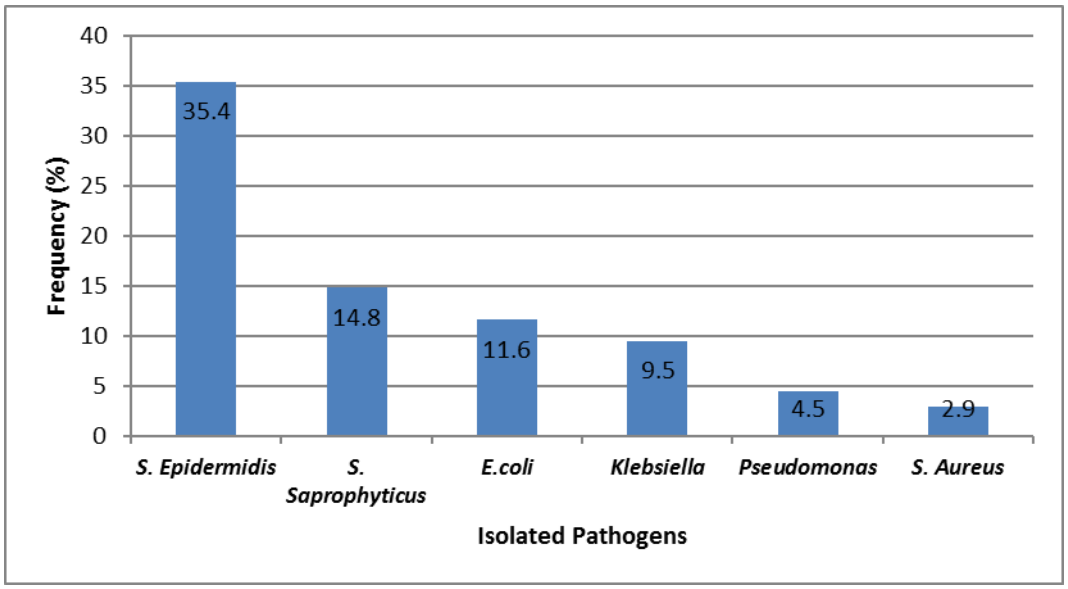

Fig.2: Microbiological results indicative of frequency of isolated pathogens.

Table-1: Age-specific distribution of isolated pathogens

Bacteria	Age group (year)						
	Neonates	0-1	1-2	2-3	3-4	4-5	5-6
S. Epidermidis	55	43	19	10	2	3	2
S. Saprophyticus	22	18	14	1	1	0	0
E.coli	10	14	10	3	2	3	2
Klebsiella	6	10	14	1	2	2	1
S. Aureus	1	5	3	1	1	0	0
Pseudomonas	2	6	7	0	0	1	1
Citrobacter	0	6	2	1	0	1	0
Other	13	5	7	34	5	3	3

S.: Staphylococcus.

Table-2: Seasonal variation in isolated pathogens

Bacteria	Season			
	Spring	Summer	Autumn	Winter
S. Epidermidis	28	35	37	34
S.Aureus	2	3	3	3
E. Coli	9	14	9	12
Klebsiella	8	9	2	17
Citrobacter	1	4	0	5
Pseudomonas	2	7	3	5
Serachia	2	2	2	4
Other	32	29	25	30

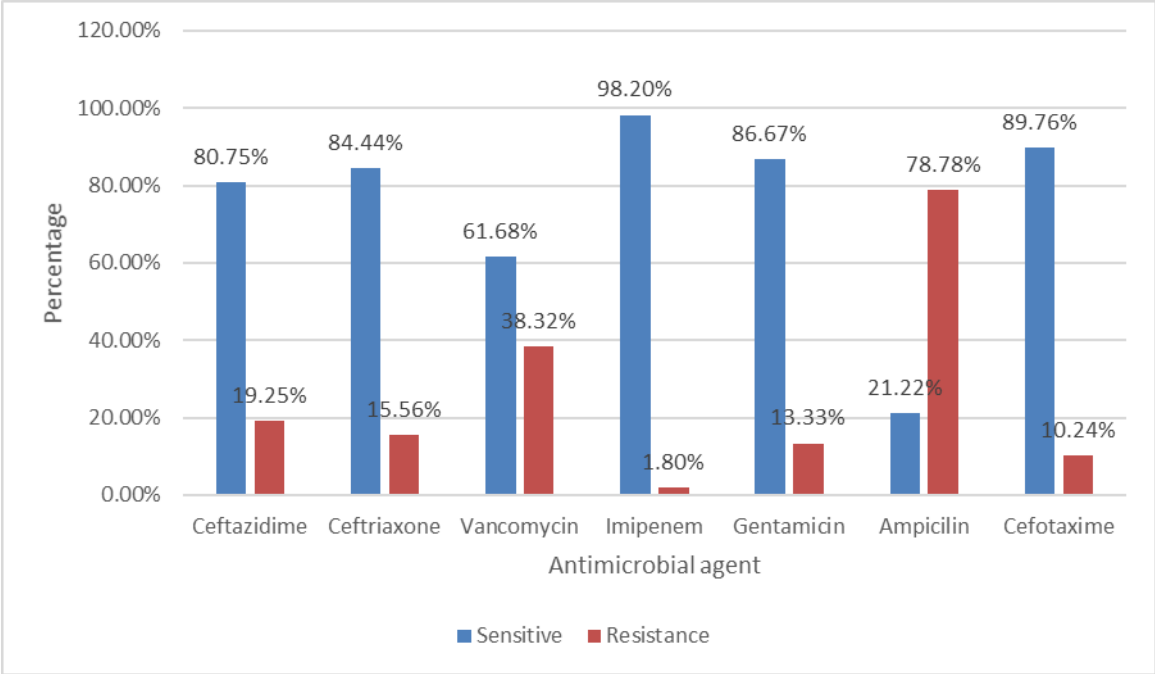

Fig.3: Comparison of the antibiogram sensitive and resistance of the antimicrobial agent.

4- DISCUSSION

Septicemia in pediatric population is a serious clinical syndrome with potentially high mortality and morbidity rate if undetected timely (2). Thus, initiating an empirical therapy would be a reasonable approach running into this condition. Epidemiological study, therefore, is inevitable to find the bacteriological distribution and antimicrobial resistance of any region and any time.

In this study, we found that *E.coli* and *Klebsiella* are, overall, the most common pathogens after coagulase-negative bacteria, notwithstanding the *E.coli*, *Citrobacter* and *Staph. Aureus* for 0-1 year-old infants as well as *Pseudomonas* and *Klebsiella* for 1-2 year-old patients were the most bacterial species identified in our series. Weinstein et al. (6), also reported *Staph. Aureus*, *E.coli*, coagulase-negative *Staphylococci*, *Klebsiella* and *Enterococcus* species, as the five most common pathogens. In another study conducted in Bangladesh (3), Gram-positive bacteria were reported to be the most common species with *Salmonella Typhi* as the most frequently isolated organism (36.9%). On the other hand, another study from Northern Tanzania (4), reported Gram-negative bacteria as the most common isolated organisms which include *Proteus Spp* (12.7%), *E.coli* (11.7%), *Pseudomonas spp*. (10.6%) and *Klebsiella* (10.1%).

In another study (7), *Staph. Aureus* (29.03%), *Klebsiella* (14.83%), *Acinetobacter* (9.74%), and *E.coli* (9.68%) were the most frequent isolated bacterial species.Boskabadi et al. (8), reported that the most commonly isolated pathogens in North East of Iran were Gram-negative bacteria (55%), coagulase-negative *Staphylococci* (35%) and Gram-positive bacteria (10%). Larru et al. (9), conducted a retrospective study on hospitalized children with bacteremia and reported that Gram-positive bacteria (72%) were the most common cause of blood stream infection followed by Gram-negative spp. (22%).

Moreover, in this study, we evaluated the results obtained from antibiogramsand reviewed patients' records in this regard. Accordingly, we found that the least and the most antimicrobial resistance was associated with Imipenem (1.8%) and Ampicillin (78.78%), respectively. Reported data from Tanzania (4) also mentioned high resistance rate for Ampicillin (92.3% for *Klebsiella* and 68.4% for *E.coli*). Consequently, combination therapy or taking high therapeutic dose of Ampicillin is strongly recommended.

In this study, it is witnessed that regarding Ceftazidime, as a 3rd generation Cephalosporin, there were 26 resistance out of 135 cases (19.25%) which is higher than previously reported data (9), and obviously is lower than another study in which a rate of 37.4% is reported (4). Ceftriaxone is another 3rd generation Cephalosporin, which is associated with 15.56% resistance rate (n=40) in our series. In this regard also, our resistance rate is much lower than that of previously reported (51.8%) (4). Vancomycin is found to be associated with 38.32% (n=64) resistance rate in our population. Nevertheless, resistance rate of 0-2.33% are reported in the literature (4, 7).

Another study from India (10), reported 100% resistance rate for Ciprofloxacin and no resistance for Gentamicin, Rifampin and Teicoplanin. Teicoplanin is a glycoside antibiotic similar to vancomycin which is effective against Gram-positive microorganisms (11). However, this medication is out of our use, so that we have had no experience with that.Imipenem is a Carbapenem antibiotic similar to Meropenem which is more effective against Gram-possitivecocci and less effective against Gram-negative bacilli (12). As mentioned above, Imipenem is the most sensitive antimicrobial agent in our series with a resistance rate of 1.8%. nevertheless, another study reported higher resistance rate of 8.7% (7).

4-1. Limitations of the study

The strength of our study is to evaluate patients with various age groups and in different times of the year to find any potential seasonal variations. However, common to each retrospective study, our study may also be restricted in terms of data collection from hospital records as well as incorrect recorded information.

5- CONCLUSION

As demonstrated from various studies in different regions, bacteriological profile and antimicrobial sensitivity of septicemia pathogens differ by region and time of the year as well as patients' characteristics such as age and gender. Given the significance of septicemia among pediatric and neonatal populations, initiating an empiric antimicrobial treatment based on regional and timely epidemiology is recommended until individual blood culture and antibiogram is prepared.

6- CONFLICT OF INTEREST: None.

7- REFERENCES

1. Dapaah-Siakwan F, Mehra S, Lodhi S, Mikhno A, Cameron G. White Cell Indices and CRP: Predictors of Meningitis in Neonatal Sepsis? International Journal of Pediatrics 2016;4(2):1355-64.

2. Wani K, Gattoo I, Ahmed K, Qadir W. Role of blood culture in critically sick paediatric patients and its clinical impact: a tertiary care hospital based study. International Journal of Research in Medical Sciences 2017;3(8):1863-7.

3. Ahmed D, Nahid MA, Sami AB, Halim F, Akter N, Sadique T, et al. Bacterial etiology of bloodstream infections and antimicrobial resistance in Dhaka, Bangladesh, 2005–2014. Antimicrobial Resistance & Infection Control 2017;6(1):2.

4. Cockerill FR. Performance standards for antimicrobial susceptibility testing: twenty-

first informational supplement: Clinical and Laboratory Standards Institute (CLSI); 2011. Available at: http://vchmedical.ajums.ac.ir/_vchmedical/documents/CLSI%202011.pdf

5. Weinstein MP, Towns ML, Quartey SM, Mirrett S, Reimer LG, Parmigiani G, et al. The clinical significance of positive blood cultures in the 1990s: a prospective comprehensive evaluation of the microbiology, epidemiology, and outcome of bacteremia and fungemia in adults. Clinical Infectious Diseases 1997;24(4):584-602.

6. Kumburu HH, Sonda T, Mmbaga BT, Alifrangis M, Lund O, Kibiki G, et al. Patterns of infections, aetiological agents, and antimicrobial resistance at a tertiary care hospital in Northern Tanzania. Tropical Medicine and International Health. 2017.

7. Sultana Q, Ansari H, Ansari M. Bacteriological profile and antimicrobial susceptibility patterns of organisms responsible for blood stream infections. Indian Journal of Microbiology Research 2016;3(2):113-7.

8. Boskabadi H, Maamouri G, Akhodian J, Zakerihamidi M, Seyedi SJ, Ghazvini K, et al. Neonatal Infections: a 5-Year Analysis in a Neonatal Care Unit in North East of Iran. International Journal of Pediatrics 2016;4(12):3989-98.

9. Larru B, Gong W, Vendetti N, Sullivan KV, Localio R, Zaoutis TE, et al. Bloodstream infections in hospitalized children: epidemiology and antimicrobial susceptibilities. The Pediatric infectious disease journal 2016;35(5):507-10.

10. Venkatesh V, Kotian S. Bacteriological profile and antimicrobial resistance of blood culture isolates among paediatric patients from tertiary care hospital. Journal of International Medicine and Dentistry 2016;3(2):80-7.

11. Pacifici GM. Clinical Pharmacology of Teicoplanin in Neonates: Effects and Pharmacokinetics. International Journal of Pediatrics 2016;4(10):3669-84.

12. Pacifici GM. Clinical Pharmacology of Meropenem in Neonates: Effects and Pharmacokinetics. International Journal of Pediatrics 2016;4(11):3925-39.