Prevalence of Enterococci Infection in Blood Cultures Based on Age Group at Makerere University Clinical Microbiology Laboratory. A Cross-Sectional Study.

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Abstract

Background:

Aminoglycoside resistance has been of great concern since it eliminates the synergy of aminoglycosides with beta-lactam antibiotics, which is the therapy of choice for most enterococcal infections and can limit the therapeutic options for clinicians. Although enterococci are not virulent as other gram-positive bacteria, they are multidrug-resistant which restricts the clinician's options for treatment of the enterococcal infections. The objective of this study is to determine the Prevalence of Enterococci Infection in Blood Cultures Based on Age Group at Makerere University Clinical Microbiology Laboratory.

Methodology:

The study was a retrospective cross-sectional study on the evaluation of high-level aminoglycoside resistance of enterococcal isolates in blood culture at MUCML between January 2017 and December 2020.

Results:

The prevalence of enterococcal species was 6.07%, from these 66.67% were found to be among children between 0 and 5 years of age. A total number of 2176 were positive blood cultures between the year 2017 to 20202 at Makerere University Clinical Microbiology Laboratory. Of these 132 blood cultures were Enterococci positive with a percentage prevalence of 6.07%. The most prevalent organism was Coagulase-negative staphylococci with a total number of 667 (30.65%) organisms and the least prevalent was Proteus Mirabilis with a total number of 4 (0.18%).

Conclusion:

The study found that ages between 0 to 5 years had the highest incidence of enterococcal infections and the occurrence of these infections increased with the years.

Recommendation:

Since the highest infections occurred between the ages 0 to 5 years, this showed that the infection was nosocomial and hence doctors should adhere to infection prevention and control protocols when handling patients.

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1. Background of the study

Enterococcus is Gram-positive bacteria and a constituent of the human and Animal

Gastrointestinal tract microflora with most strains being commensal but sections are human pathogens(Guzman Prieto et al., 2016). E. faecalis and E. faecium have attributed to the rising number of nosocomial infections in the past 30 years, (Remschmidt et al., 2018).

In a study carried out in 2013, Enterococci was found to account for more than 9% of bacteremia in the US and Canada (rates are lower in Latin America). The highest detected rate of enterococcal urinary tract infections (UTI) was in Canada (16.8%), followed by the US (12.5%), and Europe (11.7%)(Jyothi Parameswarappa, V Peerapur Basavaraj, 2013).

Moreover, antibiotic-resistant strains have been increasingly associated with nosocomial bacteremia, surgical wound infections, and urinary tract infections. Enterococcus infections are routinely treated with aminoglycosides in combination with a cell wall inhibitor like ampicillin through a common theme in the evolution of antibiotic resistance is that long-term exposure to low levels of antibiotics can lead to high-level resistance(Azadani, 2020).

In response to the emergence and spread of antibiotic-resistant bacteria, the World

Health Organization (WHO), citing data from 129 member states, concluded that antibiotic

resistance is an alarming threat to public health in every region of the world, with new evidence suggesting that by 2050 about 10 million people will be yielding to AMR every year, resulting in a reduction of 2% to 3.5% in Gross Domestic Products (GDP) and global public health care costs of about $100 trillion. In Africa alone, it is estimated that over 4 million people will be dying due to AMR by 2050(de Kraker et al., 2016).

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Enterococcal infections are often treated with synergistic combinations of a cell wall-active agent and an aminoglycoside. The addition of a cell wall-active agent, such as penicillin or vancomycin, typically results in the enhanced killing of enterococci(Harpreet Singh, Satyajeet Das, 2019).

The increasing presence of multidrug-resistant enterococcal species has become a medical concern and poses a rising public health threat resulting in increased morbidity and mortality due to nosocomial infections(Idomir& Costinaș, 2020).

Aminoglycoside resistance is of great concern since it eliminates the synergy of aminoglycosides with beta-lactam antibiotics, which is the therapy of choice for most enterococcal infections and can limit therapeutic options. Also, since enterococci can survive in a hospital environment due to their intrinsic resistance to several commonly used antibiotics and their ability to acquire resistance to all currently available antibiotics by mutation or through plasmid, it is very important to implement infection control measures, screening of health care workers, surveillance cultures in intensive care units which can control spread of multidrug-resistant enterococci(Gangurde et al., 2014).

In this study, we intend to review laboratory records on blood culture isolates of enterococcus between 2017 and 2020

The study looks at the Prevalence of Enterococci Infection in Blood Cultures Based on Age Group at Makerere University Clinical Microbiology Laboratory

2. Methodology

The methodology described in this section is similar to one by (Nashibula *et al.,* 2022).

2.1. ***Study design***

The study was a retrospective cross-sectional study on the evaluation of high-level aminoglycoside resistance of enterococcal isolates in blood cultures at MUCML between January 2017 and December 2020. It entailed a review of laboratory data.

2.2. ***Study site and settings:***

The study site was MUCML at the Department of Medical Microbiology. The laboratory receives and processes specimens from various clinical studies and other centers in the country. It

receives between 500 to 1000 blood culture specimens monthly. The department of microbiology is one of the departments of the College of Health Sciences. The department has a clinical microbiology laboratory (MUCML) that is mainly a teaching and research laboratory with well-trained scientists and all the necessary materials and equipment required to carry out microbiology work. The MUCML of the department of medical microbiology is a CAP-accredited laboratory that handles microbiological testing on behalf of various studies or a walk-in basis for a fee.

2.3. ***Study population:***

All blood cultures between 2017 and 2020 at MUCML.

Inclusion criteria

All blood cultures isolated between the years 2017 to 2020 at MUCML

Exclusion criteria

All sample isolates with missing data such as age, patient number, and result.

2.4. ***Sample size estimation***

We used sample size calculation by Kish Leslie (Kish, 1957) for cross-sectional studies:

= 2 (1 –)

2

Where; N= sample size estimate

P= assumed true population prevalence of aminoglycoside susceptibility is 61.9%

1-P= the probability of not having disseminated aminoglycosides, so 1-P= 38.1

Zα= Standard normal deviate at 95% confidence interval corresponding to 1.9611

δ= Absolute error between the estimated and true population prevalence 5%

The calculated sample size (N) therefore is:

=368 samples

Study variables

Dependent variables included prevalence of HLAR

Independent variables included patient demographics such as Age.

2.5. ***Sampling Technique***

Total of 368 blood cultures were consecutively used in this study

Sample collection and processing

Laboratory records (blood culture books) were reviewed for a period of the year 2017 to 2020 for enterococcus and their susceptibility to antibiotics. This data was reviewed, retrieved, and processed. The retrieved data was processed by entering it in a manuscript book organized in the following columns: Laboratory number, ward, age, and drug susceptibility profile (resistant, intermediate, resistant). This raw data was entered into an excel sheet, destined for further management and analysis.

Data management and analysis

The data collected was checked for correction and completion...

Data were analyzed using descriptive and analytical statistics by use of bar graphs and pie charts. Data was entered into excel Microsoft office software. The proportion of enterococci in blood culture isolates and the prevalence of resistance of enterococci to drugs such as gentamicin were reported. All values that have a p-value of 0.05 were taken as significant.

A sub-analysis was done on patients who have aminoglycoside resistance in association with resistance to other major drug classes. The proportion of patients that have aminoglycoside resistance in association with resistance to other major drug classes was reported.

2.6. ***Ethical consideration***

The study got ethical clearance from the higher degree and graduate research ethics committee (HDREC) of the School of biomedical sciences, Makerere University College of health sciences, and Uganda national council of science and technology (NCST). Permission to collect data was sought from the laboratory director through the Head of the department of medical microbiology and the laboratory Manager of the clinical microbiology laboratory to carry out a research study within their premises.

3. Results:

A total number of 2176 were positive blood cultures between the years 2017 to 20202 at Makerere University Clinical Microbiology Laboratory. Of these 132 blood cultures were Enterococci positive with a percentage prevalence of 6.07%. The most prevalent organism was Coagulase-negative staphylococci with a total number of 667 (30.65%) organisms and the least prevalent was Proteus Mirabilis with a total number of 4 (0.18%).

4. Discussion:

In our study, the prevalence of enterococcal species was 6.07%, from these 66.67% were found to be among children between 0 and 5 years of age.

A study conducted in Uganda by David P Kateete *et al* (2019) at Mulago National Referral hospital showed that the prevalence of enterococci was 5% isolated from stool, urine, and blood samples from patients between November 2011 and October 2012 (Kateete *et al.,* 2019). Another study conducted in Ethiopia from clinical samples of pediatrics had a prevalence of 5.5% (Toru *et al.,* 2018). These studies show similar resistant trends to ours.

However, studies were conducted by other authors for example in Uganda, enterococcal infections had a prevalence of 3.5% (Odoki *et al.,* 2019), and 2.3% enterococcal infections prevalence in India,from clinical samples in tertiary care hospitals (Sreeja *et al.,* 2012)

In contrast to our study, the prevalence of enterococcal bacteremia among hospitalized and outpatients in the present study was 72% and 28%, respectively (El-Mahdy *et al.,* 2018), USA and Canada had a prevalence of 18.0% and 21.2%, respectively (Ferede *et al.,* 2018),16.6% prevalence of enterococcus in Ethiopia (Komiyama *et al.,* 2016) and enterococci prevalence was 12.68% in India (Thacker *et al.,* 2014).

5. Conclusion

The study also found that ages between 0 to 5 years had the highest incidence of enterococcal infections and the occurrence of these infections increased with the years.

6. Limitation

In the study often the clinical samples that were sent to the laboratory had missing data such as age and patients number.

7. Recommendation:

Since the highest infections occurred between the ages 0 to 5 years, this showed that the infection was nosocomial and hence doctors should adhere to infection prevention and control protocols when handling patients.

Routine susceptibility testing should be done for beta-lactams and aminoglycosides such as gentamicin before prescribing to patients

8. Acknowledgement:

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9. List of Abbreviations.

MDR: Multidrug resistant
ICU: Intensive care unit
CLSI: Clinical Laboratory Standard Institute
ESBLs: Extended spectrum beta –lactamases
WHO: World Health Organization
HLAR: High-Level Aminoglycoside Resistance
MUCML: Makerere University Clinical Microbiology Laboratory
MIC: Minimum Inhibitory Concentration

10. Source of funding:

There was no source of funding for this research.

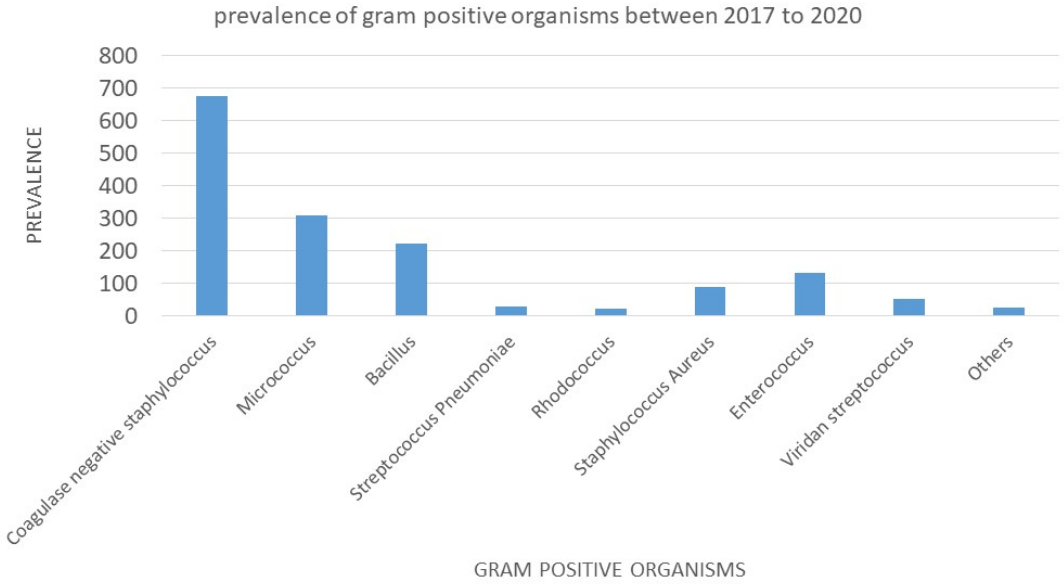

Figure 1: shows the prevalence of gram-positive organisms identified on blood cultures between the years 2017 to 2020

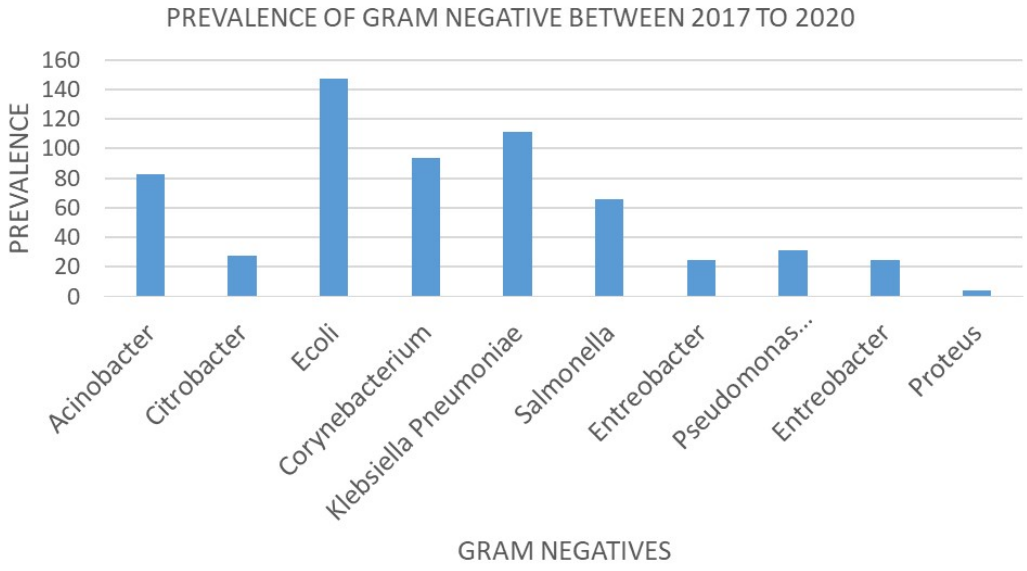

Figure 2: shows the prevalence of gram-negative organisms on blood cultures between 2017 to 2020.

November 19, 2022

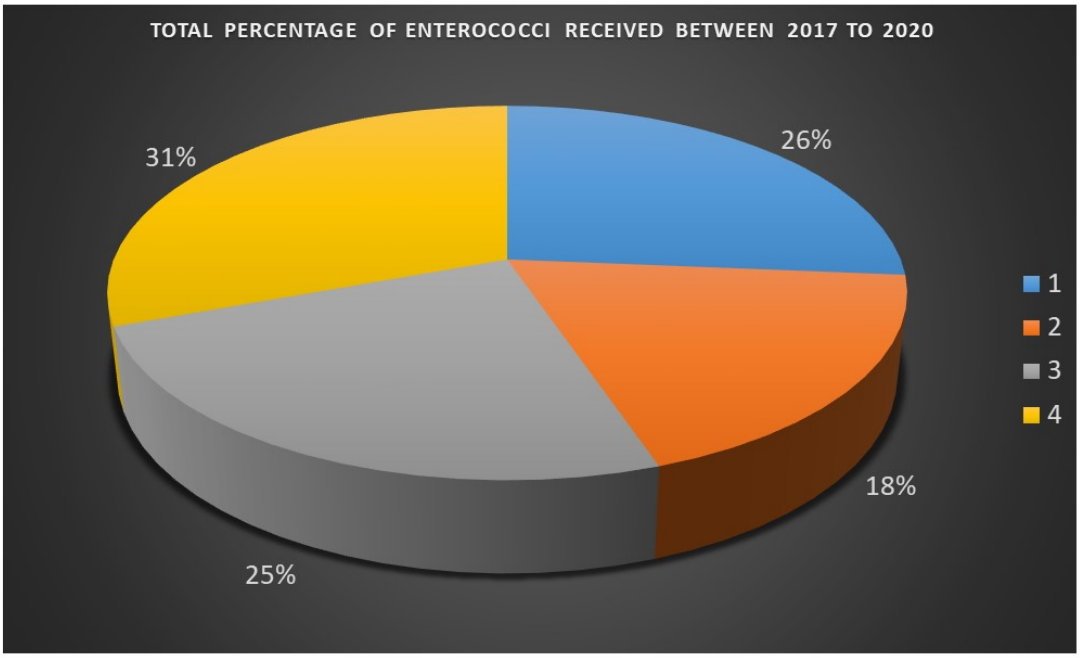

Figure 3: Shows percentage of Enterococci positive cultures between the years 2017 to 2020 **KEY**
1-2017 **2**- 2018 **3-**2019 **4**- 2020

Table 1: shows the frequency of enterococci with Age between years 2017 to 2020. The frequency was the highest, with a prevalence of 66.7% between the age of 0 years to 5 years and over 2 samples retrieved from the records identified had no age.

AGE	FREQUENCY OF ENTROCOCCUS SPECIES	PERCENTAGE
0−5	88	66.67%
6−11	6	4.55%
12−17	2	1.52%
18−23	3	2.27%
24−29	3	2.27%
30−35	6	4.55%
36−41	1	0.76%
42−47	5	3.79%
48−53	0	0.00%
54−59	3	2.27%
60−65	3	2.27%
66−71	5	3.79%
72−77	4	3.03%
78−83	1	0.76%
NO AGE	2	1.52%
TOTAL	132	100.00%

11. Conflict of interest:

Ascertaining retrospective data was a big challenge to determine where actually all samples were collected and processed using the right protocols and we could not find some data from some months of the previous years which affected our results.

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