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Original Research Article

Application of WHONET software for assessing multi drug resistant, extensive drug resistant and pan drug resistant *Enterococci* from critically ill patients

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Abstract

Objective: This study was conducted for analysing multidrug resistant profile of *Enterococcus* species, prevalent in Intensive care unit of a tertiary care centre and to study its antimicrobial susceptibility pattern.
Design and Setting: It is a prospective study design conducted in the Intensive care units of a tertiary care hospital.
Method: All *Enterococci* isolated from the study period were included in the study. Analysis for multidrug resistance, Extensive drug resistance and Pan drug resistance from all critical areas was carried out using WHONET software. Antimicrobial susceptibility pattern of *Enterococci* was also studied.
Result: 4819 samples were studied for isolation of *Enterococci*. Total 259 *Enterococci* could be isolated, amongst which 33 were from Intensive Care Unit. 20 belonged to multi drug resistant category and were later found to be extensive drug resistant and 1 isolate belonged to Pan drug resistance category.
Conclusion: Early detection and close monitoring of MDR, XDR, and PDR bacterial strains must be commenced by all clinical microbiology laboratories to reduce the menace of antimicrobial resistance which is now a global problem.
Keywords: *Enterococcus*, WHONET software, drug resistant.

1. Introduction

Enterococci have a remarkable ability to adapt to environmental changes and acquire antimicrobial resistance, leading to multiple drug-resistant phenotypes. This causes resistance to antimicrobials like ampicillin, aminoglycosides, and other beta-lactam antibiotics [1]. *Enterococci* have gained importance as a nosocomial pathogen, over the recent years. Thus, contributing towards higher drug resistance, morbidity and mortality. Critically ill patients admitted to intensive care unit (ICU) of a hospital are the most vulnerable group, to multidrug resistant organisms such as *Enterococci* [1]. This study was conducted for analyzing drug resistant profile of *Enteroccus* species, prevalent in Intensive care unit of a tertiary care.

2. Method

The present study was conducted in a tertiary care for one and a half year, from March 2016 – August 2017, after obtaining institutional ethical approval. Analysis of multi drug resistant *enterococci* was carried out using WHONET software. Data included all the clinical specimen tested in Microbiology laboratory for aerobic culture and susceptibility by Kirby Bauer's disc diffusion method and MIC method as per availability. The results were interpreted by CLSI guidelines 2016 - 2017.

3. Result

4819 samples coming from various clinical areas like Medicine, Surgery, Paediatrics, Obstetrics and Gynecology etc. were studied. Total 259 *enterococci* could be isolated, amongst which 33 isolates were from Intensive care unit of the hospital and were included in study. 11 %isolates were identified as *Enterococcus* fecalis and 6 % were *Enterococcus faecium*. Unfortunately, 84 % *Enterococci* could not be identified up to species level due to non-availability of arabinose disc.

Table I: Distribution of *enterococci* isolates from various clinical specimen in critical area

Area	Total number of specimen	Type of specimen				
		Fluids (4)	Blood culture (14)	Urine (13)	Swab (1)	Pus (1)
SICU	4	1 (AF)	1	2	-	-
OBICU	3	-	-	3	-	-
NICU	12	2 (CSF)	9	1	-	-
MICU	14	1 (PF)	4	7	1	1

SICU - Surgical Intensive Care Unit; AF- Ascitic fluid; OBICU - Obstetric Intensive Care Unit; CSF - Cerebrospinal fluid; NICU- Neonatal Intensive Care Unit; PF - Pleural Fluid; MICU- Medical Intensive Care Unit

As shown in Table I, specimen wise analysis was carried out which showed that *Enterococci* was predominantly isolated from Blood culture accounting for 42 % (14), followed by 40 % urine (13). 6 % were from cerebro spinal fluid (2). The specimen that accounted for least isolates included 3 % each of ascitic fluid, pleural fluid, pus and swab (1).

Area wise analysis was performed which showed that *Enterococci* were predominantly isolated from Neonatal intensive care unit (64 %) followed by Medical intensive care unit (29 %). *Enterococci* from Obstetric intensive care unit and Surgical intensive care unit accounted for the least number of isolates (7 %) as shown in Table I.

3.1 Multidrug resistant *Enterococci*

Current study defined MDR as non-susceptible to ≥1 agent in ≥3 antimicrobial categories. 60 % (20) isolates were found to be multidrug resistant. Area wise distribution of multi drug resistant isolates showed that 40 % (8) were from MICU while NICU accounted for 30 % (6) isolates. 15 % (3) were isolated from OBICU and SICU each. Specimen wise analysis showed that 50 % (10) were from blood culture and 40 % (8) were isolated from urine while 5 % (1) were isolated from ascitic fluid and 5 % (1) were isolated from cerebrospinal fluid as shown in table II.

Table II: Distribution of multi drug resistant *enterococci* from various clinical specimens in critical area

Area	Total number of specimen	Type of specimen		
		Fluids	Blood culture	Urine
SICU	3	1 (AF)	1	1
OBICU	3	-	-	3
NICU	6	1 (CSF)	5	-
MICU	8	-	4	4

SICU -Surgical Intensive Care Unit; AF- Ascitic fluid; OBICU- Obstetric Intensive Care Unit; CSF- Cerebrospinal fluid; NICU- Neonatal Intensive Care Unit; MICU- Medical Intensive Care Unit

3.2 Extensive drug resistance

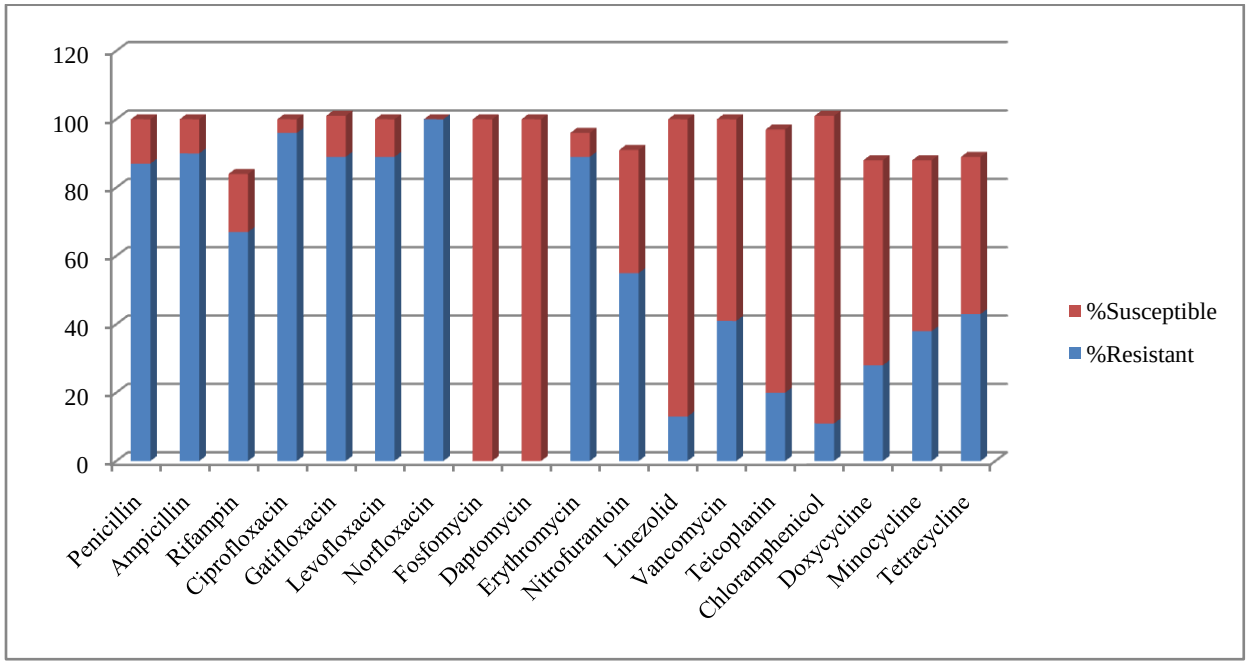
Extensive drug resistant (XDR) was defined as non-susceptibility to at least one agent in all but two or fewer antimicrobial categories i.e. bacterial isolates remained susceptible to only one or two categories of all antimicrobials used in the study. All 20 multi drug resistant *Enterococci* were found to be extensively drug resistant on further analysis.

3.3 Pan drug resistance

Pan drug resistance (PDR) was followed as non-susceptible to all antimicrobial agents listed for the current study. 5 % (1) isolates accounted for Pan drug resistant category. It showed resistance to all higher antimicrobials like Vancomycin, Teicoplanin, Daptomycin and Linezolid. Area wise analysis showed that it was from Obstetric Intensive Care unit. No Pan drug resistant isolates were found from Medical, Surgical, Neonatal and Intensive care unit. Specimen wise analysis showed that it was from a Urine specimen. Other specimen like Blood culture and fluids did not account for Pan drug resistance. Unfortunately, detailed clinical outcome and therapeutic response of this patient could not be obtained.

Antibiogram for *Enterococci* isolated from various Intensive care units (SICU, MICU, OBICU, and NICU) is shown in Figure I.

Figure I: Percentage susceptibility and resistance of *enterococci* from critical area of a tertiary care hospital



Beta lactam agents, Penicillin (10 %) and Ampicillin (13 %) showed least susceptibility rates. Amongst fluoroquinolones, Ciprofloxacin (4%) showed least susceptibility rates while Levofloxacin and Gatifloxacin showed 11% and 12 % susceptibility rates respectively. Higher antimicrobials like Daptomycin and Fosfomycin showed 100 % susceptibility. However, other higher antimicrobials like Vancomycin (75 %) and Teicoplanin (77 %) showed reduced susceptibility rates. Amongst Tetracyclines, doxycycline showed highest susceptibility rates (60 %) followed by Minocycline (50 %) and Tetracycline (46 %). High level Gentamycin and High level Streptomycin could not be tested due to non availability of discs.

4. Discussion

In present study, 60 % *Enterococci* from Intensive care units were multi drug resistant. On further analysis it was observed that all multi drug resistant *Enterococci* were extensively drug resistant. 41 % *Enterococci* were found to be Vancomycin resistant (VRE). A study conducted by Cherr Lim *et al*, showed that 3% (4/117) of *Enterococcus* spp. causing Hospital Acquired Bacteremia were Multi Drug Resistant. Vancomycin non-susceptible *Enterococcus* spp. was found in 4% of tested isolates (15/338) [2]. Bhatt *et al* study showed that the prevalence of multidrug resistance among *enterococcal* isolates was found to be 89% [3].

According to the EPIC II study, rates of vancomycin resistance among *enterococcal* isolates were approximately 33-40% in Western Europe, Eastern Europe, and Asia but approximately 50% in the Americas and Oceania[4].

In developing and low income country antibiotic use is increasing with lack of stewardship in hospital and poor control of over-the-counter sales. This is driving the emergence and spread of multidrug-resistant (MDR) pathogens in community and hospital settings [2]. The clinical and financial burden to patients and health care providers for Multi drug resistant *Enterococci* is really challenging. The problem is that the bacteria are developing resistance at a much faster pace than the new drug development. Higher antimicrobials like Vancomycin and Linezolid have shown remarkably low susceptibility rates. These drugs are considered to be the last resort for treatment. Hence, no other options are available for treating infection. Complete antimicrobial susceptibility testing and knowledge of the antibiogram is extremely essential to formulate therapeutic approach for the treatment of *Enterococcal* infections [3]. Sufficient research data is not available for prevalence of multi drug resistant, Extensive drug resistant and Pan drug resistant *Enterococci* in India. Such data should be analysed and their incidence should be recorded for implementing strategies for infection control in a healthcare setup. Hence, detection, prevention of transmission of Multidrug resistant organisms by following infection control practices, antimicrobial surveillance, and stewardship are need of the hour. This situation warrants the implementation of an efficient infection control program and regular surveillance of antimicrobial resistance of *enterococci* in order to establish a rational antibiotic policy for the better management of *enterococcal* infection [4]. Early detection and close monitoring of MDR, XDR, and PDR bacterial strains must be commenced by all laboratories to reduce the menace of antimicrobial resistance which is now a global problem.

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