Original Research Article

A Prevalence Study on Bacteriological Profile and Antimicrobial Resistance of Bacterial Isolates from Medical Intensive Care Unit in a Tertiary Care Hospital

M. A. Ashiha Begum*, R. Shanthi and Jeyamathi

Tirunelveli Medical College, Tirunelveli - 627011, India

A B S T R A C T

Studies throughout the world document that the nosocomial infections are a major cause of morbidity and mortality. Many factors contribute to the frequency of nosocomial infections like immunocompromised state of patients, invasive examinations and treatments, patient care practices and hospital environment which facilitate transmission of microbes among patients. Treatment is becoming difficult due to inappropriate use of antibiotics and hence resistance develops. Knowledge on antibiotic resistance pattern is essential for appropriate therapy. Objectives of the study are to evaluate the bacteriological profile causing Blood Stream and Urinary Tract Infections in a medical Intensive Care Unit. 2. To analyse the antibiotic susceptibility tests and hence to arrive the Antimicrobial resistance patterns from ICU patients. Blood samples and urinary samples from adult patients of both sexes admitted to ICU, for a period of six months, acquiring signs of sepsis will be analysed by blood culture done in BHI broth and MSU sample of urine collected and process in CLED media. Culture positives identified by growth in the selective media, confirmed by Biochemical tests and Antibiotic susceptibility tests done in Muller Hilton Agar by Kirby Bauer's disc diffusion method. Hence Antimicrobial resistance profiles of bacterial strains were analysed. Total of 43 BSI and 296 urinary positive samples were obtained from Medical ICU over a period of six months in Apr- Sep 2019.The most prevalent BSI pathogens were *Klebsiella pneumoniae*, *Staphylococcus aureus* and CoNS *Escherichia coli* and *Klebsiella* spp. being the prevalent pathogens from urinary tract samples. The antimicrobial resistance profile from ICU patients were analysed for generating Antibiogram in a Tertiary care hospital. Vancomycin, Merapenam, Imipenam, Linizolid, Cefiperazone /Salbactum are most effective antibiotics against Gram positive bacteria. Amikacin, Gentamycin, Piperacillin/ Tazobactum and Nitrofurantoin are effective against nosocomial UTI infection caused by Gram negative bacteria. This study also guides to formulate Antibiotic policy which helps the Clinician to choose empirical therapy and switch over to for Escalation and Cycling of Antibiotics which favours Infection control methods.

Introduction

Hospital acquired infections (HAI) are usually defined in any critical areas like ICU associated infections that occur after 48 to 72 hours of ICU admission or within 48 hours after transfer from an ICU as per CDC[7] (Centre for Disease[6] Control prevention). HAIs are important public health problem, both in developing and developed countries[1]. The most important nosocomial infections are urinary tract infection, surgical-wound infection, pneumonia, blood stream infections[8]. BSIs are responsible for approximately 17-22%[6,7]. UTI is a presence of bacteria in urine (bacteriuria) and defined as the growth of a single pathogen of $>10^5$ colony forming units/mL of properly collected mid-stream urine samples[3]. The common bacterial pathogens in BSI and UTI *Staphylococcus aureus*, Coagulase-Negative Staphylococci, *Klebsiella pneumoniae*, *Escherichia coli, Pseudomonas aeruginosa, Enterobacter* spp., *Acenietobacter* spp., *Enterococcus* spp. and *Proteus* spp[5,13]. As there is inappropriate use of antimicrobial agents, nosocomial pathogens have shifted from easily treatable ones to more resistant bacteria[4]. This is a challenge for nosocomial infection control methods. Critical area specific studies are aimed to gain knowledge about pathogen profile, antimicrobial resistance patterns which can minimise mobility and mortality rates by optimising treatments guideline[4,15]. As there is limited data in our centre, this study was undertaken to define the bacterial pathogens in BSI and UTI and to analyse the antimicrobial resistance patterns which guides for formulating Antibiotic policy.

The main objectives of this study include to evaluate the bacteriological profile causing BSI and UTI in Medical Intensive Care Unit. And to study the Antibiotic Susceptibility tests and hence to analyse the Antimicrobial Resistance patterns of bacterial isolates from ICU patients.

Materials and Methods

Study Period :   6 months
Study design :   Prevalence Study
Sample size   :   208 blood cultures and 995 urinary tract samples

This Cross sectional study was conducted in the Medical Intensive Care Unit patients of a Tertiary care hospital in South India. Adult patients who are admitted in Medical ICU, of 18 years and above, both sexes presenting with at least two clinical signs of infection like fever, hypotension, tachycardia and increase in respiratory rate, after 48 hours of admission to the ICU were included.

Patients showing clinical signs of infections prior to admission or transfer from ICU to inpatient wards were excluded. Patients admitted for short term post-operative monitoring were excluded. After obtaining Institutional Ethical Committee clearance the analysis was done.

Study tool

Only Bacterial HAIs were included by methodologies like one Blood culture and Urine culture were processed by the routine culture methods and biochemical identification. For blood culture-5 ml of blood was collected by aseptic precautions from each patient and inoculated into 50ml Brain Heart Infusion (BHI) broth. For Urine culture, midstream urine (MSU) sample inoculated into Cystene Lysine Electrolyte Deficient (CLED) media and culture done and identified by growth and biochemical tests. The bacterial isolates were subjected to Antibiotic susceptibility test (AST) in Muller Hinton Lawn culture, using Kirby Bauer's disk diffusion method as per CLSI guidelines

using various antibiotic disks like Amikacin, Gentamycin, Cefotazime, Ceftriazone, Cefepyraxone/Sulbacatum, Piperacillin/ Tazobactum, Merapenam, Imipernam, Vancomycin, Amoxyclauv, Cotrimoxazole, Nitrofurantoin, Linezolid and Norfloxacinfor evaluating Antimicrobial Resistance (AMR) patterns.

Statistical analysis

Data entry and statistical analysis were performed using SPSS v.13 software and comparisons were made using Chi-square Methods. A value <0.05 was considered indicative of statistically significant difference.

Results and Discussion

Nosocomial BSI

A total of 208blood samples received from suspected BSI were analysed. Among them 42 (19.2%) were documented as BSI of monomicrobial in nature. Of the 42 patients 20 (47.3%) were females and 22 (52.7%) were males. *Klebsiella pneumoniae* (38.6%) and *Staphylococcus aureus* (29.4%) were the prevalent organisms from nosocomial BSI patients followed by CoNS (18.2%), *Acinetobacter* (7.1%), *P. aeruginosa* (4.7 %), *Strepto. pneumoniae* (2.1%).

No significant differences among both genders were noted[9]. Highest resistance rate for *Staphylococcus aureus* and CoNS was against Penicillin and Ampicillin and lowest rate of resistance was against Vancomycin and Linezolid and Cefepyrazone /Sulbacatum. The Gram negative bacteria showed lowest resistance to Cefepyrazone /Sulbactum, Pip/ Taz, Ceftazidime, Cefotaxine, Cotrimoxazole, Nitrofurantoin, Gentamycin, Amikacin and highest resistance to Penicillin, Erythromycin, Tetracycline.

BLOOD SAMPLES - IMCU	
CULTURE SAMPLES RECEIVED	208
CULTURE POSITIVE	43

Nosocomial UTI

A total of 975 urine samples were processed in CLED media and 296 samples identified as culture positive and confirmed by battery of biochemical tests. Among them 201(68%) were females and 95 (32%)were males[9] (mean age 45.8, range: 18-80 yrs) E.coli (46.4%) of the most common Gram-negative bacilli isolated from nosocominal UTI followed by *Klebsiella* spp. (29.7 *%), Staph. aureus* (11.4%), CoNS (3.6 %), *Proteus* (3%), *Pseudomonas* (3%), *Citrobacter* (2%), *Enterococcus* (1%), *Enterobactor* (1%).

Many of HAIs are associated with pathogens showing selective pressure for different antibiotics and hence develops resistance by inappropriate antibiotics usage and spread easily in hospital surroundings[6,13,14].

The prior studies show most common organism indicative of polymicrobial in nature - *Staph. aureus*, CoNS, *Enterococcus, Streptococcus pneumoniae* among Gram positive bacteria. Among Gram negative bacteria *Klebsiella, E. coli, Acinetobacter baumannii, Enterobacter cloacae* and *Pseudomonas aeruginosa* of multi drug resistance (MDR) strains[3,8].

Our study shows distribution of bacterial strains isolated from nosocomial BSI and UTI in a tertiary care hospital and their resistance patterns are discussed. A study in Brazil revealed predominance of *Staph. aureus* followed by *E.coli, Klebsiella*. In our study among BSI patients Gram-negative bacteria like *Klebsiella, Escherichia coli* were more regularly isolated than Gram-positive

bacteria. This finding is an accordance with the results of recent studies done in many countries[10,12].

Our data shows highest resistance of *Staphylococcus aureus* and CoNS was against Penicillin followed by Ampicillin in Methicillin resistant staphylococcus species. In this study *E.coli* strains isolated from BSI patients showed higher resistance to Tetracycline and Ampicillin which is similar to a study from Ireland[1,2]. In our study6.7% *Acinetobacter* species shows high resistance to Cotrimoxazole and Gentamycin, Ciprofloxin. Re-emergence of *Acinetobacter* spp. bacteraemia increasing especially from Asian countries Iran, Iraq and Afghanistan.

The present study shows Vancomycin, Cefiperaxone / Sulbactum and Merapenam are most effective antibiotic against *Staphylococcus aureus* and CoNS organisms. This is in agreement with many recent studies.

In our study the statistical analysis showed a significant correlation between nosocomial UTI prevalence among females. This could be explained by a higher prevalence of UTI in women than men due to anatomical and physiological variations and *E.coli* is still the most common Gram negative organism in nosocomial UTI, which is consistent with the other studies from Asian countries.

Table.1 IMCU-Blood

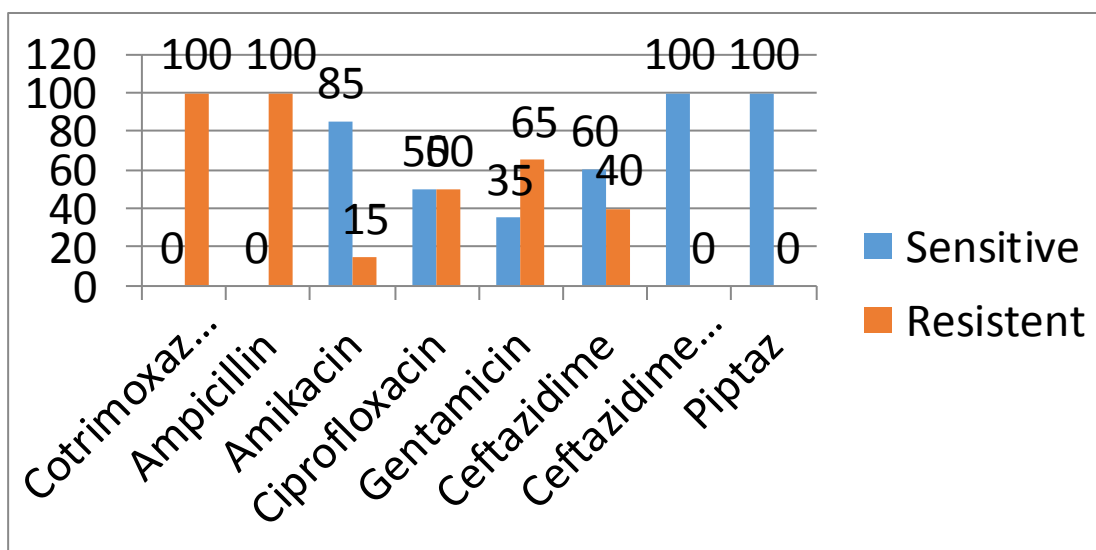| S.No.	Organism	COT		AMP		AK		CIP		GEN		MERP		CEF/SUL		P/T	
		S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
1	KLEB	0	100	0	100	85	15	50	50	35	65	60	40	100	0	100	0
2	E.Coli	0	100	0	100	100	0	75	25	100	0	100	0	100	0	90	0

Fig.1 *Klebsiella*-sensitivity pattern
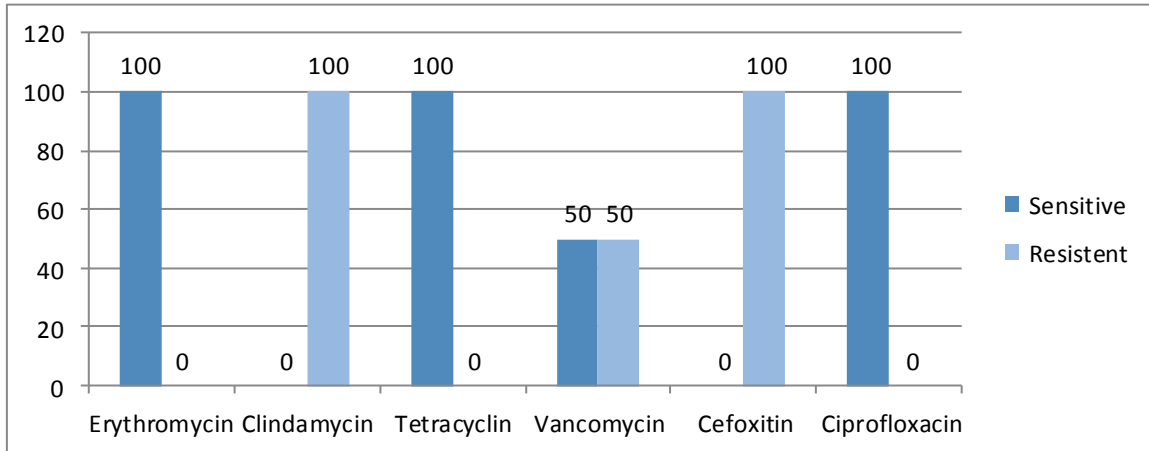IMCU-Blood

Fig.2 *S. aureus*-sensitivity pattern Blood-IMCU
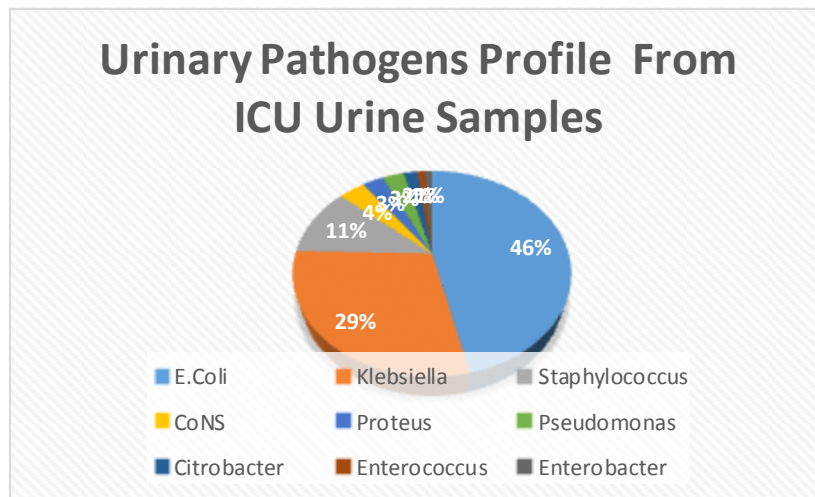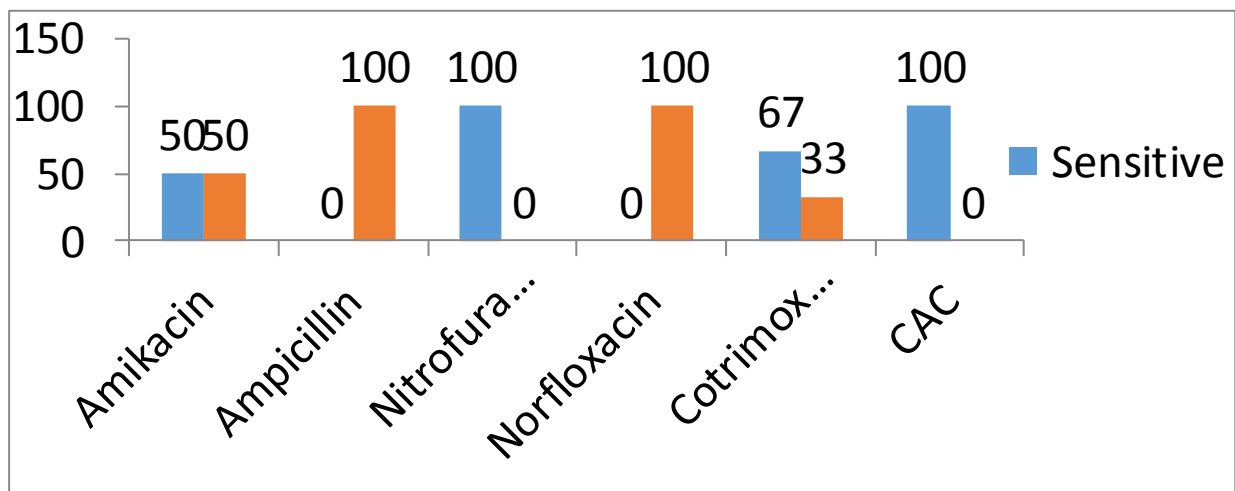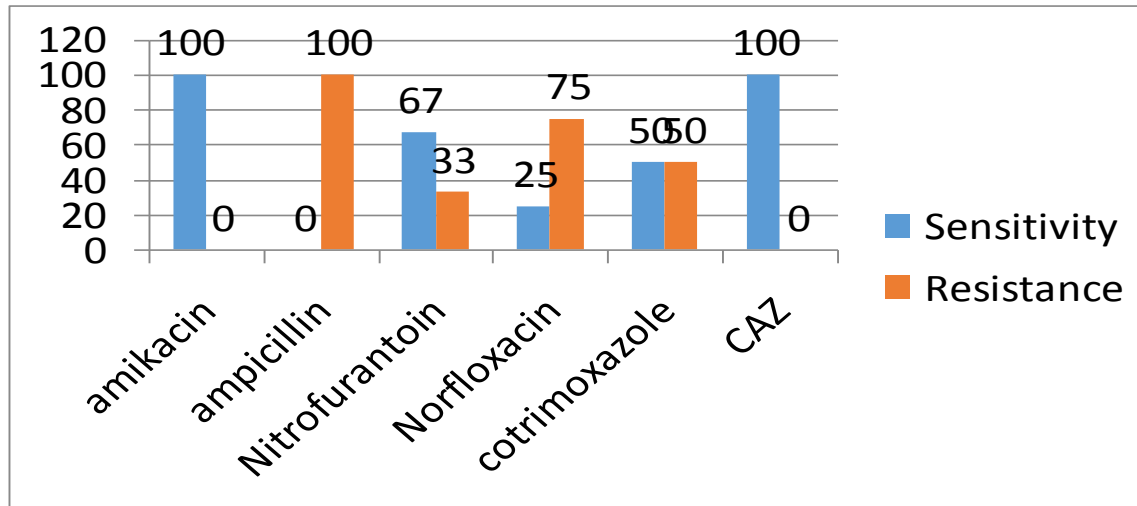

Fig.3

Fig.4 *E. coli*-sensitivity pattern urine-IMCU

Fig.5 *Klebsiella*-sensitivity pattern urine-IMCU

The higher resistance rate of *E.coli* isolates were against Cotrimoxazole, Ampicillin, and Norfloxacin and Amikacin. Cefiperaxone/ Sulbatum, Pip-Taz, Ciprofloxacin showed highest sensitivity against *E.coli* and *Klebsiella* isolates.

In conclusion, the rise of nosocomial BSI and UTI in ICUs patients due to interactions of several factors such as primary disease and its severity, duration of hospital stay and treatment and invasive interventions like use of catheters[5,12]:

It is concluded from our study Gram-negative bacteria were most frequently involved in nosocomial BSI and UTI than Gram-positive bacteria[9]. Vancomycin, Linezolid and Cefiperazone /Subactum most effective antibiotics against Gram-positive bacteria and Gentamycin, Amikacin and Imipenem, Pip-taz, Cefiperazone /Subactum proposed for nosocomial UTI treatments caused by *E. coli* followed by *Klebsiella*[8].

Hence the present study suggestions includes AMR surveillance derived by doing Antibiotic sensitivity tests helps the center to generate Antibiogram which guides to formulate Antibiotic policy which is crucial in implementing Infection Control programmes. Also AMR patterns guides the Clinicians to choose appropriate therapy and assist escalation and cycling of antibiotics in establishing Antimicrobial stewardship, and thus helps for regulating infection control methods.

Acknowledgement

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