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Study antibiotic sensitivity and resistance pattern from sputum / tracheal swab of patients on ventilatory support in ICU of tertiary care hospital

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Abstract
Objective: To study antibiotic sensitivity and resistance pattern from sputum/tracheal swab of patients on ventilatory support in ICU of tertiary care hospital.
Method: A prospective observational study was carried out based upon the reports of bacterial isolates from ICU of Dept. of Medicine, Govt. Medical College and Hospital, Aurangabad between "23 October, 2017 to 28 February, 2018". 56 patients were studied. Susceptibility testing was performed using disk diffusion method. The results were interpreted according to the guidelines of the Clinical and Laboratory Standards Institute (CLSI).
Results: The study revealed the presence *of Klebsiella* species in 28.29% (n=26) samples followed by *Pseudomonas aeruginosa* 20.69% (n=18), *Klebsiella Pneumonia* 13.79% (n=12), *Acinetobacter baumannii* 10.34% (n=9), Non-*fermenting gram negative rods* 9.19% (n=8), respectively. A high range of resistance was seen for Ceftazidime in case of *Klebsiella spp (91.66%).*Overall Colistin was the most sensitive drug among all group of microorganisms.
Conclusion: The present study is an initiative to observe serious threats in patients admitted in ICU due to nosocomial infection. Most com monest microorganisms observed were *Klebsiella* species 28.29% (n=26), *Pseudomonas aeruginosa* 20.69% (n=18), *Klebsiella pneumonia* 13.79% (n=12), *Acinetobacter baumanni* 10.34% (n=9).Maximum resistance was observed to Ceftazidime, 3rd generation cephalosporin 92.7% (51 out of 55). Highest sensitivity was seen for Colistin (80%) followed by Ciprofloxacin (76.8%). Such studies will restrict emergence of resistant bacteria, effective cost benefit, inventory and stock management.

Keywords: Antimicrobial resistance, multidrug resistance, antibiotic sensitivity

Introduction
Amongst the healthcare settings, intensive care unit (ICU) is known to be "Canopy of infections". Not only the invasive procedures but also drugs increases the risk of infection. To understand and overcome this on-going situation, the sensitivity and resistance pattern studies need to be conducted [1] it is being observed through various studies that 20-30% of ICU admissions had nosocomial infection. The multicentre trials comprising1265 ICU's all over 75 countries revealed that the hospital acquired infection was present in 50% of ICU patients [2] This may be accounted due to many invasive procedures are being carried out in the ICUs. Certain therapeutic interventions responsible for infectious complications includes indwelling catheters, sophisticated life support, intravenous fluid therapy, prosthetic devices, immunosuppressive therapy and use of broad spectrum antibiotics leading to a spectrum of multi-drug resistant pathogens. These factors contribute for emergence of nosocomial infections [3] the organisms causing infections and their antibiotic resistance patterns vary throughout the hospital settings.
The International study of infections in ICU, which was conducted in 2007, demonstrated that the patients who had longer ICU stays had higher rates of infection, especially infections due to resistant *Staphylococci, Acinetobacter, Pseudomonas* species, *Candida* species [7]
In an another study on bacterial isolates from in-patients and out-patient attendees at the Eric Williams Medical Sciences complex, a 560-bed medical complex located in the north western part of Trinidad, represented about 2.74% (31 out of 1129) of all culture positive

isolates from clinical sources [8] *Pseudomonas aeruginosa* and *Enterobacteriaceae* species are the major cause of Healthcare associated infections (HAI's) often with significant drug resistance leading to increased morbidity and mortality. Approximately, 2-10% of *P. aeruginosa* are resistant to all available treatments [7]

EPIC II study showed that 51% of patients were considered to be infected while admitted in ICU. The infection was of respiratory origin in 64% of cases. *S. aureus* (20.5%) was the most frequent organism isolated, despite the overall predominance of Gram-negative organisms as a group: 62.2% (*E. coli*, *Enterobacter* spp., *Klebsiella* spp., *Pseudomonas* spp. and *Acinetobacter* spp.) [9]

The aim of the present research is to study the antibiotic resistance and sensitivity patterns for patients admitted in ICU Department of Medicine of Government Medical College and Hospital, Aurangabad.

Materials and Method

A prospective observational study was carried out based upon the reports of bacterial isolates from ICU of Department of Medicine, Govt. Medical College and Hospital, Aurangabad with 16 beds between the periods **"23** October, 2017 to 28 February, 2018". Out of all patients admitted, 56 patients were studied.

The approval from Institutional Ethics Committee was granted and approved on date 23 October 2017 with No. Pharma/IEC-GMCA/518/2017. Individual patient's informed consent was taken since the patient file was taken for collecting the diagnostics and therapeutic data. Susceptibility testing was performed using disk diffusion method. The results were interpreted according to the guidelines of the Clinical and Laboratory Standards Institute (CLSI)

Results

For the present study the mean age group was between 30-39 years in which 58.92% were males and 41.08% females.

Klebsiella species was seen in 28.29% (n=26) samples, followed by *Pseudomonas aeruginosa* 20.69% (n=18), *Klebsiella Pneumonia* 13.79% (n=12), *Acinetobacter baumanni* 10.34% (n=9), Non-fermenting *gram negative rods* 9.19% (n=8), *Acinetobacter spp* 3.45% (n=3), Non-*Fragmenting gram negative rods*, Non-pigmented *gram negative rods* and *E. Coli* 3.57% (n=2), *Staphylococcus aureus*, Non-pigmented *Pseudomonas aeruginosa*, *Acinetobacter iwoffi*, and *proteus spp* had an incidence of 1.14% (n=1). Table 1 shows the distribution of various microorganisms.

For *Klebsiella spp*, ciprofloxacin 30% (n=6) was found to be the most sensitive antibiotic and Ceftazidime 91.66% (n=22) was the most resistant antibiotic. Similar pattern was observed in *Pseudomonas aeruginosa*. Maximum resistance was observed for Ceftazidime, 3rd generation cephalosporin 92.7% (51 out of 55). Colistin was found to be the most sensitive drug with overall sensitivity 80% (8/10).

Table 1: Frequency and percentage of bacterial species

Microorganisms	Frequency	Percentage (%)
Klebsiella. Spp.	26	28.29
Pseudomonas aeruginosa	18	20.69
Klebsiella. Pneumonia	12	13.79
Acinetobacter baumanni	9	10.34
Non-fermenting gram-ve rods	8	9.19
Acinetobacter species	3	3.45
Non-pigmented Pseudomonas aeruginosa	2	2.29
Non-fragmenting gram-ve rods	2	2.29
Escherichia coli	2	2.29
Staphylococcus aureus	1	1.14
Acinetobacter iwoffi	1	1.14
Non-pigmented gram negative rods	1	1.14
Proteus spp.	1	1.14

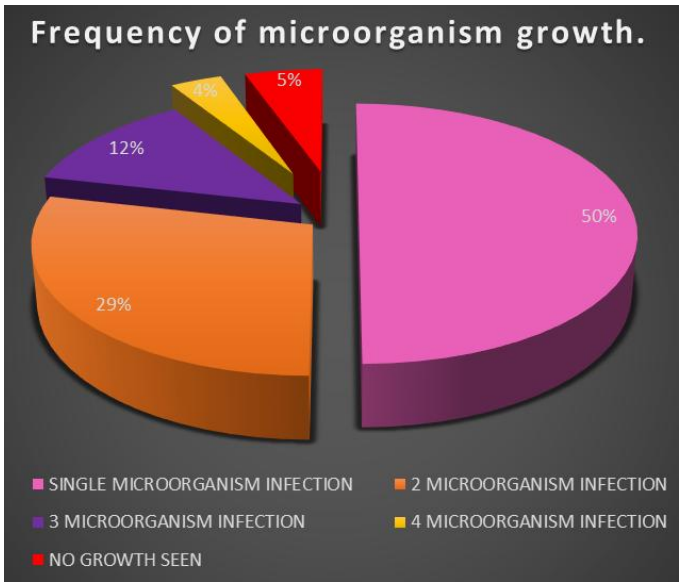

Fig 1: Frequency of microorganism growth

Table 2: Antibiotic susceptibility pattern

Antibiotic	Frequency of Test	Name of Organism	Frequency of tested in organism	Sensitivity (%) (n = Samples found)
Ceftazidime	78	*Klebsiella. spp*	23	4.34% (n=1)
		Pseudomonas aeruginosa	16	37.5% (n=6)
		Klebsiella pneumonia	7	0% (n=0)
		Acinetobacter baumanni	9	22.22% (n=2)
Ciprofloxacin	82	*Klebsiella. spp*	26	23.07% (n=6)
		Pseudomonas aeruginosa	16	43.75% (n=7)
		Klebsiella pneumonia	12	25% (n=3)
		Acinetobacter baumanni	9	22.22% (n=2)
Piperacillin + Tazobactum	53	*Klebsiella spp*	15	20% (n=3)
		Pseudomonas aeruginosa	9	33.33% (n=3)
		Klebsiella pneumonia	8	25% (n=2)
		Acinetobacter baumanni	5	40% (n=2)
Ceftazidime + Clavulanic acid	46	*Klebsiella spp*	18	16.66% (n=3)
		Pseudomonas aeruginosa	10	20% (n=2)
		Klebsiella pneumonia	3	0% (n=0)
		Acinetobacter baumanni	4	0% (n=0)
Amikacin	46	*Klebsiella spp*	17	17.64% (n=3)
		Pseudomonas aeruginosa	8	37.5% (n=3)
		Klebsiella. pneumonia	3	0% (n=0)
		Acinetobacter baumanni	3	0%(n=0)
Cefotaxime	37	*Klebsiella spp*	13	7.69% (n=1)
		Pseudomonas aeruginosa	6	33.33% (n=2)
		Klebsiella pneumonia	7	28.57% (n=2)
		Acinetobacter baumanni	7	14.28% (n=1)
Ceftriaxone	30	*Klebsiella spp*	8	0% (n=0)
		Pseudomonas aeruginosa	8	37.5% (n=3)
		Klebsiella pneumonia	9	0%(n=0)
		Acinetobacter baumanni	7	14.28% (n=1)
Meropenem	28	*Klebsiella spp*	11	27.27% (n=3)
		Pseudomonas aeruginosa	4	50% (n=2)
		Klebsiella pneumonia	5	60% (n=3)
		Acinetobacter baumanni	5	40% (n=2)
Cefaperazone	24	*Klebsiella spp*	9	0% (n=0)
		Pseudomonas aeruginosa	5	60% (n=3)
		Klebsiella pneumonia	5	0% (n=0)
		Acinetobacter baumanni	5	40% (n=2)
Colistin	10	*Klebsiella spp*	1	100% (n=1)
		Pseudomonas aeruginosa	6	83.33% (n=5)
		Klebsiella pneumonia	1	100% (n=1)
		Acinetobacter baumanni	1	100% (n=1)

Discussion

The study revealed the presence *of Klebsiella* species in 28.29% (n=26) samples followed by *Pseudomonas aeruginosa* 20.69% (n=18), *Klebsiella Pneumonia* 13.79% (n=12), *Acinetobacter baumanni* 10.34% (n=9), Non-fermenting *gram negative rods* 9.19% (n=8), *Acinetobacter spp* 3.45% (n=3), Non-Fragmenting *gram negative rods*, Non-pigmented *gram negative rods* and *E. Coli* 3.57% (n=2), *Staphylococcus aureus*, Non-pigmented *Pseudomonas aeruginosa*, *Acinetobacter iwoffi*, and *proteus spp* had an incidence of 1.14% (n=1). Similar results were observed in the study by Mahin Jamshidi *et al* titled, "Antimicrobial resistance pattern among intensive care unit patients." The study revealed that the most frequent gram negative microorganisms were *P. aeruginosa* (43.2%) and *Klebsiella spp* (33.7%); *Staphylococcus aureus* (39.2%) was most common gram positive microorganism isolated [7].

The frequency for the growth of microorganism was observed as follows: 50% patients (28/56) single microorganism, 28.57% patients (16/56) two microorganisms, 12.50% patients (7/56) three microorganism, and 3.57% patients (2/56) 4 microorganisms, respectively. The study also revealed that 5.35% (3/56) of patients were sterile throughout the stay. Fig.1 shows the distribution for frequency of microorganisms growth.

The incidence of single microorganism growth was highest as compared to the multiple microorganisms though very few of them were infectious. This may be accounted to good infection control practices like maintenance of good hygienic conditions, and following proper sampling procedures and other invasive techniques.

A similar pattern was observed in the study entitled, "Nosocomial bacterial infections and their antimicrobial susceptibility patterns among patients in intensive care units: A cross sectional study" by Peter Agaba *et al*. of Uganda. The data revealed that 32 patients developed nosocomial infection and a total of 52 isolates were obtained. About 20 (62.5%) of the patients grew one organism, 11 (34.37%) grew two organisms and only 1 (3.12%) patient grew three organisms [23].

A high resistance was seen for the drug Ceftazidime, *Klebsiella spp (91.66%), Pseudomonas aeruginosa* (62.5%) and *Klebsiella pneumonia (100%)*, respectively, while the drug Ciprofloxacin was sensitive. Table 2 shows the detailed distribution of sensitivity and resistance pattern.

The study titled, "Antimicrobial resistance pattern among aerobic gram negative bacilli of lower respiratory tract specimens of Intensive Care Unit patients in a neuro centre" of Bangalore by H.B. Veena Kumari, *et al* reported *Pseudomonas aeruginosa* of tracheal and bronchial specimens showed 59.8% and 40% resistance to Amikacin,

respectively. *Non-fermentative gram-negative bacilli* exhibited 71.4% and 75% resistance to Amikacin and 38.3% and 62.5% to netilmicin in tracheal and bronchial specimens, respectively. Netilmicin showed highest activity against *NFGNB* and Amikacin against *Klebsiella spp* and *Escherichia coli* specimens [17].

Summary and Conclusion

The present study is an initiative to observe serious threats in patients admitted in ICU due to nosocomial infection. The commonest microorganisms observed were *Klebsiella* species 28.29% (n=26), *Pseudomonas aeruginosa* 20.69% (n=18), *Klebsiella pneumonia* 13.79% (n=12), *Acinetobacter baumanni* 10.34% (n=9). Maximum resistance was observed to Ceftazidime, 3rd generation cephalosporin 92.7% (51 out of 55). Highest sensitivity was seen for Colistin 80% (8 out of 10) followed by Ciprofloxacin76.82% (63 out of 82).

In ICU, there is need of regular testing of antibiotics sensitivity patterns, guiding clinicians selecting therapy. This will restrict emergence of resistant bacteria, effective cost benefit, inventory and stock management.

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