BACTERIOLOGICAL PROFILE AND THE ANTIBIOTIC SUSCEPTIBILITY PATTERN OF ENDOTRACHEAL SECRETIONS IN ICU OF A TERTIARY CARE HOSPITAL

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ABSTRACT

BACKGROUND

Patients on mechanical ventilation are at higher risk of acquiring hospital acquired infection due to interplay of compromised host defense, virulent organism and presence of invasive device. Knowledge of local bacteriological trend of the antibiotic susceptibility pattern is a must to initiate a judicious antibiotic treatment.

MATERIALS AND METHODS

The study was a retrospective descriptive study analysis of endotracheal (ET) samples of patients on mechanical ventilation done over a period of 6 months from July 2017 to Dec 2017. This was done to analyse bacteriological profile and their antibiotic susceptibility.

RESULTS

44 out of 82 samples showed growth accounting for total of 53% (positive cultures). Gram negative bacteria were the most common isolates with *Klebsiella spp.* being the most common bacteria followed by *Pseudomonas aeruginosa. Acinetobacter baumannii*, though the most resistant organism was a rare isolate. Klebsiella was the most common as well as an MDR (multidrug resistant) isolate.

CONCLUSION

Gram negative bacteria are the major isolates from ET secretions of patients on mechanical ventilation in our ICU setup, Klebsiella being the most common and resistant too. An antibiogram specific for healthcare setting is a must that shall be based on bacteriological profile and organism's sensitivity pattern.

KEYWORDS

Endotracheal Aspirate, MDR, Klebsiella Pneumoniae, Mechanical Ventilation, Gram Negative Bacteria.

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BACKGROUND

Invasive devices continue to be essential for the management of critically ill patients, despite breath-taking advances in modern day medicine.[1] These ubiquitous devices unfortunately are a major cause of nosocomial infections, especially in the ICU.[2] As a result following these invasive methods, the incidence of nosocomial infections in ICU has raised.[3]

These infections are associated with significant rise in morbidity, mortality and healthcare cost. An additional problem is the emergence and rise in multi-drug resistant (MDR) pathogens. Several factors like new mutations, selection of resistant strains and suboptimal infection control along with the use high level antibiotics influences the rapid spread of MDR bugs in the ICU.[4] In patients on mechanical ventilation with intubation, frequent colonisation occurs either through exogenous or endogenous origin.[5]

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Ventilator-associated pneumonia (VAP) is the second-most common hospital-acquired infection (HAI), accounting for 15% of HAIs and has the highest morbidity and mortality.[6] A large number of bacteria are found to be causative factors for colonisation that may later proceed to infection.[7] Gram negative bacteria are predominant ones. Most common gram-negative bacteria are *Pseudomonas aeruginosa*, *Acinetobacter spp.* and *Klebsiella pneumoniae*.[8,9] Prolonged hospital stay and colonisation with Pseudomonas species itself is an independent risk factor for gram negative bacterial infection.

The longer the hospital stay is as in case of head trauma, the more are the chances of change of bacterial flora causing infection, thereby complicating therapy because of alteration of susceptibility pattern.[10,11]

It is very essential for the clinicians to be aware of local bacteriological flora and their susceptibility pattern to encourage rational use of antibiotics. The aim of our study was to present a data that represents the local bacterial trend in respiratory secretions of the ventilated patients and their antibiotic susceptibility patterns.

MATERIALS AND METHODS

The study was a retrospective descriptive study conducted in 2 ICUs; medical (MICU) and surgical (SICU) of a tertiary care hospital over a period of six months from July 2017 to Dec 2017. The analysis of the reports was done at the Microbiology Department.

Samples were endotracheal secretions collected from patients, who were on mechanical ventilation for more than 2 days for various reasons. Patients were selected regardless of age and sex. Samples were aseptically inoculated on blood agar and MacConkey agar. The plates were further incubated aerobically at 37^{0}C overnight. Significant growth was considered when > 10^5 colonies were obtained from tracheal secretions.[12] The antibiotics were used as per the strips suitable for the kind of growth as per standard protocol.

A total of 82 samples were collected during the study period. A total of 44 samples showed significant growth when cultured using standard microbiological techniques.[13] Significant growth was considered when > 10^5 colonies were obtained.[12] Organisms were identified by automated system; ATB reader and their antibiotic susceptibility was done as per latest CLSI guidelines 2017.[14] Exclusion criteria were the isolates identified as contaminant or same isolates from repeat culture of patient. Our gram negative bacterial isolates were defined as multi-drug resistant (MDR) when they were resistant to at least 3 different types of antimicrobials.[15]

RESULTS

The percentage of positive cultures was approximately 53% (44 positive cultures out of 82 samples). The most common bacteria isolated were *Klebsiella pneumoniae* (50%), *Pseudomonas aeruginosa* (25%), *Escherichia coli* (9%), *Enterococcus faecalis* (9%), *Staphylococcus aureus* (4.5%) and *Acinetobacter baumannii* (2.5%). Thus, gram negative bacteria (GNB) contributed to major number of isolates (86.5%); the remaining 13.5% was as a result of gram positive infections. Moreover, amongst GNB, Enterobacteriaceae (*K. pneumoniae* and *E. coli*) accounted for 59%, while non-fermenters (*P. aeruginosa* and *A. baumannii*) comprised the rest (Fig. 1).

ICU wise, the common isolates in MICU were Pseudomonas and *E. coli* followed by Klebsiella, while in NSICU *Klebsiella pneumoniae* was the most common isolate. The only Acinetobacter isolate was isolated from NSICU.

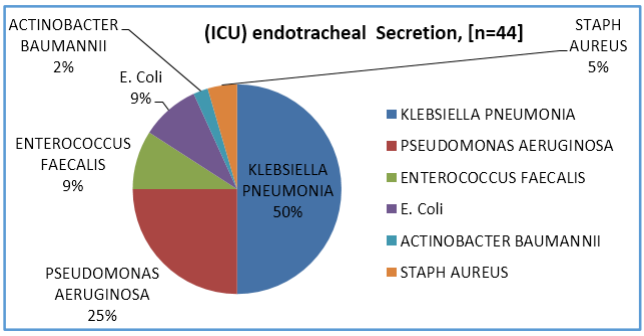

Figure 1. Bacteriological Profile of ET Secretions in MICU and NSICU

Antibiotic Susceptibility Profile

Amongst gram negative bacteria, *E. coli* was the least resistant organism being sensitive to aminoglycosides and cotrimoxazole followed by *P. aeruginosa*. On the other hand, Klebsiella isolates and Acinetobacter spp. were resistant to lower antibiotics namely cephalosporins, aminoglycosides and fluoroquinolones. While some *K. pneumoniae* isolates showed susceptibility to Tigecycline and few to carbapenems, *A. baumannii* was only sensitive to polymyxins.

Amongst gram positive bacteria, 100% susceptibility was shown to higher antibiotics viz. teicoplanin, linezolid and Vancomycin, while resistance was observed towards beta lactam antibiotics. The resistance was high towards fluoroquinolones for both gram positive and gram-negative isolates (Table 1).

None of the patients who were mechanically ventilated in our study period developed VAP.

	Pathogens	No. of Isolates	% of Isolates	Sensitive	Resistant
1.	Klebsiella	22	50	PB, Col (100%) Tgc- (70%), I, Mr (55%)	All cephalosporins, aminoglycosides, FQ
2.	Pseudomonas	11	25	PB, Col (100%), I, Mr (100%), CfS (100%), Ak (50%), PTz (50%)	Cephalosporins (100%), FQ (100%), CoT (100%)
3.	*Enterococcus faecalis*	4	9	Va, Lz, Tei (100%), PTz (50%), Tetra (70%),	Beta Lactams (100%), FQ (100%)
4.	*E. coli*	4	9	Col (100%), I/Mr (100%), PTz (75%), CfS (75%), Ak (50%),	Amc, Cip, CoTri
5.	*S. aureus*	2	4.5	Va, Lz, Tei (100%), PTz (50%), Tetra (70%), I (100%), CD-60%	Cz, E, Cip, Penicillin
6.	*A. baumannii*	1	2.5	PB, Col (100%)	Carbapenems, FQ, Aminoglycosides, cephalosporins
7.	No growth	38			

Table 1. Antibiotic Susceptibility Profile of Isolates in ET Secretions

AK= Amikacin, GEN= Gentamycin, CIP= Ciprofloxacin, IMI= Imipenem, AMC= Amox=co=Clavulanate, COT= Cotrimoxazole, PB= Polymyxin B, Col= Colistin, Mr= Meropenem, FQ= Fluoroquinolones (Ciprofloxacin, Ofloxacin), PTz (Piperacillin=tazobactam), Va= vancomycin, Lz (linezolid), Tei= teicoplanin, tetra= tetracycline, Cz= (cefazolin).

DISCUSSION

Endotracheal intubation and mechanical ventilation are life-saving procedures done to prevent or combat respiratory failure.[16] On the other hand, it may even lead to life-threatening lung infections due to various reasons that bypass the host's immune response, whereby organisms enter the airways by exogenous or endogenous route causing ventilator associated pneumonia (VAP). In our study, we chose samples from the patients who were on mechanical ventilation for more than 2 days. This would help us identify VAP.

During our study period, the VAP count was 0 as per the CDC definition. Joseph et al study in Pondicherry showed a high incidence rate of 22.4 per 1000 ventilator days.[17]

There have been many studies done in the Indian subcontinent that have identified the aetiological agents of VAP as well as the susceptibility pattern which has been showing increasing resistance. Most common VAP pathogens are *P. aeruginosa*, *Acinetobacter spp., E. coli*, *K. pneumoniae* and *S. aureus.*[15] In our study, though Klebsiella spp. was the most common organism. Nishat et al study had Pseudomonas, *Acinetobacter spp.* and *Klebsiella pneumoniae* as most common isolates (26% each) followed by *E. coli* and *S. aureus*(15) and 86.3% isolates were MDR. In our study Klebsiella and *Acinetobacter spp.* were MDR, while rest of the isolates were quite sensitive except to the beta-lactam antibiotics and fluoroquinolones. In Anusha et al study, Klebsiella was the most common bacteria followed by Pseudomonas, Acinetobacter and *E. coli*, just like our findings.[16] But their isolates were mostly susceptible to aminoglycosides and carbapenem class. In our study, Klebsiella isolates were resistant to aminoglycosides.

Summaiya M et al, while assessing biofilm formation by VAP aetiological agents found that the most common isolates are *Pseudomonas aeruginosa* and *Acinetobacter spp.*[18] While Trilok Patil study at Aurangabad found *Pseudomonas aeruginosa* to be the most common organism (37.4%) followed by *Klebsiella pneumoniae* (28.5%).[19] George P et al study had Acinetobacter as the most common isolate (37.5%) followed by Pseudomonas (21.8%) and Klebsiella (5%).[20] These studies differed from our observation of Klebsiella being the most common organism in endotracheal secretions. As per Deepti et al study, Gram negative enteric aerobic bacteria were isolated from most of the patients, most common being Klebsiella species (32.35%) followed by Acinetobacter and Pseudomonas.[21] In their study Gram positive cocci were mostly sensitive to Penicillin derivatives, Vancomycin and Clindamycin, while our GPC were resistant to Penicillin derivatives.[21] These variations in the aetiological bacteria can be due to varied population in ICU, their prior antibiotic therapy and the commensal carriage.

Gram negative bacteria as the most common isolates in ET secretion was similar in various studies, but the multi-drug resistant property of Klebsiella isolates and resistance of gram positive bacteria to penicillins in our study is alarming.

The limitation of the study is that the study was of short duration and a retrospective one. The results are not applicable to generalised healthcare settings, since the findings are from a single tertiary care hospital. The BAL sample was not included in samples and the outcome of patients could not be monitored.

CONCLUSION

Gram negative bacteria form the predominant isolates in our ICU setup; the worrisome being Klebsiella isolates which were resistant to even carbapenem group of antibiotics. Clinicians shall be aware of local bacteriological profiles and their antibiotic sensitivity pattern since that helps them in initiation of an appropriate antibiotic therapy. Thus, an updated antibiogram for a hospital and timely ET secretion culture are the keys to reduce emergence of resistant microbes in patients on mechanical ventilation.

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