Active Surveillance Of Endo-Tracheal Aspirates From Mechanically Ventilated Patients In Intensive Care Unit At A Tertiary Care Center

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ABSTRACT

Introduction: Critically ill Intensive care unit (ICU) patients are most vulnerable for developing respiratory and urinary tract infections especially who are mechanically ventilated due to complex interplay between the endotracheal tube, host immunity and virulence of invading bacteria. The aim and objective of the study was to analyze the aerobic bacteria and their antibiotic sensitivity pattern isolated from endotracheal aspirates of ventilated patients in ICU.

Materials and Methods: The prospective study was done with the endotracheal samples received in the Microbiology Laboratory in a tertiary care hospital in south India, over a period of one year. Samples were collected under sterile conditions from medical and surgical ICU patients who were ventilated for at least 48 hrs. The samples included endotracheal secretion and endotracheal tube tip which was processed as per microbiological standards.

Results: A total of 41 samples from 41 patients were collected during the study period of one year. The two major reasons for admission were organophosphate poisoning and RTA with head injury. There was predominance of male patients with M: F ratio of 3:1 respectively. The organisms commonly isolated were *Acinetobacter*, *Pseudomonas*, and *Staphylococcus aureus*. Out of 41 isolates 21 were multi-drug resistant which implies that 50% of isolates are multidrug resistant.

Conclusion: Regular periodic surveillance of microbial profile and susceptibility patterns of ventilated patients in ICU should be done to detect emerging resistant bacterial strains. To combat the high antimicrobial resistance, every center should adopt a strict hospital infection control policy which includes judicious use of antimicrobial agents, use of rational antibiotic therapy, education programs and hand hygiene.

Keywords: Antibiotic policies, endotracheal aspirates, hand hygiene, multi-drug resistant, ventilator

INTRODUCTION:

An intensive care unit (ICU) is a special department of a hospital that cater to patients with the most severe and life-threatening illnesses and injuries; that require constant, close monitoring and support from specialized equipment and medication in order to

maintain normal vital functions of the patient.¹ This increases the risk of the ICU patient five to seven fold with an increase in mortality due to nosocomial infection. Intensive care units contribute 20% to 25% of all nosocomial infections in a hospital.^{2,3} Critically ill Intensive care unit (ICU) patients are most vulnerable for developing

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respiratory and urinary tract infections as compared to those patients admitted in ward.

Respiratory infections in critically ill patients are associated with high morbidity and mortality.⁴ Rapid diagnosis and initiation of appropriate antibiotic therapy is essential for better outcomes. Patients who are intubated and mechanically ventilated are further at risk of acquiring respiratory infections due to complex interplay between the endotracheal tube, host immunity and virulence of invading bacteria. The etiological agents may vary according to the population of patients in an ICU, duration of hospital stay, pre-existing illness and prior antimicrobial therapy.⁵ Common causative agents are *Pseudomonas species*, *Acinetobacter species*, *Staphylococcus aureus*, and *Enterobacteriaceae* including the endogenous bacteria⁶. The common problem however as noted in other studies is that bacterial pathogens from tracheal aspirates tend to be a multidrug-resistant.⁷ There is much well documented evidence that hospital personnel and environment are the microbial source and prolonged hospital stay and overuse of antimicrobial agents has led to multidrug resistance of these microbes.⁸

In the hospital, endotracheal aspiration for the diagnosis of nosocomial infection is common in patients admitted in the ICU.⁹ Therefore updated knowledge of local epidemiological and susceptibility profile is recommended for guiding the clinicians regarding empirical choice of antibiotics and has become mandatory along with adequate clinical diagnosis and bacterial confirmation.¹⁰ Hence the aim and objective of the study was to analyze the spectrum of aerobic bacteria and their antibiotic sensitivity pattern

isolated from endotracheal aspirates of ventilated patients in Intensive Care Units.

AIMS AND OBJECTIVES:

To analyze the aerobic bacteria and their antibiotic sensitivity pattern isolated from endotracheal aspirates of ventilated patients in ICU.

MATERIALS AND METHODS:

The prospective study was carried out with the samples of endotracheal aspirate and endotracheal tube tip received in the Microbiology Laboratory over a period of one year (Jan 2013 - Dec 2013). Samples were collected under sterile conditions from patients admitted in both medical and surgical intensive care unit who were ventilated for at least 48 hrs. In patients who were ventilated outside, samples were taken on day of admission. The samples included endotracheal secretion and endotracheal tube tip.

Collection of Specimen:

Endotracheal Aspirate:

Sampling was done by introducing a catheter aseptically through the endotracheal tube and secretions aspirated into a sterile syringe.¹¹

Endo-tracheal tube tip:

The endo-tracheal tube tip was cut aseptically into a sterile container and sent to the Microbiology laboratory.

Processing of Specimen:

Endotracheal Aspirate:

Both 10µl of the specimen and 1 µl of the specimen was inoculated in blood agar and MacConkey agar.¹²

Endotracheal tube tip:

The lumen of endotracheal tube tip was rinsed with 0.5 ml of sterile normal saline. 10µl of the fluid was inoculated on blood agar and MacConkey agar.

A gram stain of the endotracheal secretions / endotracheal tube tip fluid was done to assess the number of pus cells and the presence of bacteria. A semi quantitative method was followed and plates were incubated overnight at 37°C.¹³ A significant growth of $>10^5$ CFU/ml was taken for identification. The organisms isolated were identified based on colony characteristics on Blood agar and MacConkey agar, Gram's stain, Biochemical reactions by using standard microbiological techniques. Isolates identified as commensals or contaminants were excluded from further process. A Kirby-Bauer method was used to test the susceptibility of organisms to various antibiotics.

Antibiotics used:

Ampicillin (AMP-10µg), Cefazolin (CZ-30µg), Cefoxitin (CX-30 µg), Vancomycin (VA-30µg), Linezolid (LZ-30µg), Clindamycin (CD-2µg), Erythromycin (E-15µg), Piperacillin (PI-100µg), Ceftazidime (CAZ-30µg), Ceftazidime/Clavulanic acid (CAC-30µg/10µg), Cefepirazole (CPZ-30µg), Cefotaxime (CTX-30µg), Tobramycin (TOB-10µg), Doxycycline (DO-30µg), Piperacillin/Tazobactam (PIT-100µg/10µg), Gentamicin (GEN-10µg), Amikacin (AK-30µg), Azteronam (AT-30µg), Ciprofloxacin (CIP-5µg), Ofloxacin (OF-5µg), Imipenem (IMP-10µg), Colistin (CL-10µg), Polymyxin B (PB-300U). Zone diameter was measured and interpreted as per the Clinical and Laboratory Standards Institute (CLSI) guidelines.

RESULTS:

A total of 41 samples from 41 patients were collected during the study period of one year. The major reason for admission was organophosphate

poisoning and second major reason being RTA with head injury. There was male predominance with a male to female ratio of 3:1 respectively. Most of the patients fell into the age group of 20-30 years. Endo-tracheal tube tip was the majority sample received and was processed as per CLSI guidelines. There was growth in 37 specimens and 4 specimens were sterile. The organisms isolated were *Acinetobacter spp* (14), *Pseudomonas spp* (9), *Staphylococcus aureus* (8), *Klebsiella pneumoniae* (4), Non-fermenting GNB – NFGNB (4), *Escherichia coli* (1) and *Citrobacter spp* (1) (Table 1). Susceptibility pattern of isolated organisms is shown in (Fig 1 – 4). Among the eight *Staphylococcus aureus* all the strains were Methicillin resistant (Cefoxitin resistant). Out of fourteen *Acinetobacter spp*, nine of them were multi-drug resistant. Two multi-drug resistant strain out of nine *Pseudomonas* isolates. There were six multi-drug resistant strains out of eight *Klebsiella pneumoniae*. *Escherichia coli*, *Citrobacter spp* and NFGNB were all multi-drug resistant and were only susceptible to Imipenem.

Table 1. Distribution of Bacterial Isolates from endo-tracheal tube aspirates

Bacterial Isolates	No. of isolates
<i>Acinetobacter spp</i>	14
<i>Pseudomonas spp</i>	9
<i>Staphylococcus aureus</i>	8
<i>Klebsiella pneumoniae</i>	4
NFGNB	4
<i>Escherichia coli</i>	1
<i>Citrobacter spp</i>	1
Total	41

Figure 1. Sensitivity pattern of *Staphylococcus aureus*

Figure 2. Sensitivity pattern of *Acinetobacter* spp

Figure 3. Sensitivity pattern of *Pseudomonas* spp

Figure 4. Sensitivity pattern of *Klebsiella pneumoniae*

DISCUSSION:

Endotracheal intubation and mechanical ventilation are life-saving procedures done on emergency or elective basis to prevent or combat respiratory failure. Many clinical conditions warrant need for ventilator support like, life threatening infections, sepsis and acute respiratory distress syndromes, neurological dysfunctions due to poisoning, drug toxicity, cerebrovascular accidents, trauma and others. On one hand while mechanical ventilation helps to prevent deaths due to respiratory failure on the other hand it poses great threat, by host immune response and infectious organisms that leads to life threatening lung infections.⁵ The mechanically ventilated and tracheotomised patients are colonized with bacteria of either endogenous or exogenous origin which might end up in VAT or VAP.⁸ Health care associated infections (HCAI) continue to be a major cause of patient morbidity and mortality in ICU.

In our study the most frequent clinical condition needing mechanical ventilation was poisoning and trauma (Head injury) was the second common condition. In a study by Arindam dey et al¹⁴, post-operative condition was the most frequent clinical

condition needing mechanical ventilation and COPD patients were the most frequently ventilated patients in a study by Ramakrishna pai et al.¹⁵ A study by Shanmugavadivoo et al⁸ showed results similar to our study. Our study showed a predominance of male ventilated patients than female in the ratio of 3:1 respectively which is correlated with the study conducted by Saha et al.⁶

In the present study, organisms isolated from endo-tracheal aspirates were *Acinetobacter spp* (14), *Pseudomonas spp* (9), *Staphylococcus aureus* (8), *Klebsiella pneumoniae* (4), Non-fermenting GNB (4), *Escherichia coli* (1) and *Citrobacter spp* (1). The predominant organism was *Acinetobacter* followed by *Pseudomonas*, *Staphylococcus aureus* and *Klebsiella pneumoniae*. Our result has been correlated with Shanmugavadivoo et al⁸ that *Acinetobacter* has overtaken the pathogenic role in ventilated patients. A study by Tihana MT et al¹⁶ showed *Pseudomonas* as a predominant organism in endotracheal aspirates. All the *S.aureus* strains were Methicillin resistant *Staphylococcus aureus* which is a most common causative agent of nosocomial infection.

In this study, microbial profile of endo-tracheal aspirates in ventilated patients showed an increase in number of *Acinetobacter spp*, of which nine of them were multi-drug resistant. Colistin is considered the treatment option for critically ill patients in the ICU with infections caused by multi-drug resistant *Acinetobacter spp*, owing to its favorable properties of rapid bacterial killing and an associated slow development of resistance¹⁷. In our study three *Acinetobacter* showed Colistin resistance. Bassetti M et al¹⁸ showed that a combination of Colistin and Rifampicin appears to be an effective and safe therapy for severe

infections due to multidrug - resistant *Acinetobacter spp*.¹⁹ In our study multi-drug resistant *Acinetobacter* (9), *Pseudomonas* (2), *Klebsiella pneumoniae* (6), Non fermenting Gram Negative bacilli (2), *E.coli* (1) and *Citrobacter* (1) has been isolated. Out of 41 isolates 21 are multi-drug resistant which implies that 50% of isolates are multidrug resistant. The major reasons for multidrug resistance are ventilators, prolonged hospital stay, irrational usage of antibiotics. There are many studies that has been shown similar results.^{1,2,5,20,21}

CONCLUSION:

In our study we found that Gram negative bacteria especially *Acinetobacter* is the most common etiological agent in tracheotomised patients. Most of the organisms were multi-drug resistant. This study has set up new research goal for surveillance of microbial profile and susceptibility patterns of ventilated patients in ICU. This should be conducted regularly in order to detect potential alterations, especially emerging resistant bacterial strains. This study can only be effective if there is a standard antibiotic policy in the hospital which is reviewed at periodic intervals by a hospital infection control committee. So, to combat the high antimicrobial resistance, every center should have a strict hospital infection control policy which includes measures like judicious use of antimicrobial agents, use of rational antibiotic therapy, education programs and hand hygiene.

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