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BACTERIAL COLONIZATION OF ENDO-TRACHEAL TUBES IN MECHANICALLY VENTILATED PATIENTS IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Nosocomial infections are the leading cause of mortality in patients admitted in Intensive Care Unit (ICU). Bacterial colonization by formation of biofilm in endo-tracheal tube and its dislodgement following suction and intubation finally leads to ventilator associated pneumonia (VAP). **AIM:** To study the pattern of bacterial colonization and its sensitivity profile in endotracheal tubes in mechanically ventilated patients. **MATERIALS AND METHODS:** A total of 93 consecutive, non-repetitive patients, on mechanical ventilation for more than 7 days were included. The tip of ET suction catheter was cultured at 24 hour, 48 hour and ET tube was removed and tip was cut and sent for culture after 7 days of incubation followed by antimicrobial sensitivity as per CLSI guidelines. **RESULTS:** A total of 87 subjects were enrolled in the study. Increasing number of organisms were cultured with increased duration of samples were found as increased stay of ET causes increased colonization. 53 out of 87 patients at 24 hours (60.92%), 68 out of 87 patients (78.16%) form ET suction catheter tips at 48 hours, and 76 out of 87 patients (87.35%) of ET tube tip at 7th day of incubation were colonized with microorganism. In whole study Pseudomonas aeruginosa was found to be more sensitive compared to NFGNB. In the study 7th day of organism were more sensitive to drugs compared to 24 hours and 48 hours cultures in both NFGNB and Pseudomonas aeruginosa. **CONCLUSION:** To prevent morbidity and mortality due to VAP in ICU patients, culture of aspirate of ET must be taken to formulate antibiotic policy for early treatment. However exact role of ET colonization is yet to be decided for the causation of VAP and also similar studies should be conducted in other areas to collect the information of antibiotic resistance in critically ill patients.

KEY WORDS: Pseudomonas aeruginosa, Ventilator associated pneumonia, ET tube tip, Culture

INTRODUCTION

Due to spread in antimicrobial resistance in the world, there is very sparse number of antibiotic remains for the treatment of critically ill patients as there are very few alternate exists. This can lead to increased mortality rate, hospital stay such as ICU, socioeconomic disturbances etc. These infections are transmitted to outer world due to discharged patients, working staff and attendants due to spread of multi-drug resistant organism.

The most common type of infection are due to carelessness in hand hygiene, nasal carriers, central line associated infection, catheter associated, surgical site infection and VAP **(1)** which includes Clostridium

species, Staphylococcus aureus, Non fermenter gram negative bacilli, Enterobacteriaceae etc. Legionella species may cause interstitial pneumonia due to inhalation of aerosol of contaminated water. **(2)** Hepatitis C and B virus, RSV, Rotavius, enterovirus. Candida albicans, cryptosporitim, cyptoocccus neoformance and Aspergillus species are also opportunistic pathogens.

In standard cuffed endo-tracheal tubes, folds are the permanent source of infection, are the cause of bacterial colonization and biofilm formation in mechanically ventilated patients. They overcome the natural defense mechanism; allow the bacteria to colonize and formation of biofilm such as Pseudomonas aeruginosa produce exopolysaccharide favoring biofilm formation. **(3, 4)** ET suction and repeated incubations leads to its dislodgement which finally leads to LRTI/ VAP.

Bacterial colonization i.e. initial portal of entry in lower respiratory tract infection is responsible for various cases of VAP. Impaired cough reflex and immune system, therapeutic measures like ET intubation and suction etc. can also be responsible for bacterial invasion. **(5, 6)**

Self-medication with antibiotics, incorrect dosage, prolonged use and lack of standards for healthcare workers, lack of hand hygiene, nasal carrier, and lack of policy formation for antibiotic cycling and prevention of antibiotic resistance finally leads to emerging of antimicrobial resistance.

This study was aimed to study the pattern of bacterial colonization and its sensitivity profile in endo-tracheal tubes in mechanically ventilated patients at different duration.

MATERIALS AND METHODS

A total of 93 consecutive, non-repetitive patients, on mechanical ventilation for more than 7 days were included in the study. It was a prospective, randomized and cross sectional study with an age incidence of 18 to 65 years of age.

Exclusion criteria: Patients below 18 years of age, more than 65 years of age, patient intubated elsewhere and shifted to ICU, pregnant and lactating women, HIV sero-positive patients, patients with pre existing sepsis, patient on steroid therapy, patient not given consent or patients with immune-suppression.

The patients were managed and investigated as per the ICU protocol, weaned off and extubated after they satisfied the extubation criteria. Patients were monitored by Truscope Ultra Q7 PATIENT MONITOR (Schiller Healthcare India Pvt. Ltd., Mumbai, Maharashtra, India). Non-Invasive Blood Pressure, Oxygen Saturation, ECG, Heart Rate, and Respiratory Rate were recorded.

The tip of ET suction catheter was cultured at 24 hour, 48 hour and ET tube was removed and 5 cms (2") of distal tip was cut and sent for culture after 7 days of incubation. ET tube tip and catheter tip was placed in a sterile container and sent immediately to microbiology lab.

The sample was finally cultured on Nutrient agar, blood agar and McConkey agar and incubated for 24 hours at 37o C. after 24 hours of incubation, size, shape, surface, colour, emulsifiability and margin etc. along with gram staining, motility testing and biochemical reaction were studied along with antimicrobial sensitivity profile done by disc diffusion technique (modified Kirby Baur Method) as per Clinical and Laboratory Standards Institute (CLSI) guidelines. **(7)**

STATISTICAL ANALYSIS

Data was recorded using Microsoft Excel 2007 (Microsoft Corp., Redmond, USA). All the entries were properly checked. Statistical analysis was done using SPSS 19 software.

RESULT

A total of 87 adult patients were included in the study fulfilling all the criteria, were on mechanical ventilation for 7 or more than 7 days. Increasing number of organisms were cultured with increased duration of samples were found as increased stay of ET causes increased colonization. 53 out of 87 patients at 24 hours (60.92%), 68 out of 87 patients (78.16%) form ET suction catheter tips at 48 hours, and 76 out of 87 patients (87.35%) of ET tube tip at 7th day of incubation were colonized with microorganism.

Non fermenter gram negative bacilli (NFGNB which include Acinetobacter sp.), Pseudomonas aeruginosa and Klebsiella species were the predominant species isolated at 24 hours, 48 hours and 7th day post incubation with increased number of organism. (Table -1, 2 and 3)

Table 1: Endotracheal suction catheter tip culture at 24 hour of incubation

Organism isolated	Number (%)
Non fermenter GNB including Acinetobacter	19 (23.75)
Pseudomonas aeruginosa	17 (21.25)
Klebsiella species	13 (16.25)
Staphylococcus aureus	12 (15)
Enterobacter	6 (7.5)
Citrobacter	5 (6.25)
CONS	4 (5)
Proteus species	2 (2.5)
Candida species	1 (1.25)
Beta hemolytic streptococci	1 (1.25)
Total	80 (100)

Table 2: Endotracheal suction catheter tip culture at 48 hour of incubation

Organism isolated	Number (%)
Non fermenter GNB including Acinetobacter	22 (20.37)
Pseudomonas aeruginosa	21 (19.44)
Klebsiella species	16 (14.81)
Staphylococcus aureus	15 (13.89)
Enterobacter	11 (10.19)
Citrobacter	9 (8.33)
CONS	7 (6.48)
Proteus species	4 (3.7)
Candida species	2 (1.85)
Beta hemolytic streptococci	1 (0.93)
Total	108 (100)

Table 3: Endotracheal tube tip culture at 7th day of incubation

Organism isolated	Number (%)
Non fermenter GNB including Acinetobacter	27 (23.28)
Pseudomonas aeruginosa	25 (21.55)
Klebsiella species	19 (16.38)
Staphylococcus aureus	18 (15.52)
Enterobacter	12 (10.35)
Citrobacter	9 (7.76)
CONS	8 (6.9)
Proteus species	5 (4.31)
Candida species	2 (1.72)
Beta hemolytic streptococci	1 (0.86)
Total	116 (100)

In whole study Pseudomonas aeruginosa was found to be more sensitive compared to NFGNB. In the study 7th day of organism were more sensitive to drugs compared to 24 hours and 48 hours cultures in both NFGNB and Pseudomonas aeruginosa. (Table 4)

Table 4: Antibiotic sensitivity pattern of gram negative bacilli (Acinetobacter and Pseudomonas)

Antibiotic	24 hours (%)		48 hours (%)		7th day (%)	
	NFGNB (19)	Pseudomonas (17)	NFGNB (22)	Pseudomonas (21)	NFGNB (27)	Pseudomonas (25)
Amikacin	31.58(6)	64.71(11)	36.36(8)	42.86(9)	37.04(10)	72(18)
Amoxyclav	15.78(3)	29.41(5)	22.72(5)	38.1(8)	33.33(9)	44 (11)
Cefoperazone + Sulbactum	36.84(7)	23.53(7)	50(11)	52.38(11)	44.44(12)	60(15)
Ceftazidime	47.37(9)	35.29(6)	40.91(9)	57.14(12)	44.44(12)	72(18)
Imipenam	26.32(5)	64.71(11)	27.27(6)	76.19(16)	62.96(17)	84(21)
Piperacillin + Tazobactum	21.05(4)	35.29(6)	27.27(6)	38.1(8)	33.33(9)	72(18)

In the study, 14 out of 87 patients developed Ventilator associated pneumonia (VAP). Enterobacter was isolated in only one case while other patients show mixed type of growth. (Table 5)

Table 5: Cause of ventilator associated pneumonia (VAP)

Causes	Number of positive cultures (%)
Polymicrobial	5 (35.71)
Pseudomonas aeruginosa + Klebsiella species	4 (28.57)
NFGNB including Acinetobacter + Staphylococcus aureus	4 (28.57)
Enterobacter	1 (7.14)

DISCUSSION

In mechanically ventilated patients, bacterial colonization is a dynamic process causing involvement of microorganisms and complex interactions associated with host defence mechanism. Bacteria causing ventilator associated pneumonia (VAP) mainly originates in oropharynx. Endotracheal tube increases the risk of colonization as it act as a nidus. Poor prognosis is associated with increased duration of stay, multidrug resistant bacteria and immune status of patients.

In our study, 53 out of 87 patients at 24 hours (60.92%), 68 out of 87 patients (78.16%) form ET suction catheter tips at 48 hours, and 76 out of 87 patients (87.35%) of ET tube tip at 7th day of incubation were colonized with microorganism. Increasing number of organisms were cultured with increased duration of samples collected were found as increased stay of endotracheal tube causes increased colonization. Our study is concordant with the study of Inglis TJ et al **(8)** while Ewig S et al **(9)** had found that initial colonization with Streptococcus viridians, Staphylococcus aureus and Hemophilus influenza which later on colonized by Enterobacteriaceae, Pseudomonas and NFGNB such as Acinetobacter species on 7th day. Gil-Perotin S et al **(10)** isolated 100% growth in ET aspirates. The difference in various studies occurs due to type of endotracheal tube used, technique of intubation, colonization during intubation, demographical variations in patient, prevalence of resident flora, inadvertent use of antibiotics, immunosuppressive state of patient, presence of chronic debilitating diseases, selection of patient type, lack of following ideal procedure of intubation and work load in emergency and ICU settings along with the ability of microorganism to produce biofilms.

Non fermenter gram negative bacilli (NFGNB which include Acinetobacter sp.), Pseudomonas aeruginosa and Klebsiella species were the predominant species isolated at 24 hours, 48 hours and 7th day post incubation with increased number of organism. Hoqye L et al **(11)** isolated Acinetobacter in 25%, Pseudomonas in 15% and Klebsiella in 10% cases is concordant with our study. In our study NFGNB were most sensitive to Ceftazidime at 24 and 48 hour sample and to imipenam on 7th day sample while pseudomonas aeruginosa was most sensitive to Imipenam in all the time trends. Tullu MS et al **(12)** showed highest susceptibility to Cefotaxime and Amikacin. Panda G et al had evaluated that Acinetobater was highly susceptible to Polymyxin B, intermediate sensitive to imipenam while resistant to Cefoperazone-Sulbactum and Piperacillin-Tazobactum. Pseudomonas was highly sensitive to Polymyxin B and Imipenam but resistant to Cefoperazone-Sulbactum. Above studies are in concordance with our study in case of NFGNB and Pseudomas aeruginosa. Geographical and demographical difference was found in various studies this can be attributed to variation in infection in ICU setting, variation in hospital stay, and technique of intubation, type of ET tube and role of prior antibiotic therapy judiciously.

Role of proper hand washing and protective gloves is a very useful method to prevent the spread of VAP in ICU setting along with host and interventional risk factor, used to minimize the VAP rates. To prevent VAP, reducing the aspiration of secretion and starting a proper antibiotic use in empirical therapy.

Acharya R et al evaluated that only 10% of patients admitted in ICU and having tracheostomy developed ventilator associated pneumonia (VAP), in which the most common organism associated with VAP was Pseudomonas aeruginosa. **(13)** In our study 16.1% of

patients develop VAP in which the most common of originating VAP was polymicrobial in nature, followed by Pseudomonas aeruginosa, klebsiella pneumonia, NFGNB including Acinetobacter and Staphylococcus aureus. Airway colonization is not enough only for the development of VAP. Prolonged hospital stay and prolonged mechanical ventilation have a role in the development of ventilator associated pneumonia (VAP).

Therefore there is a need to formulate antibiotic policy in each hospital especially in ICU setting for the isolated organism along with its antibiotic susceptibility testing to start empirical therapy before susceptibility testing report comes.

CONCLUSION

To prevent morbidity and mortality due to VAP in ICU patients, culture of aspirate of ET must be taken to formulate antibiotic policy for early treatment. However exact role of ET colonization is yet to be decided for the causation of VAP and also similar studies should be conducted in other areas to collect the information of antibiotic resistance in critically ill patients.

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