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Bacteriological Profile and Antibiogram of Endotracheal Aspirates in Patients Admitted in Neurosurgical Intensive Care Unit at a Tertiary Care Hospital

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ABSTRACT

Background: The patients with head injury have reduced consciousness, they are prone to aspirations of oral secretions. The tracheotomized patients are colonized mostly by gram negative bacteria and are likely develop pneumonia causing life threatening consequences due to severe, persistent, resistant infections. This study was undertaken to identify the common organisms which cause respiratory tract infection and their Antibiogram of ventilated patients in Neurosurgical Intensive Care Unit.

Methods: A cross-sectional study was conducted to determine the prevalence and antibiotic susceptibility analysis of Endotracheal aspirates of the patients who were admitted in Neurosurgical intensive care unit, College of medical sciences, teaching hospital, Bharatpur, for a period from October 2019 to July 2020. Aspirates were cultured onto Blood agar, McConkey and Chocolate agar. Isolation and identification was done using conventional techniques and Biochemical reactions. Antibiotic susceptibility was done by Kirby-Bauer disc diffusion method as per CLSI guidelines.

Results: Out of 163 samples, 147(90.18%) were culture positive. 78 samples were found to be polymicrobial. 16 samples showed no growth. *Acinetobacter baumanii* (36.05%) was the most common isolate followed by Enterobacter sp (25.85%), *Klebsiella pneumoniae* (15.65%), *Pseudomonas aeruginosa* (13.61%), Escherichia coli (5.44%), *Citrobacter freundii* (2.04%), and *Staphylococcus aureus* (1.36%). The gram negative bacilli were all sensitive to colistin. Comparatively, they were also sensitive to Imipenem, Meropenem, Cefaperozone/ sulbactam. *Staphylococcus aureus* is sensitive to Vancomicin.

Conclusions: Respiratory tract infection in intubated patients is risk factors which lead to morbidity and mortality. Inappropriate and inadequate antibiotic treatment causes emergence of drug resistance in pathogens and poor prognosis in patients. The study reported the alarming condition of MDR in tracheal aspirates. Hence, surveillance for source of multi drug resistant bacteria would be beneficial for intervention of infection related to it.

Keywords: multi drug resistant; neurosurgical intensive care unit; polymicrobial; tracheal aspirates.

INTRODUCTION

Tracheostomy is a surgical procedure that creates an opening directly into the trachea to ventilate and aspirate the patient in critical care setting.[1] Respiratory tract infection (RTI), especially pneumonia, is a very common disease in Neurosurgical Intensive Care Units (NSICU). Many head injury patients are in unconscious state and need an endotracheal tube (ETT).[2] More often they depend on ventilators for respiratory support.[3] Such patients will be susceptible to infections because of the decreased immunity due to stress, decreased level of consciousness leading to high chance of aspiration, and the presence of artificial tube in the airway.[4-6] There is 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.[7] The tracheostomized patients are colonized mostly by gram negative bacteria which may cause either tracheobronchitis or bronchopneumonia.[8] Lower respiratory tract infections (LRTI) are the most common bacterial infections among patients in neurological intensive care units, resulting in high overall mortality, which may range from 22% to 71%.[9] Very limited studies had been done on bacterial infections among patients in NSICU in Nepal and on the whole on south east Asian region. There is a need of studies for ventilated patients, to find out the etiological agents and their antibiotic profiles for rational use of antibiotics. Hence, this study was undertaken to determine the prevalence

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of pathogenic bacteria in respiratory secretions of ventilated patients and their antibiotic susceptibility pattern.

METHODS

A cross sectional study was conducted in the department of Microbiology, College of Medical Sciences, teaching hospital, Bharatpur, Nepal during a period of ten months (October 2019 to June 2020). Study included all the patients who had been admitted in Neurosurgery Intensive Care Unit (NSICU), who were intubated and whose ET aspirates samples were sent for routine culture and antibiotic susceptibility tests. A total of 163 samples were enrolled in the study. The clinical samples were inoculated onto Blood agar, MacConkey agar and Chocolate agar plates for routine bacterial isolation following the standard Operating procedures. The isolates were identified using conventional methods based on their colony characterization, staining and biochemical tests. Antimicrobial susceptibility testing was performed by modified Kirby- Bauer disc diffusion method strictly adhering to the standards stipulated as per Clinical and Laboratory Standards Institute guidelines (CLSI)[10]. The following antimicrobial agents (Hi Media labs, Mumbai, India) were tested - Ceftazidime (30µg), Cefoperazone/ Sulbactam (50/50µg), Levofloxacin (5µg), Ciprofloxacin (5µg), Cotrimoxazole (2µg), Amikacin (30µg), Gentamicin (10 µg), Azithromicin (15µg), Ceftriaxone (30µg), Piperacillin/Tazobactam (100/10µg), Meropenem (10µg), Imipenem (10 µg), Penicillin (2U), Ampicillin (25 µg), Vancomycin (30µg).

RESULTS

A total of 163 samples were processed, out of these 147 (90.18%) were culture positive and 16 samples showed no growth. Out of 147 positive samples, 69 samples were monomicrobial whereas, 78 samples were found to be polymicrobial (Table 1). Among these clinical isolates *Acinetobacter baumanii* (36.06%) was the most common isolate followed by *Enterobacter species* (25.85%), *Klebsiella pneumonia* (15.65%), *Escherichia coli* (5.44%), *Citrobacter freundii* (2.04%) and *Staphylococcus aureus* (1.36%) (Table2).

Table 1. Isolates of polymicrobial samples.

Types of infection	No. of isolates	Percentage
Monomicrobial	69	47.94
Polymicrobial	78	53.06

Table 2. Microorganisms isolated and percentage.

Microorganisms	Number (n)	Percentage (%)
Acinetobacter baumanii	53	36.05
Enterobacter species	38	25.85
Klebsiella pneumoniae	23	15.65
Pseudomonas aeruginosa	20	13.61
Escherichia coli	8	5.44
Citrobacter freundii	3	2.04
Staphylococcus aureus	2	1.36
Total	147	100

All isolates of *Acinetobacter* were sensitive to Colistin (100%), followed by Cefoperazone/ sulbactam (86.79%), Imipenem (84.90%), Cotrimoxazole (79.24%), Meropenem (75.47%). Apart from Colistin (100%), Other Enteric Gram negative bacteria (*Enterobacter, Klebsiella, E. coli, Citrobacter*) were sensitive to Colistin, Imipenem, Cefoperazone/sulbactam, Imipenem, Amikacin. These isolates showed high rates of resistance to Ampicillin and Ciprofloxacin. *Pseudomonas* is mainly sensitive to Cefoperazone (85%), Amikacin (80%), Piperacillin/Tazobactam (80%), Imipenem (75%) and is shown in (Table 3).

All isolates of *Staphylococcus aureus* is sensitive to Vancomycin (100%). Both the isolates of S. aureus were Methicillin resistant. Both isolates were also resistant to Penicillin, Cloxacillin,

Table 3. Antibiotic sensitivity of gram negative clinical isolates.

Antibiotics	*A. baumanii (n=53)*	*Enterobacter spp. (n=38)*	*K. pneumoniae (n=23)*	*P. aeruginosa (n=20)*	*E. coli (n=8)*	*Citrobacter spp. (n=3)*
Ceftriaxone	18 (33.9%)	16 (42.1%)	8 (34.5%)	12 (60.0%)	6 (70.0%)	2 (66.7%)
Gentamycin	24 (45.2%)	21 (55.2%)	10 (43.5%)	14 (70.0%)	4 (50.0%)	3 (100%)
Amikacin	17 (32.1%)	30 (79.0%)	17 (74.0%)	16 (80.0%)	6 (75.0%)	3 (100%)
Ciprofloxacin	21 (39.6%)	20 (52.6%)	15 (65.2%)	-	5 (62.5%)	2 (66.7%)
Ceftazidime	16 (30.1%)	12 (31.5%)	11 (47.8%)	7 (35.0%)	3 (37.5%)	0 (0%)
Levofloxacin	28 (52.8%)	31 (81.6%)	18 (78.2%)	-	5 (62.5%)	2 (66.7%)
Ampicillin	5 (9.4%)	11 (28.9%)	7 (30.4%)	3 (15.0%)	1 (12.5%)	0 (0%)
Azithromicin	31 (58.4%)	27 (71.0%)	18 (78.2%)	8 (40.0%)	2 (25.0%)	1 (33.3%)
Meropenem	40 (75.5%)	33 (86.8%)	16 (69.6%)	12 (60.0%)	5 (62.5%)	3 (100%)
Imipenem	45 (84.9%)	36 (94.7%)	18 (78.2%)	15 (75.0%)	6 (75.0%)	3 (100%)
Cotrimoxazole	42 (79.2%)	29 (76.3%)	8 (34.8%)	12 (60.0%)	6 (75.0)	2 (66.7%)
Piperacilin/ Tazobactam	37 (69.9%)	34 (89.5%)	15 (65.2%)	16 (80.0%)	4 (50.0%)	2 (66.7%)
Cefoperazone/ Sulbactam	46 (86.8%)	35 (92.1%)	13 (56.5%)	17 (85.0%)	6 (75.0%)	2 (66.7%)
Colistin	53 (100%)	38 (100%)	23 (100%)	20 (100%)	8 (100%)	3 (100%)

Ciprofloxacin, Azithromicin as shown in Table 4.

Table 4. Antibiotic sencitivity patterns of Staphylococcus aureus.

Antibiotics	S. aureus (n=2)
Penicillin	0 (0.0%)
Ciprofloxacin	0 (0.0%)
Levofloxacin	1 (50.0%)
Azithromycin	0 (0.0%)
Methicillin	0 (0.0%)
Cloxacillin	0 (0.0%)
Ampicillin	0 (0.0%)
Amoxyclavulanic acid	1 (50.0%)
Ampicillin/Salbactam	1 (50.0%)
Vancomycin	2 (100%)

DISCUSSION

Respiratory tract infection (RTI) is a major cause of morbidity and mortality in ICU. The mechanically ventilated and tracheostomized patients are colonized with bacteria of either endogenous or exogenous origin which might end up in Ventilator Associated Tracheobronchitis or Ventilator Associated Pneumonia.[11] Moreover, many patients may be comatose, if there is inadequate oral care, pathogens will colonize inside the oral cavity and tongue of these patients making the normal secretions highly infectious. Bypassing of the upper respiratory tract and imperfect functioning of mucocilliary escalator (due to insertion of tube in trachea) impair the immune system. Besides, leakage of secretion around the tube and opening of the binding site for gram negative bacteria may have caused high rate of colonization.[12] The impaired immune system along with gastrointestinal colonization may be attributed to the multiple growths and growths of multiple organisms from tracheal aspirates.[13,14]

The result of our study showed high growth rate of 90.18% from endotracheal aspirates which was in accordance with other studies.[15-18] However, it is higher than the study done by Vadivoo *et al*[19] (73%) and also as reported by Shalini *et al.*[20] The colonization of the oropharynx, aspiration of the contaminated secretions into the lower airway, mechanical ventilation, and endotracheal tube biofilm play important role as reservoirs for infecting microorganisms.[21] In our study, *Acinetobacter baumannii* (36.05%) was the most common isolate followed by *Enterbacter species* (25.85%) and *Klebsiella pneumoniae* (15.65%). This correlates with our previous study done in the same NSICU in 2018 where *Acinetobacter spp* was the most prevalent isolates.[22] Our study also is in concurrent with the study done by other authors[17,23,24] where *Acinetobacter spps* was reported as the commonest isolates from the tracheal aspirates. The ubiquitous nature in the ICU environment and inadequate infection control practice has continuously raised the incidence of this particular organism. The study by Khan *et al*[25] done in patients with chronic lung disease reported that *Acinetobacter* was not the most prevalent in those specimens which proves that this organism is entirely hospital-acquired. Contrary to our study other studiesfound Pseudomonas and *Klebsiella* to be the major organism isolated from Endotracheal aspirates[8,11,15]

Polymicrobial growths was observed in three fifth of the cases. The impaired immune system along with gastrointestinal colonization may be attributed to the multiple growths. Super infection in patient and growth of multiple organisms from tracheal aspirates was also reported by Neiderman *et al.*[14] In our study *Acinetobacter* showed 100% sensitive to Colistin, however, less sensitive to Cephalosporins. It shows sensitivity of 86.79% to Cefoperazone/sulbactam, 84.94% to Imipenem, 79.24% to Cotrimoxazole. Most of the isolates were very less sensitive to Ampicillin (9.43%). Aminoglycosides like Gentamicin (45.23%) and Amikacin (32.07%) also showed less sensitivity. Contrary to our study, a study reported by Koirala P *et al,*[8] showed Amikacin to be more sensitive than Gentamicin. Similar trends of resistance to Cephalosporins and fluoroquinolone were also observed by T. Reddy *et al.*[26] A β-lactamases that hydrolyze and confer resistance to penicillins, cephalosporins, and carbapenems. The other mechanisms of resistance include loss of porin proteins and presence of multiple efflux pumps that remove wide range of antibiotics out of the bacterial cell.[27]

In our study *Enterobacter spps* which is the second common organism isolated showed highest sensitivity to Colistin (100%), followed by Imipenem (94.73%), Cefaperozone/sulbactam (92.10%), Pipercillin /Tazobactam (89.47%). They were least sensitive to Ampicillin (28.94%). Both the isolates of Staphylococcus aureus were Methicillin resistant. All isolates S. aureus were sensitive to Vancomicin and Ampicillin/Sulbactam with 100% sensitivity. Both the isolates were resistant to Penicillin, Cloxacillin, Azithromicin, Ciprofloxacin etc. Findings of all isolates as Methicillin resistance indicated an alarming situation. Similar findings were also shown by other authors,[8,15]

Most of the organisms isolated showed multi drug resistance (MDR), maximum being in *Acinetobacter spps.* in our study. MDR organisms are considered as a clinical threat.[28,29] High rate of multi drug resistance bacteria that were being reported may be ascribed due to selective decontamination of digestive tract with different antibiotics or empirical use broad spectrum antibiotics and non adherence to hospital

antimicrobial policy.

CONCLUSIONS

Endotracheal intubation is a major risk factor in causing iatrogenic infections in head injury patients in our NSICU, *Acinetobacter baumanii* being the most common pathogen isolated. Most of the organisms are multi drug resistant bacteria (MDR), which can acts as a source of Nosocomial infection. There is high rate of polymicrobial growth of tracheal aspirates from intubated patients. Our study reported high percentage resistance to cephalosporins. The most effective drugs were Colistin and Carbapenems including meropenem and imipenem to most of the gram negative bacilli, making these drugs to be the drug of choice and can be started empirically. Amikacin is to be the second choice since it is found to be sensitive to most of the organisms isolated except for *Acinetobacter baumanii* in our study. Vancomycin is the drug of choice for Meticillin resistant *Staphylococcus aureus t*hat is isolated in our study. Inappropriate and inadequate antibiotic treatment causes emergence of drug resistance in pathogens and poor prognosis in patients. Therefore, careful microbial surveillance and antibiotic susceptibility testing is necessary for prevention of multi drug resistance among pathogens as well as effective treatment.

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