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Microbiological and Antibiotic Profile of Bronchoalveolar Lavage Aspirate in Mechanically Ventilated Patients in a Tertiary Care Hospital

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ABSTRACT

Introduction

Ventilator-associated pneumonia (VAP) increases the patient stay in the ICU and indirectly increases the cost of patient management. Based on the time of onset of VAP, it can be divided into two types. Early-onset VAP occurs during the first four days of mechanical ventilation and is usually caused by antibiotic sensitive bacteria. Late-onset VAP develops five or more days after initiation of MV and is caused by multidrug-resistant (MDR) pathogens. Early diagnosis of VAP with appropriate antibiotic therapy can reduce the emergence of resistant organisms.

Methods

This cross-sectional study was done in College of Medical Sciences Teaching Hospital, Bharatpur, Chitwan after taking clearance from the institutional review committee. Study included all the patients who required mechanical ventilation for more than 72 hours. All the included patients had their broncheoalveolar lavege aspirated using an AMBU ascope bronchoscope and sent to microbiology department for culture and sensitivity. The reports were collected after 72 hours.

Results

The most common organism grown during culture and gram staining were Acinetobacter Baumannii (81), followed by Klebsiella Peumoniae (44) than Pseudomonas Aeroginosa (32). first line of antibiotics in patients who were mechanically ventilated were piperacillin plus tazobactam, meropenem,cotrimoxazole, amikacin and gentamicin. The second line drugs were polymyxin B, colistimethate and tigecycline.

Conclusions

Acinetobactor Baumanni is the most common causative organism of ventilator associated pneumonia. In most of the cases first line antibiotics (meropenem, amikacin and clotrimoxazole) are sensitive. Among the second line antibiotics, Polymyxin B was found to be most effective.

Keywords: bronchoalveolar lavage; ventilator associated pneumonia; culture and sensitivity; microbes; antibiotics.

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INTRODUCTION

Ventilator-associated pneumonia (VAP) is a type of nosocomial pneumonia that occurs in patients who receive mechanical ventilation.[1] VAP is usually acquired in the hospital setting approximately 48–72 hours after mechanical ventilation. The main aim of mechanical ventilation is to aid in gas exchange without causing trauma to the lungs. Unfortunately, MV can harm the lungs by the stress and strain developed in the lung. High pressure and volume can cause barotrauma and volutrauma to the lungs, which is followed by biotrauma and atelectrauma. According to the International Nosocomial Infection Control Consortium (INICC), the overall rate of VAP is 13.6 per 1,000 ventilator days.[2] The incidence varies according to the patient group and hospital setting. The incidence of VAP ranges from 13–51 per 1,000 ventilation days.[3] The mean duration of occurrence of VAP is around 5–7 days. The mortality associated with VAP ranges from 24–76 per cent, and is even higher among critically ill patients.[4]

VAP increases the patient stay in the ICU and indirectly increases the cost of patient management. Based on the time of onset of VAP, it can be divided into two types. Early-onset VAP occurs during the first four days of mechanical ventilation and is usually caused by antibiotic sensitive bacteria. Late-onset VAP develops five or more days after initiation of MV and is caused by multidrug-resistant (MDR) pathogens.[5] Early diagnosis of VAP with appropriate antibiotic therapy can reduce the emergence of resistant organisms.

VAP occurs in patients who are ventilated either by an endotracheal tube or tracheostomy. Pneumonia is a host response to bacterial invasion. The normal physiology of the respiratory system is to clear the secretions from the larynx and pharynx either by mucociliary action or cough reflex. Mechanically ventilated patients are unconscious and there is no clearance of the secretions in the oropharynx. The defence mechanisms are also ineffective in patients with reduced immune response[6] The normal oral colonisers start increasing in number. These colonisers along with the secretions collected pass along the tracheal tube. It can form a biofilm and reach the distal airways leading to pneumonia.[7] The organism reaching the distal airway then overcomes the host immune response. In addition, cofactors like pulmonary edema and previous lung infections favour the bacterial multiplication. The source of infection in most patients with VAP is either the oral flora or bacteraemia. The other sources can be the stomach contents, ventilator circuits, humidifiers, and nebulisers.[8]

Around one-third of post-surgical patients have associated pulmonary infiltrate. In a study conducted by Garibaldi et al., it was found that 17 per cent of postoperative patients had pneumonia. Longer duration of surgery and history of smoking are associated with an increase in development of VAP.[9]

The incidence varies according to hospital setting and patient type. VAP increases icu stay and indirectly the cost of patient management. VAP is classified into early onset and late onset types. Early onset VAP occurs during the four days on mechanical ventilation whereas late onset type develops five or more days. Early diagnosis and use of appropriate antibiotics and other pharmacological and non pharmacological therapies can reduce the emergence of resistant antibiotics.[10]

METHODS

This cross-sectional study was done in college of medical sciences teaching hospital, Bharatpur, Chitwan after taking clearance

from the institutional review committee. Study included all the patients who required mechanical ventilation for more than 72 hours. Bronchoalveolar lavage was taken after 72 hours of mechanical ventilation. The study was done over two years (2017-2019) and includes 370 patients. Sample size was calculated using following formula.

$$X = \frac{z^2 \times p\,(1 - p)}{\epsilon^2}$$

Where, z= confidence interval =1.96

P= proportion of population = 0.61

margin of error = 5%

All the included patients had their endotracheal tube aspirated using an ambu bronchoscope and sent to microbiology department for culture and sensitivity. The reports were collected after 72 hours of inoculation and recorded in Microsoft excel, which was later imported to SPSS and the data was calculated for prevalence and pattern of microbial grown during culture and antimicrobial sensitivity.

RESULTS

Among 370 samples, 157 (42.43%) samples were culture positive.

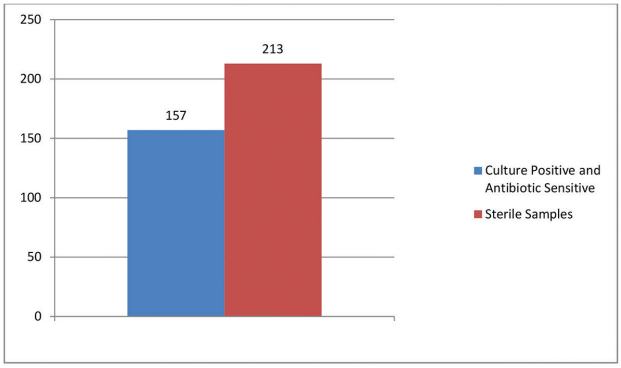

Table 1. Culture positive samples among patients.

Total Broncho-aveolar Lavage (BAL) 370 done.

Culture positive was more common in males.

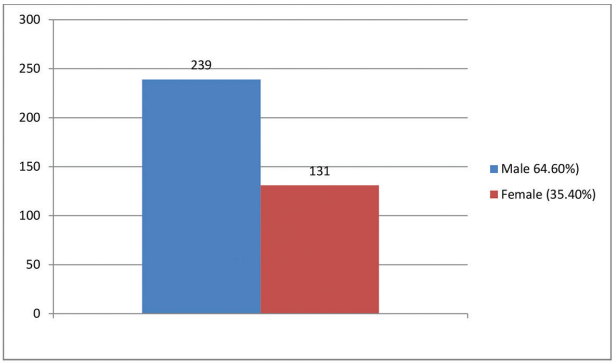

Table 2. Demographic distribution among patients.

The most common organism grown during culture and gram staining were Acinetobacter Baumannii (81), followed by Klebsiella Peumoniae (44) than Pseudomonas Aeroginosa (32).

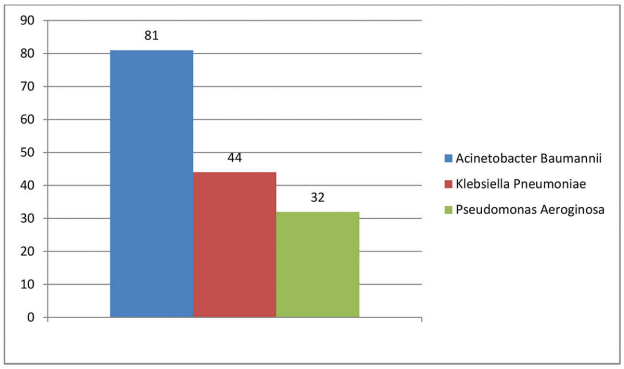

Table 3. Pattern of organisms grown among patients with VAP.

In Acinetobacter Baumannii group, Meropenem, Amikacin and Cotrimoxazole were found to be sensitive in 83.43% of samples. Second line drugs Polymyxin B, Colistimethate and Tigecycline were found sensitive in 100% of samples.

In Klebsiella Pneumoniae group, 1st line drugs Meropenem and Amikacin were found to be sensitive in 47.13% of samples. Second line drugs Polymyxin B, Colistimethate and Tigecycline were sensitive in 100% of samples.

In Pseudomonas Aeruginosa group, 1st line drugs Tazobactam plus piperacillin , Amikacin

and Gentamicin were found to be sensitive in 77.07% of the samples. Second line drugs Polymyxin B and Colistimethate were positive in 100% of the samples.

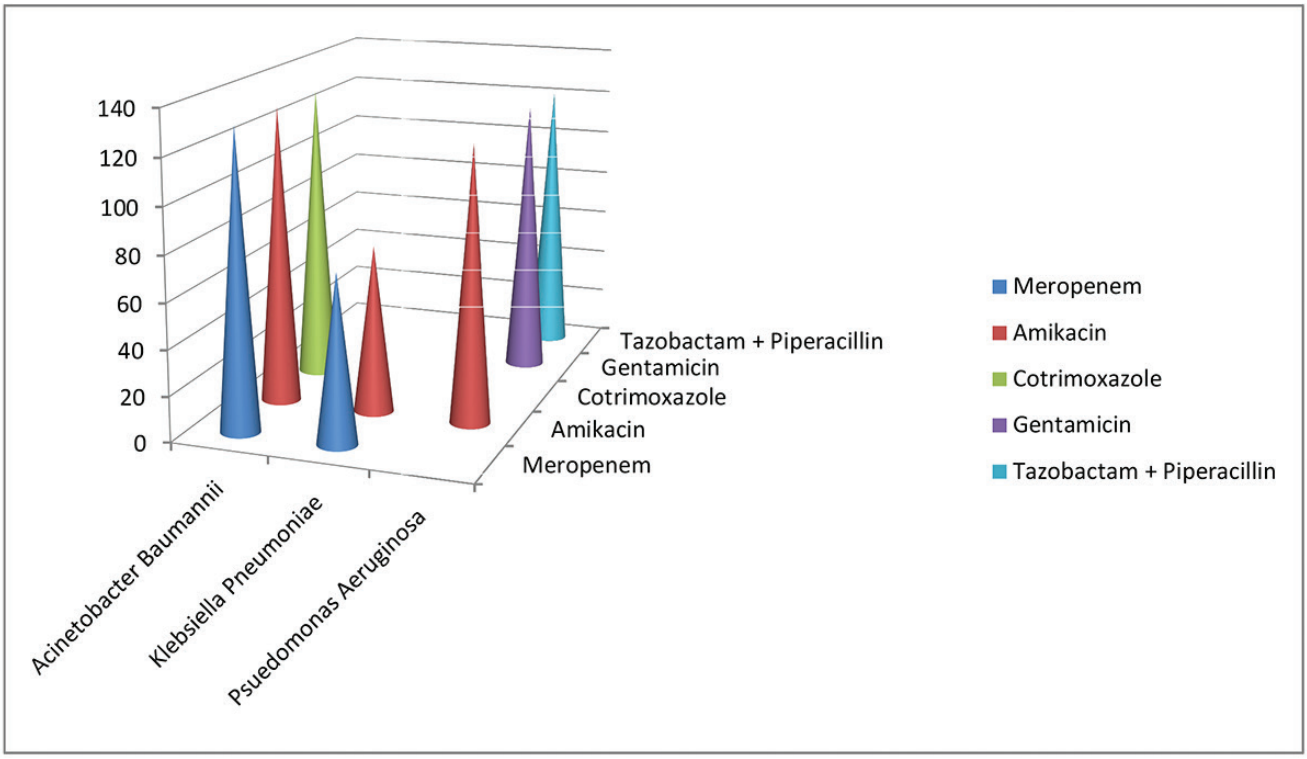

Table 4. Senstivity of first line antibiotics among patients with VAP.

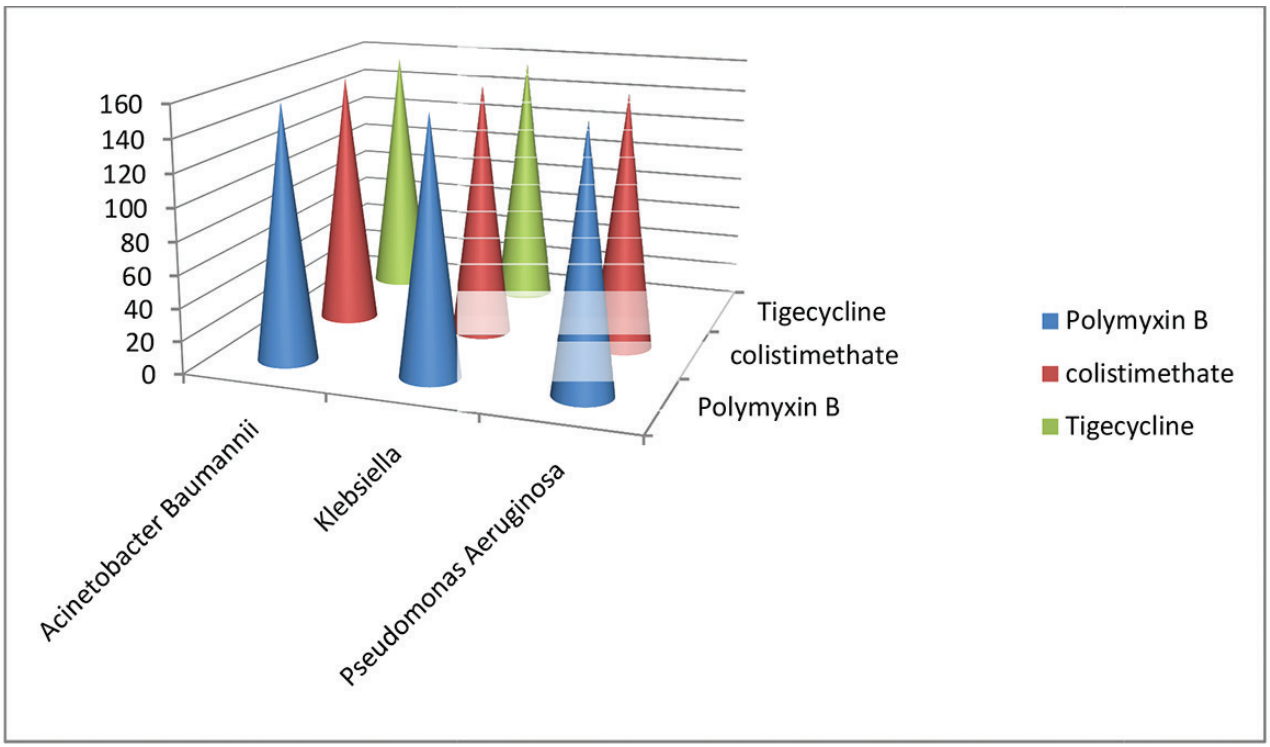

Table 5. Senstivity of second line antibiotics among patients with VAP.

DISCUSSION

Culture positive rate in our study was 42. 43% which is almost similar to various other studies done elsewhere.[11,12] The comparatively lower rate of our hospital can be justified by the fact that good infection control practices are followed here. We observed a higher rate of culture positivity from the samples of male patients than those obtained from the female patients. Similar findings were observed by Morehead et al [13] and debjita debnath et al [12] in which it was found that culture positivity was more common in elderly male patients as they have more pre-existing lung diseases and incidence of smoking is more in males compared to females. The result may also influenced by higher male participants in our study.

In our study, gram-negative bacilli were the most commonly isolated pathogen from BAL

which is similar to studies done by, debjita debnath, Fagon et al[14] and Şimşek et al[15]. In our study, Acinetobacter Baumannii (81) was the most common followed by Klebsiella Peumoniae (44) than Pseudomonas Aeroginosa (32), which is similar to study by debjita debnath who found that *Pseudomonas aeruginosa* and *Acinetobacter* species were the most common organisms isolated.

Imipenem seems to be the drug of choice unless there is a very high level of carbapenems resistance. Intravenous colistin therapy has better results in patients with MDR *Acinetobacter* spp. and *Pseudomonas* spp. Tigecycline also has better results against carbapenem-resistant *Acinetobacter* spp. [10] In our study, first line of antibiotics in patients who were mechanically ventilated were piperacillin plus tazobactam, meropenem,cotrimoxazole, amikacin and gentamicin. The second line drugs were polymyxin B, colistimethate and tigecycline. We observed that first line antibiotics were sensitive in 83.43% of samples with Acinetobacter Baumannii where as second line antibiotics were found be sensitive in 100% of samples. In our study, in samples were klebsiella Pneumoniawas grown, the first line antibiotics were sensitive in 47.13% where as second line antibiotics were 100% sensitive. In pseudomas aeuginosa group, the first line antibiotics were sensitive in 77.07% and 100% sensitive to second line antibiotics.

CONCLUSIONS

Acinetobactor Baumanni is the most common causative organism of ventilator associated pneumonia. In most of the cases first line antibiotics (meropenem, amikacin, gentamicin and clotrimoxazole) are sensitive. In the rest of the cases with unresolving or progressing pneumonia and sepsis second line antibiotics should not be delayed. Among the second line antibiotics, Polymyxin B was found to be most effective.

Conflict of Interest: There is no conflict of interest.

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