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Overview of Ventilator-Associated Pneumonia in Traumatic Cervical Spinal Injury in Trauma Center of Nepal

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ABSTRACT

Background

Cervical spine, crucial for nerve innervation and head and neck motion, is vulnerable to injury due to its over-reliance on ligaments. This study examines the increasing incidence of traumatic spinal cord injuries, particularly in fall and traffic accidents, with respiratory complications being the leading cause of morbidity and mortality, with VAP being a significant complication.

Methods

A retrospective cross-section study involving 52 patient data, using self-prepared proforma. The patient's age, sex, injury severity, and CPIS score were used to determine VAP.

Results

The study involved 52 patients with a mean age of 50.96. Of these, 67.3% were male and 11.5% female, with 45-60 years being the most common age group. The most severe spinal injury patients, i.e., ASIA A Neurology, developed VAP. Patients with prolonged ICU stay and intubation days also developed VAP, but no statistical significance was seen (P-value: 0.3941 and 0.4751). Mortality had a significant association with VAP (P-value: 0.023). Acinetobacter Baumann was the most common microorganism causing VAP, while Staphylococcus aureus was the least common. The most sensitive antibiotics for isolated organisms were Polymyxin B, Amikacin, Colistin, and Levofloxacin.

Conclusions

The study found a high prevalence of ventilator association pneumonia (VAP) in cervical spine fracture patients, with mortality associated with the most common organism being Acinetobacter, sensitivity to Polymyxin b. Further monitoring and implementation of VAP prevention strategies are recommended.

Keywords: ventilator-associated pneumonia; morbidity; mortality; respiratory complications.

INTRODUCTION

The cervical spine, crucial for nerve innervation and head and neck motion, is vulnerable to injury due to its over-reliance on ligaments. Traumatic spinal cord injuries are increasing due to falls and traffic accidents, causing respiratory complications and resulting in 36%-83% morbidity and mortality. Studies show an upward trend in cervical injuries, particularly C1-C4 injuries, leading to increased spinal cord injuries and mechanical ventilation dependency.[1-5] Intubation compromises the natural barrier between the oropharynx and trachea, allowing bacteria to enter the lungs.[6] Ventilator-associated pneumonia is usually caused by Staphylococcus aureus and Pseudomonas aeruginosa, occurs 48 hours after intubation and mechanical ventilator initiation, and is diagnosed by the presence of tracheal discharge, fevers, respiratory discomfort, white blood cells in tracheal aspirate, and radiological evidence.[7,8] The study aims to assess the severity of VAP in cervical spine injuries and identify common organisms and their antibiotic sensitivity, potentially influencing prevention strategies and patient care.

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METHODS

After approval of the Institutional Review Board of the National Academy of Medical Science (IRB No: 315/2080/81), data was obtained by reviewing the available medical records of the patients diagnosed with a traumatic cervical spine injury, which required mechanical ventilation for respiratory support from the time of April 2020 to April 2023 were included in the study. Patient data with incomplete information, and known cases of pulmonary fibrosis, chest infection, and chronic chest conditions like chronic obstructive disease before cervical spine injury were also excluded from the study. Only the data needed for the objective of the study was collected. Data was collected by the researchers with the help of a hospital medical recorder. A list of the patients with cervical spine injuries admitted to the ICU during the study period was made using the hospital management software for electronic data. Then, individual patient data was identified and screened to record all required parameters. Only those data which has all the information were included in the study. ASIA (American Spine Injury Association) was used to assess the severity. Information regarding age, gender, ICU duration, intubated days, and other respiratory complications like atelectasis, delayed weaning, ARDS, and Pulmonary embolism was obtained via ICU nursing charting, consultant, and medical officer notes of the patients. The CPIS (Clinical pulmonary infection score) was used to diagnose the VAP. A CPIS score of six or more than six is diagnosed as VAP. The causative microorganisms and their antibiotic sensitivity were obtained from the microbiological report and data stored in the hospital software.

RESULTS

A total of 52 patients' medical data were included in the study, out of which 82.69 % were male, 17.31 % were female patients, and the mean age of the patients was 50.96. Among them, 78.8% of the patients develop VAP. Males were more prone to VAP, which is 67.3%, whereas only 11.5% of female patients developed VAP. The most common age group that developed VAP is 45-60 years, and the 18-30 years age group was least prone to VAP in this study. Most of the spinal injury cases that developed VAP are those patients who fall in the ASIA A Neurology category, i.e., 50% of patients with ASIA A Neurology developed VAP. Only one case of ASIA D Neurology developed VAP. None of the ASIA E patients was admitted to the ICU during the study (Table 1).

Table 1. Presence of VAP in cervical spine fracture in different age and sex.

Variables	Presence of VAP criteria
Age	
18-30	4(7.69)
30-45	5(9.61)
45-60	19(36.53)
>60	13(25)
Sex	
Male	35(67.30)
Female	6(11.50)
Asia grading	
A	26(50)
B	11(21.11)
C	3(5.76)
D	1(1.92)
E	0

Furthermore, patients who had prolonged ICU stays and prolonged intubation days developed Ventilator-Associated Pneumonia, but there is no statistical significance seen. However, mortality had a significant association with VAP (Table 2).

Table 2. Table showing Association of VAP on clinical outcome.

Impact of VAP	Presence of VAP	Absence of VAP	p-value
Length of ICU stay (Mean SD)	21.3±28.4	13.8±8.27	0.3941
Mortality	10	2	
Mean Length of Intubation	16.4±19.3	12.1±7.70	0.4751

In this study setting, Acinetobacter Baumann was found to be the most common micro-organism causing VAP, Staphylococcus aureus was the least common micro-organism causing VAP (Table 3).

During three-year study period the most sensitive antibiotics for isolated organism was Polymyxin B followed by Amikacin, Colistin, and Levofloxacin.

Table 3: List of isolated micro-organisms.	
List of the micro-organisms	**Present in total no of VAP patient (%)**
Acinetobacter baumanni	9 (28.125)
Klebsiella Pneumonia	4 (12.5)
Beta hemolytic streptococcus	4 (12.5)
Staphylococcus aureus	4 (12.5)
Proteus sps	4 (12.5)
Staph Aureus	3 (9.375)
Pseudomonas auriginosa	2 (6.25)
Pseudo oxidase	1 (3.125)
E coli	1 (3.125)

Table 4. Table showing commonly sensitive antibiotics.	
Sensitive antibiotics	**Frequency (%)**
Polymyxin B	14 (19.17)
Amikacin	12 (16.43)
Colistin	10 (13.69)
Levofloxacin	10 (13.69)
Tigecycline	7 (9.58)
Ceftriaxone	5 (6.84)
Gentamycin	5 (6.84)
Imipenem	4 (5.47)
Ampicillin	2 (2.73)
Meropenem	2 (2.73)
Cefoperazone	2 (2.73)

DISCUSSION

This retro-prospective study conducted at the National Trauma Center aimed at determining the presence of VAP in patients with traumatic spinal cord injury. Among 52 patients with traumatic cervical spine injury, majority of them i.e. 78.8% patients developed VAP which is consistent with the findings of Schurink et al.[9] However, studies conducted by Gadani et al. showed VAP in 37% patient.[10] The difference in our studies and Gadani et al.[10] study may be due to differences in sample size, sample demographic characteristic like cervical spine fracture which has high ICU stay. Furthermore, the VAP prevention bundles are not fully implemented in this center. The mean age of the patients with VAP with traumatic spinal injury in this study was 50.96. The most affected age group was 46 to 60 years. We observed male predominance in this study, which is consistent with the survey conducted by Dhakal et al.[11] Another study conducted by Fredø et al.[12] revealed that the highest frequency of traumatic spinal injury among 46 to 90 years age group which is more in accordance with our study result. This study shows that the incidence of VAP increases with the prolongation of intubation and ICU stay. Still, there is no significant association between ventilator-associated pneumonia and prolonged days of intubation and ICU stay. The findings may be due to the nature of the diagnosis as the patient with cervical spine injury stays prolong in ICU. However, the study conducted by oathman et al. [13] showed significant association between VAP and length of intubation and length of ICU stay. Even though there is a clinical prolongation of ICU stays in VAP-positive patients, neither group has statistical significance. The contrast between our findings and those of this study may be due to the inclusion criteria. We have only included patients diagnosed with traumatic cervical spine injury who usually have longer ICU stays with high prevalence, whereas they have included all patients admitted to ICU. Microbiological data shows that the main microorganism causing ventilator-associated pneumonia in this study center was Gram-negative Acinetobacter Baumannii, followed by Beta Hemolytic streptococcus, Klebsiella Pneumonia, and Proteus sps. This data closely resembles the analysis conducted by Kelkar et al.[6], which revealed that Acinetobacter baumannii, Pseudomonas aeruginosa, and Klebsiella pneumoniae (16.6%) were the commonest microorganisms associated with VAP. Similarly, a study conducted by Mumtaz et al. [14] also found out that Acinetobacter sp., followed by Pseudomonas aeruginosa, are common gram-negative organisms causing VAP, while Staphylococcus aureus is a common gram-positive organism. The microorganisms that cause VAP can vary depending on the number of ICU patients, hospital and ICU stay length, and the specific diagnostic methods used. This study finding suggests that the most sensitive antibiotic is Polymyxin B (26.92%), followed by Amikacin (23.07%), Colistin (19.23%) and Levofloxacin (19.23%). A prospective, open, epidemiological clinical study conducted by Mishra et al. [15] revealed that Colistin was the most sensitive antibiotic, followed by polymyxin B and amikacin, with susceptibility

rates of 67%, 60% and 58%, respectively. The study findings suggest the alarming incidence of Ventilator-Associated Pneumonia and its risk factors.

CONCLUSIONS

The prevalence of ventilator-association pneumonia in cervical spine fracture was high as compared to other populations. Even though the total length of the ICU stays, and duration of mechanical ventilation are not associated with the presence of VAP, they are associated with mortality. Acinetobacter is the most common organism isolated in this center, with sensitivity to Polymyxin b. VAP prevention strategies should be monitored and implemented more thoroughly in this population.

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