

A Study on Incidence of Ventilator-Associated Pneumonia Causing Bacteria with Drug Resistance among the Diabetes and Non Diabetes**B. Nirmala Grace¹, K Lakshmanarao², KSR Krishna Sai³, M.Rama Rao⁴, T Jaya Chandra⁵**¹Assistant Professor, Department of Microbiology, Rangaraya Medical College, Kakinada.²Assistant Professor, Department of Anaesthesia, Government Medical College, Rajamahendravaram.³Assistant Professor, Department of Bio Chemistry, Rangaraya Medical College, Kakinada.⁴Associate Professor, Department of Anaesthesia, Government Medical College, Rajamahendravaram.⁵Professor, Department of Microbiology, GSL Medical College, Rajamahendravaram

Received: 10-03-2023 / Revised: 21-04-2023 / Accepted: 15-05-2023

Corresponding Author: Dr. M. Rama Rao

Conflict of interest: Nil

Abstract**Introduction:** Pneumonia in the lung parenchyma among the patients after 48 – 72 hours after invasive mechanical ventilation is termed as ventilator-associated pneumonia (VAP) A study was conducted to find the various bacteria responsible for VAP and comparison of antimicrobial susceptibility among the diabetes and non diabetes individuals.**Methods:** It was a prospective research conducted in the department of Microbiology, GSL Medical College, Rajahmundry. Study protocol was approved by the institutional ethics committee. Study was conducted between February to December 2022. Individuals of both gender, >18 years, those on ventilator support were included in this study. Sputum sample, broncho alveolar lavage (BAL) venous blood specimen was collected. Specimen culture and sensitivity and HbA1c technique was used for glucose estimation. Bacterial identification and AST were studied as per the standard guidelines. Chi square test was used for the statistical analysis and P<0.05 was considered statistically significant.**Results:** VAP was detected in 52 (100%) members, statistically there was no significant difference in DM and non DM individuals with VAP. *Pseudomonas aeruginosa* (40.4%) was the leading pathogen that cause VAP followed by *Staphylococcus aureus* (29%). More drug resistance (DR) was detected in DM individuals.**Conclusion:** VAP along with DR was common among the DM individuals. Improved care may be required for better outcome.**Keywords:** Incidence, VAP, Study, Research.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Pneumonia in the lung parenchyma among the patients after 48 – 72 hours after invasive mechanical ventilation is termed as ventilator-associated pneumonia (VAP) [1]. It is the commonest ICU acquired pneumonia among the mechanically ventilated patients. It has been recognised as a major issue in the globe and commonest healthcare associated infection (HAI) especially in the developing countries. VAP leads to high mortality as well as prolonged hospital stay.

Rapid diagnosis and initiation of proper treatment is mandatory for VAP. Delay in the initiation of treatment leads to increased mortality. As per the reports, using 1000 ventilator days as denominator, in United States, the VAP rates ranged between 4 – 14 and it was 10 – 52.7 days in other developing countries. [2]

With this a study was conducted to find the various bacteria responsible for VAP and comparison of antimicrobial susceptibility among the diabetes and non diabetes individuals.

Methods

It was a prospective research conducted in the department of Microbiology, GSL Medical College, Rajahmundry. Study protocol was approved by the institutional ethics committee. Study was conducted between February to December 2022. Informed written consent was taken from the legal heirs of the study members. Individuals of both gender, >18 years, those on ventilator support were included in this study. Non cooperative individuals were not included in this research. Individuals satisfied the inclusion criteria during the study period were enrolled in this research.

Study protocol was explained. As part of the institutional protocol, the study participant's data was recorded in the research proforma. After this, if the individual is conscious, sputum sample was collected. Otherwise, broncho alveolar lavage (BAL) was collected. Immediately after collection, BAL was transported to the Microbiology laboratory. Simultaneously 3 – 5 ml venous blood specimen was collected by following universal safety precautions; serum was separated and analysed for average glucose levels by HbA1c technique. [3]

In the Microbiology laboratory, first the specimen was cultured on blood agar, chocolate agar and MacConkey agar, incubated at 37°C for 24 – 48 hrs. After this, smear was also prepared, stained by gram technique and observed under microscope, findings were recorded. After the incubation, the growth was identified by gram stain and using different biochemical reactions. Simultaneously, antibiotic susceptibility testing (AST) was carried. Bacterial identification and AST were studied as per

the standard guidelines and the drug resistance (DR) was analysed by comparing the zone of inhibition. [4]

Statistical Analysis: Data were analysed using SPSS version 22. Data was presented in mean and percentage. Chi square test was used for the statistical analysis and P<0.05 was considered statistically significant.

Results

Total 322 (100%) members were included in this research. In this 123 (39%) were found to be diabetes mellitus (DM). VAP was detected in 52 (100%) members. In this 31 (60%) were male and the male female ratio was 1.48. In the VAP category, 33 were DM individuals; gender wise, statistically there was no significant difference in DM and non DM individuals with VAP (Table 1). In this research, *Pseudomonas aeruginosa* (21; 40.4%) was the leading pathogen that cause VAP followed by *Staphylococcus aureus* (15; 29%). More DR was detected in DM individuals.

Table 1: Gender wise correlation between VAP and DM; n (%)

Blood glucose	Male	Female	Total
DM	21 (40.4)	12 (23.1)	33 (63.7)
Non DM	10 (19.3)	9 (17.3)	19 (36.4)
Total	31 (59.7)	21 (40.4)	52 (100)
Statistical analysis	Ψ ² value = 0.6065; P value = 0.436097. Statistically not significant.		

Discussion

VAP infection is common in ICU patients with an incidence of 8 – 20%. [5] Due to prolonged hospital stays, increased cost is the important finding. In the current research, out of the 322 (100%) study members, the incidence of VAP was 39% (123). As per the research by Arabi et al., the VAP incidence was reported to be 42%. [6] Another report from China, declared an incidence of 23%. The reason for this disparity is not clear. [7]

DM is one of the largest health emergencies of the globe; it is the one of the top 10 leading causes of mortality next to cardiovascular disease, respiratory disease and cancer. [8] The incidence is significant in India also. Lack of exercise, life style modification, and increased food intake and so on were reported to be the causes for the raise in DM. Out of the 52 (100%) VAP individuals, the incidence was 64% (33) among the DM. In this research there was high rate of VAP among the DM. Similar view was opined in the literature also. [9] Among the DM, there is high blood glucose concentration. Glucose is the simplest carbohydrate, which can be metabolised easily. Hence this can be a suitable environment for the bacterial growth. Hence VAP is more among the DM. [10]

In this research, *Pseudomonas* is was the leading cause of VAP followed by *Staphylococcus aureus*. *Acinetobacter* was found to be the common VAP causative agent followed by *Pseudomonas* and *Staph. aureus*. *Streptococcus pneumoniae* was also reported to be the common VAP causing agent. But in this research, *Strept.pneumoniae* was not isolated. [11] Due to indiscriminate usage of antibiotics, DR was reported more among the DM. In the literature also more drug resistance was reported in DM cases. Here the ICU atmosphere as well maintenance were also considered. High populated country such as India these are very difficult. Whereas the current study was conducted in a tertiary health care unit. In this setup man power is not an issue due to the availability of medical UG and PG students. To these patient care is also part of curriculum. In spite of all these significant DR was reported. Small sample size and incomplete analysis of the data are the limitations of this research.

Conclusion

VAP along with DR was common among the DM individuals. Improved care may be required for better outcome.

References

1. Kharel S, Bist A, Mishra SK. Ventilator-associated pneumonia among ICU patients in WHO

- Southeast Asian region: A systematic review. *PLoS ONE*. 2021; 16(3): e0247832
2. Ranjan N, Chaudhary U, Chaudhry D, Ranjan KP. Ventilator-associated pneumonia in a tertiary care intensive care unit: Analysis of incidence, risk factors and mortality. *Indian J Crit Care Med* 2014; 18: 200 – 4.
 3. Nomura, S., Sakamoto, H., Rauniyar, S.K. et al. Analysis of the relationship between the HbA1c screening results and the development and worsening of diabetes among adults aged over 40 years: a 4-year follow-up study of 140,000 people in Japan – the Shizuoka study. *BMC Public Health*. 2021; 21: 1880.
 4. Chandra TJ, T.Lakshmi prasanna, AVenka-teswar rao. A study on isolation and identification of bacteria causing nosocomial infections on mobile phones of health care workers. *Calicut Medical Journal* 2011; 9(1):e2
 5. Mathai AS, Phillips A, Isaac R. Ventilator-associated pneumonia: A persistent healthcare problem in Indian Intensive Care Units! *Lung India*. 2016; 33(5): 512 – 6.
 6. Arabi Y, Al-Shirawi N, Memish Z, Anzueto A. Ventilator-associated pneumonia in adults in developing countries: a systematic review. *Int J Infect Dis*. 2018; 12(5): 505 – 12.
 7. Ding C, Zhang Y, Yang Z, Wang J, Jin A, Wang W, et al. Incidence, temporal trend and factors associated with ventilator-associated pneumonia in mainland China: a systematic review and meta-analysis. *BMC Infectious Diseases*. 2017; 17: 222 – 32.
 8. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. *Indian J Ophthalmol*. 2021; 69(11): 2932 – 8.
 9. Darvishi-Khezri H, Alipour A, Emami Zeydi A, Firouzian A, Mahmudi G, Omrani-Nava M. Is type 2 diabetes mellitus in mechanically ventilated adult trauma patients potentially related to the occurrence of ventilator-associated pneumonia? *J Res Med Sci*. 2016; 21: 19.
 10. Hassan ME, Al-Khawaja SA, Saeed NK, Al-Khawaja SA, Al-Awainati M, Radhi SSY, Al-saffar MH, Al-Beltagi M. Causative bacteria of ventilator-associated pneumonia in intensive care unit in Bahrain: Prevalence and antibiotics susceptibility pattern. *World J Crit Care Med*. 2023; 12(3): 165 – 75.
 11. American Thoracic Society Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Am J Respir Crit Care Med*. 2005; 171: 388 – 416
 12. Dong Huang, Yan Wang, Yu Wang, Zongan Lian. The impact of diabetes mellitus on drug resistance in patients with newly diagnosed tuberculosis: a systematic review and meta-analysis. *Ann Palliat Med* 2020; 9(2): 152 – 62.