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STUDY OF RISK FACTORS AND BACTERIOLOGICAL PROFILE OF VENTILATOR ASSOCIATED PNEUMONIA

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ABSTRACT **Background:** Ventilator-associated pneumonia (VAP) is a significant cause of morbidity and mortality in critically unwell patients within the intensive care unit (ICU) who undergo invasive mechanical ventilation. Objective: To study bacteriological profile and the risk factors associated with the ventilator associated pneumonia. **Materials & Methods:** This present cross sectional study was done a tertiary health care teaching hospital during periods of January 2020 to June 2021 on 100 study subjects. **Results:** VAP was common among patients with diabetes (35%), chronic obstructive pulmonary disease (21%), Chronic heart failure (19%), Poisoning (10%), immunocompromised 15%. Among the 123 VAP pathogens, 87.81% were gram negative bacilli and 12.19%-gram positive cocci. Klebsiella pneumoniae (34.95%) were predominant pathogen in our study followed by Pseudomonas aeruginosa (34%) followed by Acinetobacter baumannii (23%). **Conclusion:** VAP continues to be commonly encountered challenges amongst critically ill patients and carries significant burdens of morbidity, antibiotic utilization and cost. Any intubated patient is at risk for development of VAP and longer duration of mechanical ventilation, the higher the risk. Thus, prevention of VAP must begin with avoiding or limiting time of mechanical ventilation.

KEYWORDS :

INTRODUCTION:

Hospital-acquired pneumonia (HAP) is an infection of the pulmonary parenchyma caused by pathogens that are present in hospital settings. Nosocomial pneumonia develops in patients admitted to the hospital for >48 h and usually the incubation period is at least 2 days.[1]

Among nosocomial pneumonias, ventilator-associated pneumonia (VAP) develops in intensive care unit (ICU) patients who have been mechanically ventilated for at least 48 h. Patients with severe nosocomial pneumonia who require mechanical ventilation during their treatment after the onset of infection do not meet the definition of VAP. [2]

Ventilator-associated pneumonia (VAP) is a significant cause of morbidity and mortality in critically unwell patients within the intensive care unit (ICU) who undergo invasive mechanical ventilation (MV) via an endotracheal tube (ETT) or tracheostomy. Early diagnosis and adoption of practices known to prevent VAP can reduce mortality and decrease the development of multidrug–resistant organisms[3].

There are several risk factors affecting the development of VAP. Some of these risk factors may already be present at admission to the intensive care unit (ICU), such as advanced age, presence of a respiratory or cardiovascular system disease, organ failure, burns, trauma, acute respiratory distress syndrome (ARDS), gastric colonization, sinusitis, high-volume gastric aspiration, and seasonal changes. Other includes inappropriate antibiotic therapy; diabetes mellitus; tracheostomy; Confusion, Urea, Respiratory rate and Blood pressure (CURB) score; high C-reactive protein levels; high creatinine levels; VAP-related septic shock; and chronic respiratory disease.[4]

Information about bacteria, antibiotic susceptibilities, and prognostic risk factors in ventilator-associated pneumonia may play a significant role in reducing morbidity and mortality caused by VAP.[5]

Considering above facts this present study was conducted to study bacteriological profile and the risk factors associated with the ventilator associated pneumonia.

MATERIALS & METHODS:

The present cross sectional study was conducted in Medical Intensive care unit of Government Medical College & Hospital Aurangabad, a tertiary care teaching hospital. By Convenient sampling method total 100 study subjects were studied during period January 2020 to June 2021. Patients admitted and who underwent mechanical ventilation for 48 hours in tertiary care centre medicine intensive care unit were included in this study. Patient not giving informed consent, Patients who left against medical advice/ or their attendants wanted to take them to some other hospital were excluded from the study.

All ethical considerations and necessary approvals were taken before the start of the study by institutional ethics committee. After the approval, all the study participants were interviewed and necessary examinations were done.

Endotracheal aspirate & Bronchoalveolar lavage were collected from the patients under strict aseptic precautions and transported immediately to the laboratory in appropriate settings and sample processing done Respiratory (ETA&BAL) Samples were mechanically subjected to microscopy- Direct Gram stain, Direct examination of Gram-stained preparations was performed and studied for the presence of squamous cells, polymorphonuclear cells, bacteria (Gram positive and Gram negative) and their morphology.

For Gram stain results, the thresholds for the diagnosis of VAP with the ETA samples were[6] (a) >10 polymorphonuclear neutrophils (PMN) / high power field (HPF) (b) ≥ 1 bacteria / oil immersion field & Presence of intracellular bacterial inclusions.

Criteria used to reject endotracheal aspirates from adult patients by Gram's stain[6] were (a) Greater than 10 squamous epithelial cells per low power field. (b)No organism seen under oil immersion field.

Endotracheal aspirate (EA) /BAL specimens were culture processed semi quantitatively for the identification and categorization of pathogens and colonizers. ETA and BAL were inoculated by using a wire loop holding 1 microliter volume for semiquantitative estimation. Samples were inoculated on chocolate agar, whole plate of blood agar and MacConkey agar. Blood agar and mac Conkey agar plate was incubated aerobically and the chocolate plate in candle jar at 35-37 0 for 18 -24 hrs.

The plates which showed threshold growth were studied by colony morphology, Gram reaction and identified using standard biochemical reactions. After initial characterization of the isolates by colony morphology and Gram stain, species identification and susceptibility testing were done.

The patients satisfying both the clinical and microbiological criteria were diagnosed with VAP. Identification of the organisms was done by various biochemical tests. Biochemical tests include following tests like: Catalase test, Oxidase test, Coagulase test, Indole test, Methyl red

test, Voges Proskauer test, Citrate utilization test, Urease test, Triple sugar iron agar test, Mannitol, Motility test and by standard bacteriological procedures.

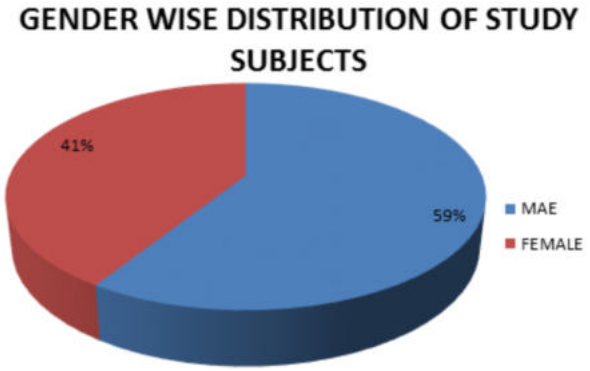
These findings were recorded in the case record form and the same were entered in the Microsoft excel 2013 version. This information was represented in the form frequencies, proportions, tables etc. Graphs, Charts figures were drawn wherever necessary.

RESULTS:

Table No.1: Distribution Of VAP Patients According To Age (n= 100)

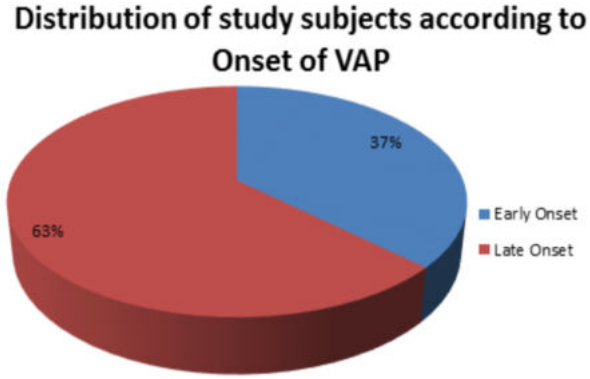
Age Group (Yrs.)	Frequency (n)	Percentage (%)
15 to 25	19	19.00
26 to 40	19	19.00
41 to 55	34	34.00
56 to 70	23	23.00
>70	05	05.00
Total	100	100.00

Out of 100 patients of VAP maximum number of patients were from age group between 41 to 55yrs 43 (34.00%) followed by 56 to 70 yrs 23 (23.00%). 19 (19.00%) patients were from age group from 15 to 15yrs and 26 to 40yrs each. Only 05 (5.00%) patients were from more than 70yrs group.



Pie Diag. No.3: Distribution of VAP patients according to Gender

Out of 100 patients 59 (59.00%) were male and 41 (41.00%) were female.



Pie Diag. No.2: Distribution Of Study Subjects According To Onset Of VAP

More than half of the study subjects have late onset (63%) and 37 % study subjects were having early onset.

Table No.2: Distribution Of VAP Patients According Risk Factors And Co-morbidities

Co-morbidities*	Frequency	Percentage (%)
Diabetes	35	35.00
COPD	21	21.00
CHF	19	19.00
Poisoning	10	10.00
Immunocompromised	15	15.00

***(Multiple responses)**

35 (35.00%) cases were having Diabetes, 21 (21.00%) having COPD, 15 (15%) were immune-compromised, 19(19%) were having CHF and 10 (10.00%) were of Poisoning.

Table No.3: Distribution Of VAP Patients According To Complications

Complications	Frequency	Percentage (%)
Severe sepsis/ shock	33	33.00
ARDS	16	16.00
Pneumothorax	08	08.00
Atelectasis	29	29.00
MDR	30	30.00
Tracheobronchitis	29	29.00
Tracheostomy	07	07.00
Mortality	33	33.00
Re-intubation	23	23.00
Re-admission	13	13.00

Out of 100 patients, 33 (33%) deaths were observed, 33(33%) were of severe sepsis, 29 (29.00%) patients have complication of Atelectasis, 30 (30.00%) of MDR, 29 (29.00%) of Tracheobronchitis, 16 (16.00%) of ARDS.

Table No.4: Distribution Of Patients According To Underline Condition

Underline condition	Frequency	Percentage (%)
Post-operative	14	14.00
COPD	10	10.00
Neurological illness	11	11.00
Poisoning	16	16.00
Snake Bite	15	15.00
Respiratory Failure	14	14.00
Miscellaneous	20	20.00
Total	100	100.00

Out of 100 patients 16 (16.00%) were having Poisoning as an underline condition, followed by Snake Bite 15 (15.00%), Respiratory Failure 14 (14.00%), post-operative 14 (14.00%), Neurological illness 11 (11.00%) and COPD 10 (10.00%).

Mean days of ventilation were 15.2 + 9.32 and mean length of stay in ICU was 19.4 + 9.4.

Table No.5: Distribution of VAP pathogens

VAP pathogens	Number of pathogens	Percentage
Gram negative organisms	108	87.81%
Gram positive organisms	15	12.19%
Total	123	100

Majority that is 87.81% isolated VAP pathogen were gram negative organism while only 12.19% was caused by gram positive organism.

Table No.6: Distribution Of Organisms Isolated In VAP Patients

Organisms	Frequency	Percentage (%)
Klebsiella pneumoniae ss. pneumoniae	43	34.95%
Pseudomonas aeruginosa	34	27.65%
Acinetobacter baumannii	23	18.70%
Staphylococcus aureus ss. Aureus	12	9.75%
Escherichia coli	4	3.25%
Proteus mirabilis	3	2.44%
Enterococcus spp.	2	1.64%
Acinetobacter lowffii	1	0.81%
Coagulase negative staphylococcus	1	0.81%
Total	123	100

The above table no.6 shows that from 100 patients 43 (34.95%) *Klebsiella pneumoniae ss. Pneumoniae,* 34 (27.65%) *Pseudomonas aeruginosa*, 23 (18.70%) *Acinetobacter baumannii,* 12 (9.75%) *Staphylococcus aureus ss. Aureus*, 4 (3.25%) *Escherichia coli*, 3 (2.44%) *Proteus mirabilis*, 2 (1.64%) *Enterococcus* sp., 1 (0.81%) *Acinetobacter lowffii* and *coagulase negative staphylococcus* each isolated.

Table No.7: Distribution Of Microbial Flora In VAP Patients

Microbial flora	Number of patients	Percentages
Monomicrobial	77	77%
Polymicrobial	23	23%
Total	100	100

Out of 100 VAP patients 77(77%) were polymicrobial and 23(23%) were monomicrobial. In the polymicrobial infection also, gram

negative was predominant with the most common combination being *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*.

DISCUSSION:

Ventilator-associated pneumonia (VAP) is a major cause of hospital morbidity and mortality in Intensive Care Unit (ICU) patients despite recent advances in diagnosis and accuracy of management. VAP is the most frequent ICU acquired infection, occurring in most of patients intubated longer than 48 hrs. The incidence of VAP observed from previous studies ranges from 13 to 51 per 1000 ventilator days. Early-onset VAP is usually less severe, associated with a better prognosis, and is more likely to be caused by antibiotic-sensitive bacteria. Late-onset VAP, is usually caused by multi-drug resistant (MDR) pathogens and is associated with increased morbidity and mortality[7].

In this study maximum number of patients were from age group 41 to 70 yrs and male patients were more than female. Ahmed Abdelrazik Othman[8] in his study mentioned that a mean age 55 ± 15 (range 27–88 yrs.), 28 male (58.3%).

In this study 50 (50.00%) cases of Diabetes, 51 (51.00%) of COPD, 35 (35%) of immune-compromised, 21 (21%) of CHF and 10 (10.00%) of Poisoning with multiple response. Ahmed Abdelrazik Othman[8] in his study observed that patients having Diabetes was 41.1%, CHF 29.4%, Poisoning 11.7%, Use of steroids 35%. Awareness of these risk factors may help in identifying patients at increased risk of VAP and guide implementation of appropriate preventive measures during management.

In our study out of 100 patients 16 (16.00%) were having Poisoning as an underlying condition, followed by Snake Bite 15 (15.00%), Respiratory Failure 14 (14.00%), post-operative 14 (14.00%), Neurological illness 11 (11.00%) and COPD 10 (10.00%). Poisoning cases are subjected to gastric lavage prior to admission. These patients develop severe respiratory distress and therefore an increase need for mechanical ventilation. The pulmonary symptoms might be due to aspiration as a result of induced vomiting and lavage. Neelima Ranjan[9] mentioned that trauma was the most common. Many studies have shown that injured patients (head injury and multiple fractures) are at increased risk for VAP relative to medical patients. Alizamin Sadigov[10] et al in their study mentioned that Chronic heart failure (26.4%), COPD (34.7%), severe renal disease (15.7%, stage 4 and stage 5 chronic kidney disease with glomerular filtration rate between 15-30 ml/min and <15ml/min), malnutrition (29.7%) and neurological disorders (23.1%) were the most common underlying disease.

In our study, while considering the complications, 33 (33.00%) were having severe sepsis, 30 (30.00%) were of MDR, 29 (29.00%) of Tracheobronchitis, 29 (29.00%) complication of Atelectasis, 16 (16.00%) of ARDS, 33 (33%) deaths observed with multiple response. Ahmed Abdelrazik Othman[8] in their study mentioned complications as Sever sepsis/Septic shock 52.9%. It was observed that in our study severe sepsis was most common complication. Similarly, some other studies observed [8,11] similar finding. Greater susceptibility to infection among these patients is justified by their impaired immunological state.

In this study mean days of ventilation was 15.2 with standard deviation of 9.32 and mean length of stay in ICU was 19.4 with standard deviation of 9.4. Ahmed Abdelrazik Othman[8] in their study mentioned that mean days of ventilation was 17.4 ± 10 days and mean length of stay in ICU was 20.1 ± 10 days. Longer ICU length of stay which exposed VAP patients to higher rate of complication and hospital stay.

In this study gram negative were predominant pathogen (87.80%). In 100 patients of VAP, 43 (34.95%) *Klebsiella pneumoniae ss. Pneumoniae,* 34 (27.65%) *Pseudomonas aeruginosa*, 23 (18.70%) *Acinetobacter baumannii*, 12 (9.75%) *Staphylococcus aureus ss. Aureus*, 4 (3.25%) *Escherichia coli,* 3 (2.44%) *Proteus mirabilis* and 2 (1.64%) *Enterococcus sp*. Were isolated. Several other studies observed [12-14] that *Klebsiella pneumonia, Pseudomonas aeruginosa*, *Acinetobacter baumannii* were predominately found as infected organisms. All these organisms have a very high propensity of forming biofilms on catheters and tubbing which make them ideal candidates for causing infections in patients requiring ICU.

CONCLUSION:

Most common risk factors for VAP were found to be diabetes, chronic obstructive pulmonary disease, chronic heart failure, Poisoning, reintubation & Immuno-compromised patients. While considering microbial profile associated with VAP it was found that majority of pathogens were gram negative bacilli and few were gram positive cocci. *Klebsiella pneumoniae* was predominant pathogen in our study followed by *Pseudomonas aeruginosa* followed by *Acinetobacter baumannii*.

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