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Original Research Article

Study of incidence of ventilator associated pneumonia in adult patients in Intensive care unit

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Abstract: Pneumonia accounts for nearly 15% of all hospital acquired (nosocomial) infections and 24% to 27% of all those acquired in coronary care units and medical intensive care units (ICU) respectively. Ventilator-Associated Pneumonia (VAP) is a serious complication of mechanical ventilation which increases the patient's stay in the ICU and overall length of hospital stay and adds to overall costs. VAP is the most common of all nosocomial infections which contribute to death. The present study was undertaken to Study of incidence of ventilator associated pneumonia in adult patients in Intensive care unit. The study was conducted over a period of 2 years in an intensive care unit (ICU) of SMBT medical college, Ghoti, dist- Nashik. A total of 200 patients who were kept on mechanical ventilator were randomly selected. The patients were of both sexes kept on ventilator for more than 48 hour and having age of > 15 years. It was analyzed in our study that those requiring prolonged ventilator support (>15 days) had a significantly higher incidence of VAP (P-value, 0.001). Of the 200 patients, 84 patients developed VAP during the ICU stay. VAP continues to be a commonly encountered challenge amongst critically ill patients and carries significant burdens of morbidity, antibiotic utilization and cost.
Keywords: Ventilator associated pneumonia, Intensive care unit, Nosocomial infections

INTRODUCTION:

Ventilator associated pneumonia (VAP) is defined as pneumonia occurring more than 48 hours after the initiation of endotracheal intubation and mechanical ventilation. VAP can also be conceptually defined as an inflammation of the lung parenchyma caused by infectious agents not present or incubating at the time MV was started. Despite the clarity of this concept, numerous operational definitions have been proposed over the decades, none of which is universally accepted. Even definitions based on histopathological examination of biopsy or autopsy tissue may lack precision in diagnosis of VAP. Involvement of focal areas of a lobe may be missed and culture may be negative despite the presence of inflammation in the lung. The absence of a "gold standard" for diagnosis continues to fuel controversy about the adequacy and accuracy of this definition [1-3].

The association of VAP and increased mortality is somewhat more controversial. It is unclear to date whether more patients die with VAP or because of VAP. However, despite this controversy, it is increasingly clear to patients, providers and health care systems the significant benefit that exists in the prevention of VAP [4-6].

The present study was done to study the incidence of ventilator associated pneumonia in adult patients in Intensive care unit.

MATERIALS AND METHODS:

The study was conducted over a period of 2 years in an intensive care unit (ICU) of SMBT medical college, Ghoti, dist- Nashik. A total of 200 patients who were kept on mechanical ventilator were randomly selected. The patients were of both sexes kept on ventilator for more than 48 hour and having age of > 15 years.

Exclusion criteria:

- Patients who died or
- Developed pneumonia within 48 hour or
- Those who were admitted with pneumonia at the time of admission and

- Patients of ARDS (Acute respiratory distress syndrome) were excluded from the study.

Most of the patients put of ventilator support were previously treated elsewhere using antibiotics in indoor ward or health care centers. Age, sex, date of admission to ICU, date of initiating mechanical ventilation and mode of assess to the patients airway were all recorded. Indication for the mechanical ventilation was also recorded. Patient's vitals, oxygen saturation, position of the patients, general and physical examination were monitored on regular basis.

Patients were monitored from the date of inclusion in the study to the final outcome in the ICU. VAP was diagnosed on clinical grounds based on the modified CPIS system [Table 1] originally developed by Plugin and others [7, 8] giving 0–2 points each for fever, leukocyte count, oxygenation status, quantity and purulence of tracheal secretions, type of radiographic abnormality and result of sputum culture and Gram stain. The VAP group was classified into two groups, early-onset type (within 48–96 h) and late-onset type (>96 h). Once the clinical suspicion was established, empirical antibiotic therapy was initiated based on guidelines prescribed by the American Thoracic Society. Patients were routinely screened by arterial blood gas (ABG) analysis every 12 hourly and appropriate steps were taken to correct any change.

Statistical analysis was performed with the help of IBM SPSS statistics version 20 using univariate analysis subjecting to chi-square test.

RESULTS:

The study was comprised of 200 patients of various cases of poisoning, neurological disorders, sepsis and others. The mean age of the patient was 36 years, having a predominance of male population. Of the 200 patients, 84 patients developed VAP during the ICU stay. The mean duration of mechanical ventilation was found to be 11 days for the non-VAP group and 18 days for the VAP group (Table 2). It was analyzed in our study that those requiring prolonged ventilator support (>15 days) had a significantly higher incidence of VAP (P-value, 0.001). (Table 3)

Table 1: Clinical pulmonary infection scoring system

CPIS points	**0**	**1**	**2**
Tracheal secretions	Rare	Abundant	Purulent
Leukocyte count (mm^3)	>4000 and < 11000	<4000 and > 11000	<04000 and > 11000 + band forms
Temperature (^oC)	>36.5 and < 38.4	>38.5 and < 38.9	>39 and < 36
PaO_2 /FIO $_2$ ratio (mmHg)	>240 or ARDS	-	<240 and no ARDS
Chest radiograph	No infiltrate	Diffuse infiltrate	Localized infiltrate
Culture of tracheal aspirate	Negative	-	positive

Table 2: Gender distribution and incidence of VAP

Gender	**No. of cases**	**No. of VAP cases**	**Percentage of VAP cases**	**P value**
Male	132	59	44.69	0.2345
Female	68	25	36.76	
Total	200	84		

p>0.05 = not significant.

Table 3: Comparison of duration of mechanical ventilation and incidence of VAP ventilator-associated pneumonia

Days on ventilator	**Cases**	**VAP**	**percentage**	**P value**
<15	170	62	36.47	0.001
>15	30	22	73.33	
Total	200	84		

P<0.001 = highly significant.

DISCUSSION:

Ventilator-associated pneumonia (VAP) is a major contributor to morbidity and mortality in the intensive care unit (ICU). Little disagreement exists with this statement in the literature. Many guidelines have been developed to try to deal with this serious condition. The Centers for Medicare & Medicaid Services offers an extensive list of resources for VAP prevention implementation [9].

Ventilator-associated pneumonia (VAP) is the most frequent intensive-care-unit (ICU)-acquired infection, with an incidence ranging from 6 to 52%. Several studies have shown that critically ill patients are

at high risk for getting such nosocomial infections. The incidence of VAP is varied among different studies, depending on the definition, the type of hospital or ICU, the population studied and the level of antibiotic exposure.33 Critically ill patients who are intubated for > 24 hours are at 6 to 21 times the risk of developing ventilator-associated pneumonia (VAP) and those intubated for < 24 hours are at 3 times the risk of VAP.20 Other risk factors for VAP include decreased level of consciousness, supine positioning with HOB flat, use of H2 antagonists and antacids, gastric distention, presence of gastric or small intestine tubes, enteral feedings, and a trauma or COPD diagnosis.1,18-22 VAP is reported to occur at rates of 10 to 35 cases / 1000 ventilator days, depending on the clinical situation [10].

VAP is one of the infections related to health care, because it involves the relationship between pathogen, host and epidemiological variables. In the United States of America, there is a concern about the measures for control and prevention of VAP, evidenced by the publication of the report to err is human: building a safer health care system, which highlighted the deficiencies in the area of patient safety and revealed 98,000 deaths per year as a result of medical errors [11, 12].

Pathogenesis:

The complex interplay between the endotracheal tube, presence of risk factors, virulence of the invading bacteria and host immunity largely determine the development of VAP. The presence of an endotracheal tube is by far the most important risk factor, resulting in a violation of natural defense mechanisms (the cough reflex of glottis and larynx) against micro aspiration around the cuff of the tube.

Infectious bacteria obtain direct access to the lower respiratory tract via:

1. Micro aspiration, which can occur during intubation itself;
2. Development of a biofilm laden with bacteria (typically Gram-negative bacteria and fungal species) within the endotracheal tube;
3. Pooling and trickling of secretions around the cuff; and
4. Impairment of mucociliary clearance of secretions with gravity dependence of mucus flow within the airways. Pathogenic material can also collect in surrounding anatomic structures, such as the stomach, sinuses, nasopharynx and oropharynx, with replacement of normal flora by more virulent strains [11-14].

Microbiology:

The type of organism that causes VAP usually depends on the duration of mechanical ventilation. In general, early VAP is caused by pathogens that are sensitive to antibiotics, whereas late onset VAP is caused by multi-drug resistant and more difficult to treat bacteria. However, this is by no means a rule and merely a guide to initiate antibiotic therapy until further clinical information is available [14].

Typically, bacteria causing early-onset VAP include Streptococcus pneumoniae (as well as other streptococcus species), Haemophilus influenzae, methicillin-sensitive Staphylo coccus aureus (MSSA), antibiotic-sensitive enteric Gram-negative bacilli, Escherichia coli, Klebsiella pneumonia, Enterobacter species, Proteus species and Serratia marcescens. Culprits of late VAP are typically MDR bacteria, such as methicillin-resistant S. aureus (MRSA), Acinetobacter, Pseudomonas aeruginosa, and extended-spectrum beta-lactamase producing bacteria (ESBL) [14].

VAP is the second most common cause of the nosocomial infection after urinary tract infection among pediatric and neonatal intensive care unit (NICU) patients.3 Infants mechanically ventilated in the NICU are at a particularly high risk of developing Ventilator-associated pneumonia because of poor host factors, severe underlying diseases, prolonged use of mechanical ventilation, inadequate pulmonary toilet and extensive use of invasive devices and procedures [15, 16].

CONCLUSION:

VAP continues to be a commonly encountered challenge amongst critically ill patients and carries significant burdens of morbidity, antibiotic utilization and cost. Studies on prevention strategies directed towards the pathophysiologic mechanisms of VAP have shown variable success. However, certain measures as described in this study have been shown to improve patient outcomes and, therefore, we recommend care providers consider a multidisciplinary strategy incorporating the following: NPPV when able; sedation and weaning protocols for those patients who do require mechanical ventilation; mechanical ventilation protocols including head of bed elevation and oral care; and removal of subglottic secretions. Future research that considers clinical outcomes as primary endpoints will hopefully result in more detailed prevention strategies.

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