Original Article

Organisms associated with ventilator associated pneumonia (VAP) in intensive care units (ICU)

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Abstract

Background: *Organisms associated with ventilator associated pneumonia (VAP) in intensive care units (ICU).*

***Aims and objectives**: To identify the organisms associated with ventilator associated pneumonia and to compare our study with other international studies.*

Methods: *This observational study on VAP was conducted in different ICU of Square Hospital Limited during the two years. Any ventilated patient who developed fever or respiratory distress was clinically assessed by attending physician. This includes time of developing fever after intubation, physical examination findings (auscultation finding, pattern of temperature) and X-ray findings. On the day of onset of fever or respiratory distress, tracheal aspiration was done and the aspirated fluid was sent to microbiology lab. for culture and sensitivity test. If patient was designated to be suffering from VAP all relevant information was documented in a structured questionnaire.*

Results: *In our study we found 15 organisms responsible for VAP. Among these common organisms were pseudomonus(35%), acinetobacter(29%), klebsiella(16%), MSSA (10%), MRSA(9).Total number of cases was 79. Among these 21 patients expired which was 26.5% of the whole series. Total 534 patients died in this hospital during this 2 years. Death for VAP was 4% of the total death of the hospital.*

Conclusion: *Pseudomonas was the most commonest among identified organisms with ventilator associated pneumonia and medicine department having maximum number of VAP patients. To compare our results with those of international studies we found similarity in organisms, primary diagnosis and mortality.*

Key words: *ventilator associated pneumonia, organism and intensive care unit.*

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Introduction:

Ventilator-associated pneumonia (VAP) is the most common nosocomial infection in the ICU and contributes disproportionately to both poor outcomes and the high cost of care in critically ill patients[1]. Since the initial 1996 American Thoracic Society (ATS) guideline on nosocomial pneumonia, a number of new developments have appeared, mandating a new evidence-based guideline for hospital-acquired pneumonia (HAP) including healthcare-associated pneumonia (HCAP) and ventilator-associated pneumonia (VAP).

Ventilator-associated pneumonia is a common and highly morbid condition in critically ill patients[2]. Epidemiologic investigations have shown cumulative incidence rates of 10% to 25%[3], crude mortality rates of 10% to 40%[4] and attributable mortality rates of 5% to 27%[5]. Hospital length of stay and cost are both increased in patients who develop ventilator-associated pneumonia[6].

The predominant organisms responsible for infection are *Staphylococcus aureus Pseudomonas aeruginosa* and *Enterobacteriaceae* but etiologic agents widely differ according to the population of patients in an intensive care unit duration of hospital stay and prior antimicrobial therapy. Because appropriate antimicrobial treatment of patients with VAP significantly improves outcome more rapid

identification of infected patients and accurate selection of antimicrobial agents represent important clinical goals[7].

Organisms causing ventilator-associated pneumonia generally fall into two groups: those causing early-onset ventilator-associated pneumonia (<4 days of mechanical ventilation) and those causing late-onset ventilator-associated pneumonia (>4 days of mechanical ventilation)[3]. Early-onset organisms are typically antibiotic-susceptible community-acquired bacteria, while late-onset organisms are commonly antibiotic-resistant nosocomial organisms. Colonization of the oropharynx and the stomach with potentially pathogenic organisms precedes the development of ventilator-associated pneumonia in most patients. The pathogenesis of ventilator-associated pneumonia probably involves microaspiration of oropharyngeal or gastric secretions contaminated with these organisms[4].

The most widely studied preventive strategies have focused on the prevention of oropharyngeal or gastric colonization and the prevention of aspiration of contaminated oropharyngeal or gastric secretions[8]. This evidence-based systematic review aims to identify interventions for the prevention of ventilator-associated pneumonia, critically evaluate their efficacy and adverse effects and recommend an approach to their use.

The diagnosis of VAP is usually based on three components: systemic signs of infection, new or worsening infiltrates seen on the chest roentgenogram and bacteriologic evidence of pulmonary parenchymal infection[9]. The systemic signs of infection such as fever, tachycardia and leukocytosis are nonspecific findings and can be caused by any condition that releases cytokines[10]. In trauma and other surgical patients, fever and leukocytosis should prompt the physician to suspect infection but during the early post traumatic or postoperative period (i.e., during the first 72 hours) these findings usually are not conclusive. However, later, fever and leukocytosis are more likely to be caused by infection but even then other events associated with an inflammatory response (e.g., devascularized tissue, open wounds, pulmonary edema and/or infarction) can be responsible for these findings.

Aim of our study was to identify the organisms associated with ventilator associated pneumonia (VAP) and to compare our study with other international studies.

Method:

This observational study on ventilator associated pneumonia (VAP) was conducted at Square Hospitals Ltd. Dhaka during April 2007 to March 2009. The aim of the study was to determine the organisms associated with the disease.

Any ventilated patient who developed clinical pneumonia along with culture positive aspirated tracheal fluid constituted VAP. Clinical pneumonia was defined as inflammation of one or both lungs with consolidation which is frequently but not always due to infection. The infection may be bacterial, viral, fungal or parasitic. Symptoms may include fever, chills, cough with sputum production, chest pain, and shortness of breath.

Patients who developed other infections along with VAP and patients who underwent tracheostomy were excluded from the study.

Any ventilated patient who developed fever or respiratory distress was clinically assessed by attending physician. This includes time of developing fever after intubation, Physical examination findings (auscultation findings, pattern of temperature) and chest X-ray findings. On the day of onset of fever or respiratory distress tracheal aspiration was done and the aspirated fluid was sent to microbiology lab for culture and sensitivity test. If bacteria were isolated in culture, the patient was evaluated to asses whether the patient fell under case definition of VAP. If patient was designated to be suffering from VAP all relevant information was documented in a structured questionnaire.

At the end of the data collection period all the questionnaires were complied and a master sheet was made.

Results:

This is an observational analytical cross-sectional study of 'Organisms responsible for ventilator associated pneumonia (VAP) in different department of Hospital'. All the patients diagnosed as VAP was included in this study. Total number of cases was 79. Among these patients 21 patients died which was 26.5 % of the whole series. Study period was 2

years. Total 534 patients died in this hospital during this 2 years period. Death for VAP was 4 % of the total death of the hospital.

Among the 79 VAP patients 52 patients (66%) was male and 27 patients was female. Male : Female ratio was 1.9 : 1.

Table-I

Age distribution of VAP patients (n=79).

Age frequency (year)	No of cases	Percentage	Mean age (year)
<= 30	08	10.13 %	
31-40	05	06.33 %	
41-50	10	12.67 %	60.17
51-60	10	12.67 %	
61-70	18	22.78 %	
>70	28	35.44 %	

Shows the distribution of VAP patients according to their age frequency. Highest number of patients (35.44%) was in more than 70 year age group. Second highest was 61 to 70 years age group. Patients of 41-50 years and 51-60 years age group were equal in number (10 patients). We had 8 patients (10.13%) in below 30 years age group and only 5 patients (6.33%) in 31-40 years age group.

Table-II

Age distribution of expired VAP patients (n=21)

Age frequency (year)	No of cases	Percentage
<= 30	1	4.7 %
31-40	2	9.5 %
41-50	1	4.7 %
51-60	2	9.5 %
61-70	6	28.5 %
>70	9	43 %

This demonstrates the distribution of age frequency among the patients who died of VAP. Age of highest number of patients (43%) was more than 70 years. Six patients (28.5%) were in 61-70 year age group. Number of expired patients was 2 in 31-40 and 51-60 year age group. Where as that was only 1 in number (4.7%) in below 30 year and 41-50 year age group.

Table -III

Distribution of organisms among VAP cases

Sl.	Organism	Number of cases	Percentage
1.	Pseudomonas spp.	28	35 %
2.	Acinetobacter spp.	23	29 %
3.	Klebsiella spp.	13	16.3 %
4.	MSSA	08	10 %
5.	MRSA	07	9 %
6.	Group D non enterococci	05	6 %
7.	Candida	05	6 %
8.	CONS	05	6 %
9.	E. coli	04	5 %
10.	Sternotrophomonas	04	5 %
11.	N. meningitidis	03	4 %
12.	Sterptococcus pneumoniae	02	2.5 %
13.	Entero faecalis	01	1.3 %
14.	Proteus spp.	01	1.3 %
15.	Alpha hemolytic streptococci	01	1.3 %

In our study we found 15 organisms responsible for VAP. Single organism was isolated in 54 cases. Other 25 patients had more than 1 organism. Table-III has tabulated the list of isolated organisms in VAP cases. Pseudomonas spp. was responsible for more than one third cases (28 cases). Acinatobacter spp. was isolated in 23 cases (29%). We found Klebsiella spp. in 13 cases (16.3%). Methicillin Sensitive Staphylococcus Aureas (MSSA) and Methicillin Resistant Staphylococcus Aureas (MRSA) were found respectively in 08 and 07 cases. Group D non enterococci, Candida and Coagulase Negative Staphylococcus species (CONS) were present in 5 cases (6%). E.coli and Sternotrophomonas were isolated in 4 cases. Streptococcus pneumoniae was responsible for 2 cases. Other 3 organisms which were present in 1 case respectively were Entero faecalis, Proteus spp. and Alpha hemolytic streptococci.

Table – IV

Distribution of organisms among expired VAP cases

Sl	Name of the organism	No. of cases	Percentage
1	Pseudomonus spp.	10	48 %
2	Klebsiella	05	24 %
3	Acinetobacter spp.	04	19 %
4	Candida	03	14 %
5	E. coli	03	14 %
6	MRSA	02	9.5 %
7	MSSA	1	5 %
8	CONS	1	5 %
9	N. meningitidis	1	5 %
10	Sternotrophomonas	1	5 %

This shows the distribution of organisms among expired VAP cases. In near about half (48%) of the cases Pseudomonas spp. was responsible for VAP. Klebsiella was isolated in approximately quarter (24%) of the patients. Acinatobacter spp. was found in 19% (04 cases) of cases. Number of affected cases by Candida and E.coli was three (14%) respectively. Methicillin Resistant Staphylococcus Aureas (MRSA) was responsible for 2 cases. Number of patient affected by Methicillin Sensitive Staphylococcus Aureas (MSSA), Coagulase Negative Staphylococcus species (CONS), N. meningitidis and Sternotrophomonas was 1 for each organism.

This elaborates the statistics of VAP patients among all departments of hospital. Highest number of VAP patient was from medicine department (27 patients), followed by Neurosurgery (19 patients), Surgery (08 patients) and Cardiology (08 patients). Nephrology had 05 patients. Neurology and Oncology had 3 patients from each department. Number of VAP patients from CT surgery and Gastroenterology was respectively 2 in number. Orthopedics department had only 1 patient. Highest number of patients expired in medicine department (06 cases) followed by neurosurgery (3 cases) and cardiology (3 cases). Two patients expired respectively from the department of nephrology, CT surgery, oncology and gastroenterology. Only 1 patient expired from surgery department. Other departments like neurology and orthopedics didn't have any mortality. Time duration of developing VAP after intubation was 7 to 9.7 days for all cases. Mean was 8.3 days for all cases. Common organisms were acinatobacter, pseudomonus spp., staph aureas, klebsiella and MRSA.

Table-V

Statistics according to different departments.

Department	No. of cases	Mean age (year)	No of death	Percentage of death	Mean time of developing VAP after intubation (day)	Commom two organisms
Medicine	27	59	06	22 %	9.7	Acinetobacter Pseudomonus
Neurosurgery	19	55	03	16 %	7.0	Pseudomonus Staph aureas
Surgery	08	55	01	13 %	9.3	Pseudomonus Acinetobacter
Cardiology	08	74	03	38 %	8.5	Klebsiella Pseudomonus
Nephrology	05	79	02	40 %	8.6	MRSA Acinetobacter
Neurology	03	71	00	00 %	7	Acinetobacter MRSA
CT surgery	02	47	02	100 %	9	Pseudomonus Acinetobacter
Oncology	03	62	02	67 %	8	Pseudomonus Candida
Gastroenterology	02	68	02	100 %	8	Acinetobacter Pseudomonus
Orthopedics	01	30	00	00 %	7	Pseudomonus Klebsiella
Clinical Hematology	01	32	00	00 %	9	Acinetobacter
					Mean 8.3	

Discussion:

We have performed our study on "Organisms associated with ventilator associated pneumonia (VAP) in intensive care unit (ICU)". This was an observational analytic cross section study. Total number of patients was 79. Main objective of our study was to identify the organisms associated with VAP (Ventilator Associated Pneumonia) in intensive care unit (ICU). All patients were diagnosed on the basis of their clinical features, radiological findings and tracheal swab culture sensitivity. Age, sex, time of onset of VAP after intubation, primary diagnosis of patient, isolated organisms and clinical status at the time of discharge was documented as variable in data collection sheet. After collection of data we have tabulated the result and compared with that of international studies.

According to the study of Kollef et al 15.5 % of their ICU patient had developed VAP[11]. Common primary diagnosis of VAP was cardiothoracic (21.6%) and medical disease (9.3%). Mortality rate was 37.2% in their series. In our study we found primary diagnosis of cardiac origin was in 12.6% cases and that of medicine origin was in 34% cases. Mortality was 26.5% in our series.

Kimberly et al. found mortality of VAP in between 20% - 50% in their study[12]. In our study mortality rate was 26.5%.

Marin et al. had their study on VAP. According to their study primary diagnosis of VAP was post surgery (15.6%), neurologic disease (13.3%), sepsis (13.1%) and cardiac (10.8%) [13]. In our study primary diagnosis was surgical in 10%, neurological in 28% and cardiac in 12.6%. According to their study duration of developing VAP after intubation was 7.3 days. In our study mean was 8.3 days. Marin et al. found common responsible organisms MRSA (14.8%), *Staphylococcus aureas* (14.8%), *Pseudomonas aeruginosa* (14.3%) and other *Staphylococcus* species (8.8%) in their study. In our study we found *Pseudomonas spp.* commonest (35%) followed by A*cinatobacter spp.* (29%) and *Klebsiella* (16.3%). We found only 9% cases caused disease by MRSA. Overall mortality was 25.1% in their series which was 26.5% in our series.

According to the study of Chastre J. et al. mortality was 24% to 50% for VAP in their series. Isolated organisms mostly were *Staphylococcus aureas*, *Pseudomonas aeruginosa* and *Enterobacteriaceae*[14]. We found mortality 26.5% in our study. *Staphylococcus aureas* (10%) and *Pseudomonas aeruginosa* (35%) were also common in our series.

Donald E et al. performed their epidemiological study on VAP. According to their study rate of VAP increases 6 to 21 fold for intubated patients in ICU[15]. They found the rate of the occurrence of VAP was higher in surgical patients then the medical patients. In our study percentage of medical cases (34%) was more than that of surgical cases (10%).

According to the study of Bonten et al. primary cause of VAP was COPD, ARDS, head injury and trauma in most of the patients[16]. In our study we found primary diagnosis was neurosurgical, medical and surgical in most of the patients. Bonten et al found that maximum number of their patient developed VAP after 5 days of intubation. In our study mean time was 8.3 days to develop VAP.

Shaw et al. found *Staphylococcus aureas* as commonest organism in VAP cases of their series[17]. Other common organisms were *Pseudomonas aeruginosa* and *Acinatobacter baumanii*. In our study commonest organism was *Pseudomonas aeruginosa* (35%) followed by A*cinetobacter* (29%) and *Klebsiella* (16.3%).

Mortality of VAP patients was 37% in the study of Rakshit et al. In their study male was 56.9% and female was 43.1%. We found mortality 26.5% in our study[18]. Male was 55% in our study where as female was 45%. Rakshit et al. found commonest organism *Pseudomonas aeruginosa* in their study followed by *Klebsiella pneumonae*. We also found *Pseudomonas spp.* commonest organism in our series.

Conclusion:

Pseudomonas spp was the commonest among identified organisms with ventilator associated pneumonia and medicine department having maximum number of VAP patients and compared our results with those of international studies we found similarity in organisms, primary diagnosis and mortality.

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