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Original Research Article

Prevalence of ventilator associated pneumonia in adult at medico-surgical ICU of medical college hospital

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Abstract

Background: For treatment of Ventilator-associated pneumonia (VAP) the prevalent causative agent needs to be known at individual Intensive Care Unit (ICU) for choosing empirical antibiotics. We aimed to determine the prevalence of VAP, rate of VAP, prevalence of microbiological agent along with drug sensitivity and the factor associated with survival of ventilated patient.

Methodology: This study included 65 patients on mechanical ventilation for more than 24 hours at medical college ICU. VAP was diagnosed based on Modified Clinical Pulmonary Infection Score (CPIS) > 6 and having a positive quantitative culture of the endotracheal aspirate with the presence of radiological infiltrates in chest X-ray.

Results: VAP developed in 41.5% of patients & 12.35 cases /1000 ventilator days. 37% were caused by Klebsiella pneumoniae, 26% by Acinetobacter baumanii & 15% by Pseudomonas aeruginosa. 96% of patients were harbouring extended spectrum beta-lactamases (ESBL) producing isolates, 78% multi drug resistant(MDR), 18% carbapenem resistant. Factors like age, gender, type of patient (medical/surgical), number of ventilator days were not associated with the occurrence of VAP. Advanced age, number of days in mechanical ventilator, presence of radiological finding & resistant organism were risk factors associated with the non-survival of non-VAP patients. Younger age, male gender & early onset VAP were associated with survival in a VAP group of patients.

Conclusions: In our ICU the rate of VAP is very high along with the high prevalence of MDR organism also. But occurrence of VAP was not associated with a length of mechanical ventilation. VAP not even associated with high mortality rate.

Introduction

Ventilator associated pneumonia (VAP) refers to the development of parenchymal lung infection more than 48 hours after a patient has undergone endotracheal intubation [1]. It continues to be a major problem in the intensive care unit (ICU) patients. It has been linked to a significant rise of morbidity and mortality, including prolongation of mechanical ventilation, hospital stay, and higher risks of death as well as increased health care expenditures [2-5]. Eventually, patients who are intubated and mechanically ventilated may have a 3 to 10 fold risk of developing pneumonia [3]. There is a noticeable discrepancy in the prevalence of VAP in different regions of the world. This is probably attributed to the different diagnostic criteria, the study population, hospital resources, and the type of ICU and organisms prevalence [6,7]. Estimated prevalence of VAP rate ranges from 9-27% of all mechanically ventilated patients [1,3]. VAP rates range from 1.2 to 8.5 per 1,000 ventilator days, which depended on the definition used for the diagnostic criteria [8]. Despite the advancements in antimicrobial regimen the mortality rate of VAP is still high, ranging from 33 to 50% [1]. In some specific settings like VAP caused by a high-risk pathogen, the mortality can reach up to an alarming 76% [3]. It has been seen that VAP, associated with a prolonged ICU length of stay and higher costs for medical care. VAP requires early diagnosis and early initiation of appropriate antibiotic treatment, as inadequate antimicrobial treatment or delayed initiation of antimicrobials may lead to the emergence of multi drug resistance (MDR) pathogens and higher hospital mortality [9,10].

The etiological agents of VAP vary with different patient populations in the Intensive Care Unit (ICU), types of ICU, duration of hospital stay and prior antimicrobial therapy and co-morbidities [3,11]. Therefore, the local microbial flora causing VAP needs to be studied in each setting to guide more effective and rational utilization of empiric antimicrobial agents.

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The objectives of this study was to find out the prevalence of VAP, VAP rate, prevalence of microorganisms responsible for VAP along with their drug susceptibility patterns and factors associated with survival of ventilated patients.

Materials and Methods

This study is a hospital based prospective, observational& analytical study. The study was conducted between November 2015 and October 2017 at Central Intensive Care Unit (CICU) of Veer Surendra Sai Institute of Medical Sciences and Research (VIMSAR). This is a 1000-bed tertiary care hospital in western Odisha. CICU is comprised 20 beds and patients were either admitted directly to the CICU or transferred from other wards, namely General medicine, Pulmonary Medicine, General Surgery, Orthopaedics, Gynaecology and Obstetrics, Cardiology, Neurosurgery and Urosurgery wards. The study was approved by the institutional ethical committee and an informed consent was taken from the legally authorized representative of the patient. The patients, those having pre-existing pneumonia or those who developed pneumonia within 48 hours of intubation / mechanical Ventilation were excluded from the study. Patient with pre-existing lung disease (clinically/ radiologically) or age less than 18 years were excluded from this study. A clinical suspicion of VAP was made in patients with a Modified Clinical Pulmonary Infection Score (CPIS) > 6 [12]. The diagnosis was confirmed by performing a quantitative culture of the endotracheal aspirate and observing $\geq 10^5$cfu/ ml isolates with infiltration or consolidation in Chest X-ray. Patient with modified CPIS more than 6 but normal Chest X-ray and/or no organism isolated from endotracheal aspirate (ETA) on culture, was not considered as VAP. All the patients fulfilling the inclusion criteria (definite diagnosis of VAP) and after excluding based on exclusion criteria during the above period were taken into the study. Table 1 showed the different variable with their scoring pattern. Figure 1, showed the patient flow. All the positive culture isolates, sensitivity pattern to antibiotics was done as per our institutional protocol. The patients diagnosed as VAP & non-VAP based on above criteria were followed up till stayed in ICU. Non randomised consecutive sampling technique was used in this study.

Extended spectrum beta-lactamases (ESBLs) producing isolates phenotypes confirmation was done by testing the sensitivity of Cefotaxime (30µg) or Ceftazidime (30µg) disk with or without Clavulanate (10µg) [13]. Vancomycin resistance Enterococci (VRE) was diagnosed by detection of enterococci by disc diffusion test & MIC value of ≥32µg/ml. Multi Drug Resistant (MDR) defined as non-susceptibility to at least one agent in three or more antimicrobial categories [14]. Extensively drug resistant (XDR) defined as non-susceptibility to at least one agent in all but two or fewer antimicrobial categories (i.e. bacterial isolates remain susceptible to only one or two antimicrobials categories)[14]. Pan drug resistant (PDR) defined as non-susceptibility to all agents in all antimicrobial categories [14]. VAP rate is defined as the number of ventilator-associated pneumonias per 1,000 ventilator days during our study period. This was calculated as number patients diagnosed as VAP divided by number of days on ventilator in all ventilated patients during the study period multiply by 1000.

Statistics

The statistical analysis was performed with the help of SPSS (Verson 22, IBM). Normally distributed continuous variables are presented as mean (±SD). Categorical variables are expressed as percentage. Comparison of different mean was done with Student's t test& comparison of proportions was done with the chi square test. P-value of 0.05 or less was considered statistically significant.

Results

In our study 65 patients were put on mechanical ventilator for more than 48 hours. Table 2, showed the base line characteristics of ventilated patient. In our study, the majority (40 numbers) of patients were male out of which 23 were in non-VAP group. The majority (49 numbers) of patients were from medical ward & out of which 29 patients were non-VAP group. Age, gender & the primary type of patient (either medical ward or surgical ward) were matched in both (VAP / Non-VAP) group as p value >0.05(as shown in Table 2). Mortality in the non-VAP group was more, but statistically not significant. Radiological abnormality was more seen in VAP group. Diffused radiological lesions were more seen in the VAP group than non-VAP group which was also statistically significant. Nine patients were localized lesion & one patient had diffuse lesion on X-ray chest. We could not demonstrate any microbial agent among those ten patients, so as per our definition, they were not VAP.

Out of 65 patients, 27 (41.5%) patients developed VAP. VAP rate was 12.35/1000 mechanical ventilator days. Out of 27 patients, early VAP (VAP within 5 days of MV) was 8 patients & Late VAP (VAP after 5 days of MV) 19 patients. In our study, majority 10 (37%) of VAP was caused by Klebsiella Pneumoniae. Other bacterial causes of VAP were acinetobacter baumanii 7(26%), pseudomonas aeruginosa 4(15%), staphylococcus aureus 3(11%), Escherichia Coli 2(7%) & Stenotrophomonas maltophilia1 (4%).

Susceptibility of various antibiotics were tested against the isolates. 100% Klebsiella pneumoniae isolates were sensitive to 3rd generation cephalosporin, 90% to amino glycoside, 70% to chloramphenicol, 50% to carbapenem, 30% to Ampicillin-salbactam, 20% to Piperacillin-tazobactam and 10% to quinolone. Acinetobacter baumanii isolates were100% sensitive to carbapenem, 86% to amino glycoside, 43% to ampicillin-salbactam& 28% to 3rd generation cephalosporin. Pseudomonas aeruginosa isolates were 100% sensitive to amino glycoside, 50% to carbapenem, 50% to piperacillin-tazobactam &50% to 4th generation cephalosporin. Staphylococcus aureus isolates were 67% sensitive to vancomycin, 33% to Linezolid, 33% to piperacillin-tazobactam&33% to ampicillin-salbactam.

Escherichia Coli isolates were 100% sensitive to amino glycoside, 100% to carbapenem, 100% to Trimethoprim-sulphamethoxazole, 50% to piperacillin-tazobactam, 50% to 3rdgeneration Cephalosporin, 50% to quinolone &50% chloramphenicol. Stenotrophomonas maltophilia isolate was sensitive to ampicillin-salbactam, quinolone, amino glycoside, trimethoprim-sulphamethoxazole & chloramphenicol. In our study, 96% (26) of patients were harbouring ESBL isolates, 78% (21) were MDR organisms, 18% (5) Carbapenem resistant, 4% (1) XDR organism and all Staphylococcus aureus isolates were MRSA.

Table 3 showed the factors associated with survival of ventilated patients both VAP & non-VAP patients. Advance age, more number of days in mechanical ventilator, presence of radiological finding & resistant organism were risk factors associated with the non-survival of non-VAP patients which was statistically significant. Younger age, male gender & early onset VAP were statistically significant factors associated with survival in VAP group of patients.

Table 1: Modified CPIS score

CPIS Points	**0**	**1**	**2**
Tracheal secretions	Rare	Abundant	Abundant and purulent
Chest X-ray infiltrates	No infiltrate	Diffuse	Localize
Temperature(°C)	≥ 36.5 and ≤38.4	≥38.5 and ≤38.9	≥39 or ≤ 36
Leukocyte count (mm3)	>4,000 &<11,000	<4,000 &>11,000	<4,000 or >11,000 & band forms
PaO2/FiO2 (mmHg)	>240 or ARDS	-	≤240 and no ARDS
Culture of tracheal aspirate	Negative	--	Positive

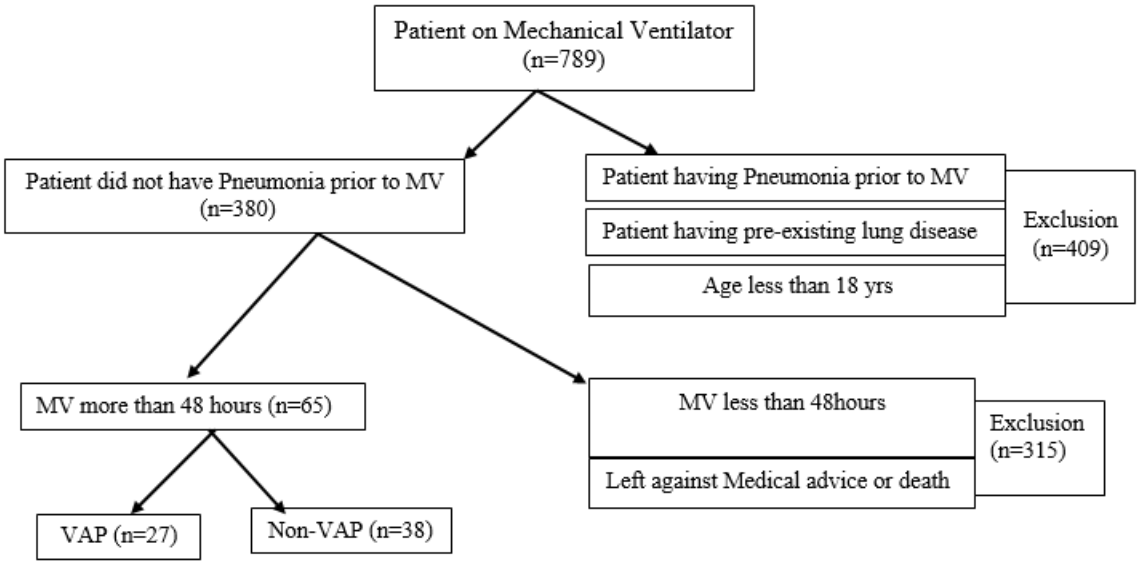

Fig.1: Patient flow

Table 2: Demographic characteristics between patient with Ventilator associated pneumonia and without ventilator-associated pneumonia

Characteristics		**Non-VAP (n-38)**	**VAP (n-27)**	**p Value**
Age (years): Mean±SD		48.29±17.53	46.22±19.60	0.65
Male		23	17	0.52
Primary Type of Patient (Medical)		29	20	0.53
Ventilator days (Mean±SD)		7.97±4.18	8.89±3.03	0.36
X-ray Chest Finding	No Parenchymal Lesion(n-29)	28	1	0.00
	Localised Parenchymal Lesion(n-20)	9	11	
	Diffused Parenchymal Lesion(n-16)	1	15	

Organism Isolated from Respiratory Sample	2	27	0.00
Mortality	14	9	0.77

Table 3: Factor related to Survival of ventilated patient

Variables	**Non-VAP(n=38)**			**VAP(n=27)**		
	Survival (n=24)	Non-Survival (n=14)	p value	Survival (n=18)	Non-survival (n=9)	p value
Age	40.29±14.98	62.00±12.54	0.000	37.89±18.31	62.89±8.26	0.001
Gender(Male)	15	8	0.7	15	2	0.002
Type of Patient(Medical)	18	11	0.8	12	8	0.2
Duration of MV	5.96±3.113	11.43±3.50	0.000	8.33±3.37	10.00±1.87	0.18
X-ray Finding Present	3	7	0.011	17	9	0.47
Type of Resistant(MDR)	0	13	0.000	13	8	0.5
Type of VAP(Late onset)	NA	NA	NA	10	9	0.017

NA: not applicable

Discussion

The rate of VAP infection in developing countries ranges from 8.9 to 46/ 1000 mechanical ventilator days [7,15-17]. But in our study rate of VAP was 12.35/ 1000 mechanical ventilator days. The incidence of VAP in our study was 41.5%. Very high incidence also seen in other studies which ranges from 15 % to 58%[16-21].The wide range probably due to difference in study population, lack of uniform diagnostic criteria, type of technique used for collection of samples for microbiological test & use of preventive practice. This high VAP rate in our study could be due to small sample size, less study duration, poor infection control policy.

In this study there was no difference in age & gender among VAP & Non-VAP patients. But, there was significant association in male gender and elder individual among VAP patient in other studies [20,22,26]. More mortality was associated with advanced age group in both VAP and non-VAP patients. Similar observation seen by Gumaraes et al.,[17]. Mortality more seen in elder individual which was probably due to poor immunity status of the patient.

Gender distribution was matched in both VAP and non-VAP group. Male gender was associated with survival of VAP group which was not seen in non-VAP group. This finding was probably due to more number of male patients in this study.

Our study site (ICU) is a mixed pattern, i.e. both surgical as well medical patients get admitted. Type of patient was neither associated with VAP nor with mortality. Contrary to another study, higher rate was seen in surgical patients [23]. Mortality rate was around 33% among VAP patient & VAP as such is not associated with increased the mortality in ICU patients, which was similar to other Indian study [20]. Whereas other studies, mortality rate ranges from 20% to 76% [3,24]. Mean duration of mechanical ventilation was proportionately equal in both VAP & Non-VAP group. But, other Indian studies reported that incidence of VAP increases with increase in duration of mechanical ventilation [7,19,20]. This opposite finding in our study was probably due to small sample size. However, prolonged duration of mechanical ventilation was associated with non-survival of both VAP & non-VAP group of patients. In our study radiological finding were more seen in VAP group & also diffuse radiological finding were more seen in VAP group. Almost all non-survival VAP patients had radiological lesion. The more number of resistant bacterial isolates were associated with non-survival of patients in both VAP & Non-VAP group.

Mortality was equal proportion in both VAP & non-VAP group. This finding was not matched with many of previous studies, as mortality rate was 2-10 fold higher in VAP patient compared to ventilated patient without pneumonia [25]. But study by Guimaraes et al., there was no difference in mortality among VAP & non-VAP patient [17]. So mortality in ICU does not depend on mechanical ventilation rather duration of mechanical ventilation. Early-onset VAP in our study was found around 30%, while in another study it was around 40% [20]. This low value could be due to prior use of antibiotic before admitting to ICU. Probably that might be the cause of high MDR organism in our study. In our study all non-survival VAP patients were of late onset. Similar finding was also seen in another study [20,25].

Gram-negative organisms were the predominant pathogens causing VAP infections in our study; similar finding was seen in other study [16,22,26]. Common organisms isolated in around 80% VAP patient in our study were Klebsiella Pneumonia, acinetobacter baumanii, Pseudomonas aeruginosa. Indian studies reported that the common organisms responsible for VAP were Klebsiella, Pseudomonas aeruginosa and A. baumannii [7,20,24,27]. In our study, 96% of VAP infection were caused by ESBL pathogen & 78% were MDR pathogen. Whereas study by Patro et al, 60.87% of bacterial pathogen were MDR and 21.74% were ESBL [21]. A study from an Indian tertiary care hospital was reported 48% of MDR Acinetobacter infections and 27%of MDR Pseudomonas infections [28]. Study by Guimaraes et al., showed the rate of MDR was 43% of VAP patient & 22% were due to Pseudomonas aeruginosa [17]. Antibiotics susceptible to these organisms were 3rd or 4th generation cephalosporin, amino glycoside, and carbapenem. As amino glycosides are having poor penetrations to lung tissue as well as causes more renal toxicity, so at our ICU empirical choice of antibiotics for VAP will be 3rd or 4th

generation cephalosporin or carbapenem. However, before giving the empirical antibiotic, we need to know the antibiotic history of the patient. Chastre et al., pointed out in their study that organisms like Pseudomonas, Acinetobacter, MRSA were associated with high mortality rates [3]. But such type of association was not found in our study.

The strength of our study was prospectively examined through clinical, radiological& microbiological parameters. Limitation of the study was small sample size, microbiological sample taken from tracheal aspirate may not be the ideal representative of VAP. This study was done in a single centered medical college mixed pattern ICU. We have not taken any data regarding co-morbidity and underline diseases of patient which might be some association to VAP or antibiotic resistance pattern. Therefore, extreme caution should be taken before implementing data due to non-uniform method of diagnosis, non-uniform method of collection of pathological sample for the diagnosis.

Conclusion

We found a very high prevalence of VAP even with a high MDR pathogen in our ICU which needs strict infection control policy. Based on our study, at ICU empirical choice of antibiotics for VAP will be 3rd or 4th generation cephalosporin or carbapenem. Advance age, more number of days in mechanical ventilator & presence of radiological finding were risk factors associated with the non-survival of non-VAP patients. Younger age, male gender & early onset VAP were associated with survival in VAP group of patients.

Conflict of interest

None

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