Incidence of ventilator associated events among intubated patients in neurosurgery ICU of a tertiary health centre in India

Andrew Thomas[1], Ashish Jitendranath[2*], Ivy Vishwamohanan[3], Geetha Bhai[4], Sarika[5]

[1]Student, [2]Associate Professor, [3]Assistant Professor, [4]Professor and HOD, Sree Gokulam Medical College and Research Foundation, Kerala, India

***Corresponding Author: Ashish Jitendranath**
Email: ashishjit11@gmail.com

Abstract
Ventilator associated events (VAE) by Centers for Disease Control and Prevention (CDC) was created to overcome the difficulty in surveillance of ventilator associated pneumonia (VAP). Pathogens causing VAP vary from hospitals to hospitals thus necessitating the need for local surveillance. The objective was to calculate the incidence of VAE in our hospital, to assess various organisms responsible for PVAP and to analyse their sensitivity to different antibiotics. The study retro-prospectively analysed 53 patients by consecutive sampling who were intubated from January 2018 to November 2018 in Neuro surgery ICU of our hospital. We used CDC's guidelines to report VAE. Patient's case files were traced using their MRD numbers and data regarding causative organism and their culture and sensitivity reports were obtained. Out of 53 intubated patients, we had eight VAE. All of them were reported as possible ventilator associated pneumonia (PVAP). Prolonged ventilator days (> 5 days) were associated with increased risk of VAE in our study. The incidence and VAE rate per 1000 ventilation days were 15.1 % and was 29.6 respectively. Six patients (75%) had monomicrobial aetiology in which two patients died. Remaining two patients (25%) had polymicrobial aetiology. Klebsiella pneumoniae was seen in majority (n=6) of the patients. Colistin had the highest sensitivity to the isolates while Ampicillin was resistant to all four organisms. All of the organisms isolated were MDR pathogen which was resistant to most of the regular anti-biotics. Therefore, it is important to frame local antibiotic policies and precautions to prevent VAE in the future.

Keywords: VAE, E coli, Acinetobacter.

Introduction
Ventilator associated pneumonia (VAP) is the most common yet preventable infection in mechanical ventilated patients.[1] VAP causes significant mortality and morbidity to the patients, thus making the treatment vital.[2] VAP is difficult to diagnose and its diagnostic algorithms are often criticised due to its poor reliability.[3] In 2013, Centres for Disease Control (CDC) published a new surveillance method for patients with mechanical ventilation to track the complications.[4] This replaces CDC's previous definitions of VAP as Ventilator Associated Events (VAE). VAE definitions were therefore created to increase the objectivity and reproducibility of surveillance, facilitate automation, and broaden the focus of safety surveillance to encompass any event severe enough to require a sustained increase in ventilator support.[5]

The VAE framework includes a hierarchy of definitions beginning with "ventilator associated conditions" (VACs). VAC is defined as more than or equal to 2 days of increased ventilator settings after more than or equal to 2 days of stable or improving settings. The second VAE target is "infection-related ventilator-associated complications" (IVACs), defined as the subset of VACs with concurrent inflammatory signs and more than or equal to 4 days of new antibiotics. The third VAE tier is possible or probable ventilator associated pneumonia (PVAP). Patients with IVAC and concurrent purulent sputum or positive pulmonary cultures have possible pneumonia. Patients with IVAC and concurrent purulent sputum plus positive pulmonary cultures have probable pneumonia.[6]

ICU is often called "the hub of infections" and the organism causing these infections are highly evolved and resistant to most anti-biotics.[7] Thus, treating this infections are difficult and are often associated with high mortality rates. Micro-organisms causing VAP vary from hospitals to hospitals thus necessitating the need for local surveillance.[8] In view of rising importance of VAE in ICU's, this study was done to assess the incidence of VAE, different micro-organisms causing PVAP and to analyse different anti-biotic resistance in the isolates taken from Intubated patients in neurosurgery ICU of our hospital.

Materials and Methods
A retrospective study was conducted in Sree Gokulam Medical College and Research Foundation (SGMC&RF), Trivandrum. The study group consisted of patients who received mechanical ventilation in the Neuro-surgery ICU from January 2018 to November 2018. Consecutive sampling was used. Patients who developed pneumonia before 48 hours of intubation and patients who were below 18 years of age were excluded from the study. Patients records were taken from the ICU and their detailed reports were traced by using their MRD numbers. Demographic details, Days of mechanical ventilaton, PEEP, FiO_2 values, Temperature, WBC counts, Polymorphs counts were taken. Details regarding organisms isolated from the sputum samples and their anti-biotic sensitivity pattern were taken from the microbiology department. The details were recorded in individual case study forms. Events were then classified into VAC, IVAC and PVAP according to CDC's guidelines of VAE. The results were statistically analysed by using SPSS software.

Results

53 patients were intubated in Neuro-surgery ICU from January 2018 to November 2018. The minimum age of our study sample was 18 years and we had one patient who was 89 years of age. The mean age was 54.51 with standard deviation of ∓19.94. We had 42 males and 11 females in our study. Eight patients had VAE. All the patients had growth in their pulmonary cultures and thus, recorded as PVAP. The incidence and VAE rate per 1000 ventilation days were 15.1% and 29.6 respectively. Out of the eight patients who developed PVAP, seven patients were intubated for more than five days. The number of ventilation days was associated with VAE (Table 1) with p value less than 0.005.

Table 1: Showing ventilation days and VAE cases

Days	Positive	Negative
<5 days	1	43
5 -10 days	3	0
10 - 15 days	1	2
>15 days	3	0

Median: 4, Mode: 3, Min: 2, Max: 21, Chi square: 40.123, P value <0.005

Six patients had mono-microbial aetiology (Table 2) among which two died. Another two patients had poly-microbial aetiology. Four organisms were isolated from the patients. Klebsiella pneumonia (Fig. 1) was seen in majority (n=6) of the patients followed by Pseudomonas aeruginosa in two patients. Proteus mirabilis (n=1) and Stenotrophomonas maltophilia (n=1). The overall mortality rate of VAE cases in our study was 25%.

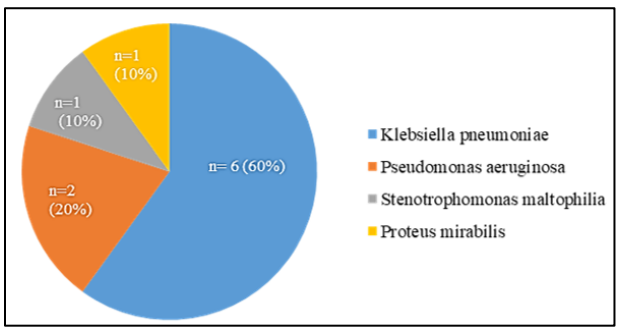

Fig. 1: Showing distribution of various micro organisms

Table 2: Showing the microbial etiology and mortality

Aetiology	Number of patients	Percentage	Mortality
Monomicrobial	6	75	33.3
Polymicrobial	2	25	0

Colistin and Tigecycline (Fig. 2) had the highest sensitivity of 67% and 56.6% respectively. Aminoglycosides and were moderately sensitive. Beta lactams had the lowest sensitivity to the isolates among which ampicillin was resistance to all the isolated organisms. The association between other co-morbidities and the incidence of VAE was not assessed due to small sample population.

Discussion

In 2013, The National Healthcare safety Network replaced VAP surveillance with VAE surveillance. VAE is a new surveillance method for monitoring complications in mechanically ventilated persons. Recent investigations have confirmed the strong association between VAEs and adverse outcomes and are starting to provide data on how best to prevent VAEs.[10] There are numerous studies on CDC's website to support this claim. However, VAE definitions, have their own shortcomings. A systematic review and meta-analysis conducted by Yunzhou Fan[11] et al found that, VAE surveillance missed many cases of VAP, in their study and the population characteristics identified by the two surveillance paradigms differed. Furthermore, VAE surveillance does not accurately detect cases of traditional VAP in ICUs according to their study. Scientific communities around the world are beginning to address important knowledge gaps, including the extent to which VAEs are preventable. A study by Ashu[14] et al at Christian Medical College, Punjab found the incidence of VAP to be 38% and VAP per 1000 ventilation days to be 40.1 and another study by Neelima[15] et al in a tertiary health care in India found the incidence of VAP to be 57.14% and VAP per 1000 days to be 31.7 Both these studies have more incidence of VAP than our study. However, there are very few studies in India which used VAE guidelines. Hence, the incidence of VAE from our studies cannot be compared with other studies.

Klebsiella pneumonia (60%) was present in majority of patients in our study. However, the pathogens responsible vary among different healthcare setups. A study done by Surbhu[12] et al in Northern India found that, Acinetobacter baumannii (54%) was the most common pathogen, followed by Pseudomonas aeruginosa (21%). This study also found that MDR pathogens were associated with high fatality. Another study done by Su Young Chi et al[13] in South Korea found that Staphylococcus aureus (44%) was the most frequently present bacteria followed by Acinetobacter baumanii (30%) and all of the organisms were multi-drug resistance.

VAP by multi-drug resistance organisms is an emerging global health concern. A study done at Sri Venkateswara Institute of Medical Sciences, Tirupati, India, found that very high frequency of resistance ranging from 45 to 100 per cent was exhibited by the organisms for AMP, AXV, CIP and for CTX throughout their study period. AK resistance showed a steady rise for *E. coli*and other *Enterobacteriaceae*, but for *Klebsiella* spp., a fall was seen initially. Except for *Enterobacter*spp., most others showed an increasing resistance for IPM, as well as PTZ and CFS; the three drugs most commonly used in ICU settings. This study also found that, the resistance to CTX rose to 78.8 per cent in *Klebsiella* spp. and almost 90 per cent in *E. coli*. All the organisms isolated in our study were MDR pathogens. Beta-lactams were least sensitive among the anti-biotics which can be because of the increased use of beta-lactam anti-biotics.

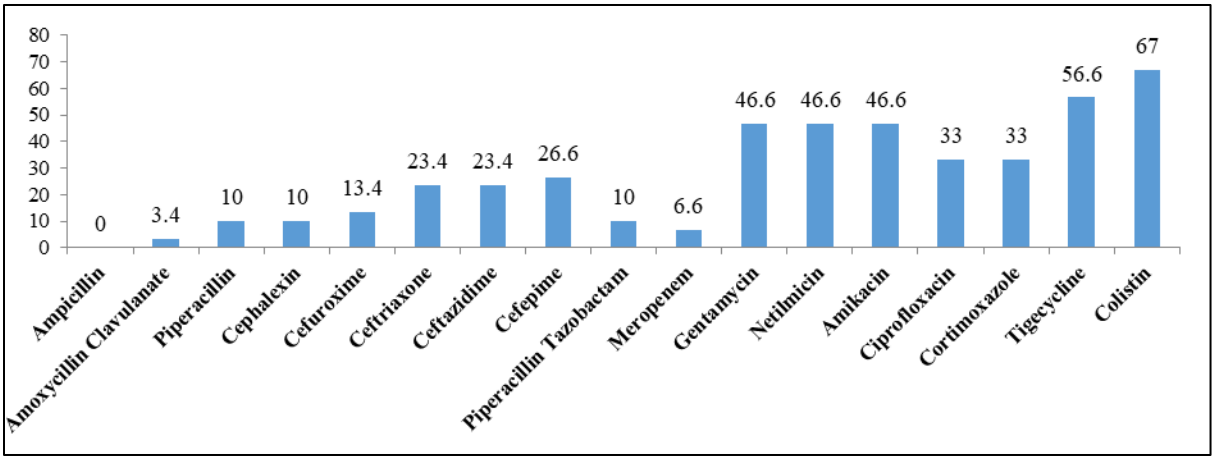

Fig. 2: Showing sensitivity pattern of different anti-biotics

Neuro-surgery ICU was selected because the study sample mostly constituted patients who suffered head injuries and was relatively free from other co-morbidities. In our study, we found that increased days of intubation were associated with VAE. A study by Klompas et al[9] from 2006 to 2011 also had similar results. The limitation of our study is that, the sample population was small and association between co-morbidities and risk factors couldn't be assessed.

To conclude, our study shows that VAE with MDR pathogens is an increasing concern. With limited treatment, this may take us back to pre-anti-biotic era. Our study will be useful for the hospital to construct an anti-biotic policy to prevent further VAE. More studies around India should be conducted using VAE definitions to find out the incidence and better management of this condition.

Conflict of Interest: None.

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