INCIDENCE OF VENTILATOR ASSOCIATED PNEUMONIA (VAP) IN THE INTENSIVE CARE UNITS AND THE TREND ANALYSIS OF THE MICROBIAL PATHOGENS TO ARRIVE AT THE EMPIRICAL USAGE OF ANTIBIOTICS

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ABSTRACT: PURPOSE: To compare the VAP incidence in various (ICUs) and analyze the trend of the microbial pathogens and their antimicrobial susceptibility pattern. METHOD: The prospective observational study with a surveillance module consisting of a ventilator bundle checklist and modified CPI score card was created for each patient on ventilator. The pathogens isolated by quantitative culture of the endotracheal aspirate (ETA) from suspected VAP cases were identified and the antimicrobial susceptibility was determined by Vitek 2 compact. RESULT: There was a decline in the overall incidence of VAP from 3.11 in 2011 to 1.73 in 2012. A similar trend was seen in the medical ICUs, from 4.16 to 1.07 in MICU, 2.48 to 0 in LICU. A decline in the incidence in surgical ICUs, from 7.38 to 2.64 in CTVS, 7.55 to 2.41 in STICU was observed. Pseudomonas spp, Acinetobacterspp, ESBL producing Klebsiella pneumoniae were the most common pathogens causing late-onset VAP. The resistance to colistin has increased from 0 to 25%, ceftazidime from 36 to 95% in Pseudomonas spp. In case of Acinetobacterspp, susceptibility to colistin remained 100% but tigecycline resistance increased from 12 to 50%. For ESBL producing Klebsiella pneumoniae resistance to amikacin increased from 14 to 67%, imipenem and meropenem had no resistance. CONCLUSION: A high clinical suspicion of pneumonia with prompt correlation with microbiological culture findings and radiological studies helps to identify VAP cases and reduce the incidence of VAP. Aggressive surveillance of the microbial pathogens with their antimicrobial susceptibility pattern gives an insight of the local Microbiologic milieu of a given unit, thereby helps us to arrive at an empirical usage of antibiotics. Antimicrobial resistant pattern has to be closely watched and corrective measures like rotation of or change of empirical antibiotics will help in overcoming resistance.

KEY WORDS: ICU, VAP, MICU, STICU

INTRODUCTION: VAP is one of the most common hospital acquired infections in intensive care units (ICUs).

In early studies, it was reported that 10%-20% of patients undergoing ventilation developed VAP1, 2. More recent publications report rates of VAP that range from 1 to 4 cases per 1,000 ventilator days, but rates may exceed 10 cases per 1,000 ventilator days in surgical patient populations3-7. VAP is an ongoing challenge for the critical care team and infection control personnel. As it is preventable, a proper approach can decrease its incidence and thereby the hospital stay cost, morbidity and mortality.
The microbial pathogens of VAP vary with different patient populations and types of ICUs. Therefore, the local microbial flora causing VAP needs to be studied in each setting to guide more effective and rational utilization of antimicrobial agents.

MATERIALS AND METHODS: A prospective observational study was conducted to analyze and compare the VAP incidence over 2 yrs extending from Jan 2011- Dec 2012, in the Intensive care units with a total bed strength of 47 of which 10 beds in Medical intensive care unit (MICU), 10 beds in Cardio thoracic vascular surgery (CTVS), 8 beds in Liver intensive care unit (LICU), 10 beds in Stroke Intensive care unit (STICU), 9 beds in Trauma intensive care unit (TICU). MICU and LICU, are the medical intensive care units and CTVS, STICU and TICU are surgical intensive care units.

A total of 521 ventilator patients in 2011 with 2889 ventilator days and 774 ventilator patients in 2012 with 4608 were included in the study. An inclusion criteria of greater than or equal to 48 hours on mechanical ventilation and adults over 18 years was set up.

A surveillance module consisting of a ventilator bundle checklist and modified CPI (clinical pulmonary infection) score card was created for each patient on ventilator. A ventilator bundle checklist which includes head end elevation 30-45 deg, daily assessment of extubation, daily sedative interruption, PUD (peptic ulcer disease) prophylaxis, Deep vein thrombosis prophylaxis, continues subglotic suctioning and chlorhexidine oral rinse was adopted. It was tracked by the infection control nurse and reviewed by the Infection control in charge.

A clinical suspicion of VAP was confirmed by performing a quantitative culture of the endotracheal aspirate and a colony count of more than $10^5$ cfu/ml was accepted as significant. VAP was diagnosed based on CPI scoring which uses 3 groups of criteria: clinical, radiographic, and microbiological. A CPI score ≥6 was considered in favour of VAP. The organisms isolated by quantitative culture of the endotracheal aspirate (ETA) from VAP patients were identified using Vitek compact and the antimicrobial susceptibility of the clinical isolates was determined by the MIC method. The incidence of ventilator associated pneumonia for 1000 ventilator days were calculated.

The microbial flora of endotracheal aspirate of all patients on ventilator of individual critical care units was studied simultaneously over the same period to give us the trend of their antimicrobial susceptibility. In our study we have included the antimicrobial susceptibility of MICU and STICU to observe the trend of the pathogens.

The study was approved by the Institutional ethics committee.

STATISTICAL ANALYSIS: Data was entered into MS excel and analysed using SPSS version 20.0.

Descriptive analysis comprising of mean (±SD) was computed for continuous variables such as average length of stay and incidence rates were computed per 1000 ventilator days. Percentages were computed for individual microbial pathogens responsible for infections. Appropriate bar graphs were generated for graphical depiction.

RESULTS: A total of 521 ventilator patients with 2889 ventilator days in 2011 and a total of 774 ventilator patients with 4608 ventilator days in 2012 of which the overall incidence of VAP was 3.11 in 2011 and 1.73 in 2012. The VAP incidence is summarized in the (Figure 1)
The mean of onset of VAP in 2011 is 9.87 and the mean of onset of VAP in 2012 is 11 categorizing it as late on set VAP.

The mean of outside hospitalization cases is 0.33 in 2011 and 0.625 in 2012, which shows a trend of increase in patients with repeated outside hospitalization.

The patient profiles at admission associated with VAP in 2011 were road traffic accident with head injury(3), chronic obstructive pulmonary disease(3), cerebro vascular accident(2), ischemic heart disease(2), hypertension(3), organophosphorous poisoning(0), aspiration pneumonitis (1) and diabetes mellitus(2).

The patient profiles at admission associated with VAP in 2012 were road traffic accident with head injury(3), chronic obstructive pulmonary disease(0), cerebro vascular accident(3), ischemic heart disease(1), hypertension (4), organophosphorous poisoning(1), aspiration pneumonitis (1) and diabetes mellitus (2).

ETA isolates and VAP pathogens are summarized in (Table 1)

<table>
<thead>
<tr>
<th>ETA pathogens</th>
<th>Total ETA isolates</th>
<th>VAP Pathogens</th>
<th>%</th>
<th>Total ETA isolates</th>
<th>VAP Pathogens</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudomonas spp</td>
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<td>9.09</td>
<td>97</td>
<td>4</td>
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<tr>
<td>Acinetobacterspp</td>
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<td>5</td>
<td>12.5</td>
<td>82</td>
<td>3</td>
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<tr>
<td>K. pneumoniae ESBL +</td>
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<td>2</td>
<td>7.14</td>
<td>33</td>
<td>3</td>
<td>9.09</td>
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<tr>
<td>E.ColiESBL+</td>
<td>24</td>
<td>1</td>
<td>4.16</td>
<td>29</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 1: ETA isolates and VAP pathogens

The antibiotic susceptibility pattern of the endotracheal aspirate pathogens of MICU and TICU were studied.
Acinetobacter, Pseudomonas spp and ESBL producing K. pneumoniae remained the common isolates causing VAP in MICU and TICU in both the years.

The antibiotic susceptibility pattern of the endotracheal secretion isolates of MICU and TICU are summarized in (Figure 2-7)

**FIGURE 2:** The antibiotic susceptibility pattern of the ETA isolates of MICU for Pseudomonas spp

**FIGURE 3:** The antibiotic susceptibility pattern of the ETA isolates of MICU for Acinetobacter spp
FIGURE 4: The antibiotic susceptibility pattern of the ETA isolates of MICU for K. Pneumoniae ESBL.

FIGURE 5: The antibiotic susceptibility pattern of the ETA isolates of TICU for Pseudomonas spp.
FIGURE 6: The antibiotic susceptibility pattern of the ETA isolates of TICU for Acinetobacterspp.

FIGURE 7: The antibiotic susceptibility pattern of the ETA isolates of TICU for ESBL producing K.Pneumoniae.
DISCUSSION: In 2011 the VAP incidence was 4.16 in the MICU, 2.48 in LICU and in 2012 the VAP incidence was 1.07 in the MICU, and 0 in LICU which are the medical intensive care units. Similar studies showed 4.2 /1000 ventilator-days and 9.1/1000 ventilator days in India. In one of the Indian studies the VAP in MICU and CCU were 30.67 and 15.87 per 1000 ventilator days respectively. In 2011 the VAP incidence was 7.38 in CTVS, 7.55 in STICU which are the surgical intensive care units and in 2012 the VAP incidence was 2.64 in the CTVS, 2.41 in STICU which is comparable favourably, with a study which shows 5.2 VAP cases/1000 ventilator days in surgical ICUs. In 2011 the VAP incidence was 7.99 in the TICU and in 2012 the VAP incidence was 3.24. A similar study shows 10.2 VAP cases/1000 ventilator days in trauma ICUs. In other Asian countries the incidence ranges from 9 to 12 per 1000 Ventilator days. There was a significant reduction in the overall incidence of VAP over 2 years.

All the VAP cases were late onset with similar patient profiles over both the years. Though there was an increase in patients with previous hospitalization, the VAP incidence showed a downward trend which reflects the good Infection control practices. The ICN played a major role as a liaison between all the faculties during the surveillance.

Continued monitoring of the VAP Bundle checklist, with the involvement of the critical care team to counter check the aspects of the Bundle with regards to the CPI scoring helped us to put in the clinical, radiological and microbiological findings together for an efficient scoring. Strict adherence to Critical care nursing programmes with the involvement of the Respiratory therapists and Intensivist helped us to give an overall better insight to the program.

MICROBIAL FLORA: Analysis of the Microbial flora helps us to know the trend of the Antimicrobial susceptibility pattern as to the decline or the increase in sensitivity to the organism.

Pseudomonas spp. (39%) and Acinetobacter spp. (32%) are the most common pathogens causing late-onset VAP.

In our study Pseudomonas spp (5.92) and Acinetobacterspp (6.55), ESBL producing Klebsiella pneumonia (8.19) were the most common pathogens causing late-onset VAP.

But the trend of the Antimicrobial susceptibility pattern over two years was interesting.

The resistance to colistin in MICU for Pseudomonas spp increased from 0 to 25%, ceftazidime from 36 to 95%, piperacillin-tazobactum from 14 to 100%. Amikacin resistance remained at 50%. Resistance to imipenem and meropenem increased from 25 to 28%, 41 to 50% respectively. For Acinetobacters ptegicycline resistance increased from 12 to 50%. For imipenem resistance increased from 93% to 100% and meropenem resistance remained at 100%. Interestingly the susceptibility for colistin remained 100% both the years. For Klebsiella pneumoniae ESBL resistance to amikacin increased from 14 to 67%, for cefepime resistance decreased from 60 to 0% and for imipenem and meropenem there was no resistance.

The resistance to colistin in TICU for Pseudomonas spp increased from 6% to 16%, ceftazidime from 52% to 58% imipenem and meropenem increased from 55% to 67%, 54% to 67% respectively. Piperacillin-tazobactum resistance decreased from 58% to 0%. Amikacin from 52% to 40%. For Acinetobacter sp. tgecyline resistance decreased from 26% to 8%. The susceptibility for colistin remained 100% both the years. For imipenem and meropenem resistance remained at 100%. For ESBL producing Klebsiella pneumoniae resistance to amikacin increased from 6 to 23%.
for cefepime resistance decreased from 100 to 63%, for imipenem resistance increased from 20 to 40%, and for meropenem resistance increased from 20 to 37%.

The NHSN data showed up to 60% of the isolates being MDR. In a similar study, the resistance to ceftazidime for Pseudomonas spp saw an increased trend over years. 25% of Klebsiellapneumoniae ESBL isolates were meropenem-resistant in a study similar to ours. This shows the requirement of continuous monitoring of the trends of Antimicrobial susceptibility.

CONCLUSION: Strict surveillance and analysis of the ICUs day to day care and a high clinical suspicion of pneumonia with prompt correlation with microbiological culture findings and radiological studies helps to identify VAP cases.

Aggressive surveillance of the microbial pathogens with their antimicrobial susceptibility pattern gives an insight of the local Microbiologic milieu of a given unit, thereby helps us to arrive at an empirical usage of antibiotics. Antimicrobial resistant pattern has to be closely watched. Repeated use of same antibiotics over time in ICU has reduced the susceptibility of the pathogen, thereby reducing the treatment options available. Employing a rotational schedule for empirical antibiotic usage for suspected VAP cases may indeed lead to a reduced incidence of resistant pathogens. An annual review of the antibiotic susceptibility pattern of the Microbial Flora will help us to arrive at the Empirical usage of antibiotics and to formulate the Antibiotic policy for the setup.

REFERENCES:


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