Ventilator Associated Pneumonia in Intensive Care Units of a Tertiary Care Hospital in Nepal

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ABSTRACT

INTRODUCTION: Ventilator-associated pneumonia (VAP) is a major cause of morbidity in the Intensive Care Unit (ICU). Data from developing countries reveal an incidence ranging from 15.87% to 30.67%. The objective of this study was to find the incidence, organisms involved, associated risk factors and outcomes of VAP.

METHOD: It was a prospective observational study conducted among mechanically ventilated 102 patients. Clinical Pulmonary Infection Score (CPIS) was used to diagnose VAP. Data was subjected to univariate analysis using chi-square and z-test. Level of significance was set at 0.05.

RESULT: Thirty-nine (38.23%) patients developed VAP. Acinetobacter calcacaetricus baumannii complex (37.93%) was the predominant organism. Use of steroids (Relative risk (RR) = 8.07), reintubation (RR=2.04), H2 blocker (RR=1.62) and vasopressors (RR=1.40) were identified as major risk factors. Mean length of stay in ICU was 19.07 ± 8.53 days in VAP group and 8.14 ±2.48 days in non VAP group (P value 0.0001). Mean duration in mechanical ventilation (MV) was 16.05 ±8.87 days in VAP group and 6.95± 2.35 days in non VAP group (P value 0.0001). Mortality (53.84%) was significantly high in patients who developed VAP. (P value <0.05)

CONCLUSION: The incidence of VAP is high. Acinetobacter calcacaetricus baumannii complex is the commonest organism involved. Use of steroids is the commonest risk factor for VAP. Duration of mechanical ventilation, duration of ICU stay and mortality in patients who developed VAP is also high. Strategies to reduce VAP should be implemented to improve the patient outcome.

KEY WORDS: Clinical Pulmonary Infection Score, Intensive Care Unit, Ventilator Associated Pneumonia.

INTRODUCTION

Ventilator Associated Pneumonia (VAP) is defined as pneumonia that occurs 48–72 hours or thereafter following endotracheal intubation.[1] VAP represents the second most common nosocomial infection in ICU.[2] Incidence of VAP in developing countries ranges from 15.87% to 30.67%.[3]

During mechanical ventilation, secretions pooled into the subglottic space leaks to the lower respiratory tract, thus causing pneumonia. Risk factors for VAP include intubated patients, re-intubation, duration of ventilator support, higher Acute Physiology And Chronic Health Evaluation (APACHE) II score, multiple invasive lines, immunosuppression, inotropes/ vasopressors, enteral feeding via nasogastric tube, H2 blockers, antacids, steroids, supine head position, paralytic agents and sedation.[4,5]

Mortality rate due to VAP has been reported 24% to 76%.[6] VAP is associated with increased morbidity, prolonged length of ICU stay and increased costs of hospitalization.[7]

This study was conducted to define the magnitude of VAP in the Intensive Care Units of a tertiary hospital by finding out the incidence, common organisms involved, associated risk factors and the outcome.

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METHOD

This prospective observational study was carried out in five different ICUs of National Academy of Medical Sciences (NAMS), Bir Hospital and National Trauma Centre, which include five-bed Medical/Surgical ICU, six-bed Medical ICU, five-bed Neurosurgical ICU, three-bed Thoracic ICU and ten-bed Trauma ICU from January 2017 to July 2017. Ethical approval was obtained from institutional review board before commencing the study. Sample size calculation was based on the study of VAP with incidence of 41.6% conducted by Dr. Deebya Raj Mishra in 2013 in ICU of Tribhuwan University Teaching Hospital. Assuming new incidence within 25% with the power of 80% and significance level of 95%, sample size was 92. Taking 10% dropouts, sample size calculated was 102. So, the study as conducted till the sample size of 102 patients meeting the inclusion criteria was achieved. During the study period, 389 patients were mechanically ventilated for >48 hours. Patient of age group 15-80 years were enrolled in the study. Patients with Pneumonia, Chronic Obstructive Airway Disease, pulmonary infection at the time of admission, patients who had been intubated or had tracheostomy performed at another hospital, patients having Acquired Immune Deficiency Syndrome or severe neutropenia (<500 polymorphonuclear cells/mm3) and patients who died or left against medical advice before 48 hours of ventilation were excluded from the study.

On admission to ICUs, age, gender, admission diagnosis, co-morbidities, date of admission in the hospital and the ICU, indication for mechanical ventilator were noted. APACHE II score, total leukocyte count, chest X-ray were done. The relevant data were recorded from medical records, bedside flow sheets, radiographic reports and reports of microbiological studies of the patients. The study patients were monitored at third day, then every day for the development of VAP until either discharge or death using clinical pulmonary infection score (CPIS) criteria.[8] A CPIS score >6 within 96 hours of mechanical ventilation was categorized as early onset VAP and those who developed the same after this time period was categorized as late onset VAP. The incidence of early onset VAP, late onset VAP and VAP overall was noted. The patients with the organisms detected on culture of tracheal aspirate were charted for the purpose of identifying the causative agent. Culture positive cases were charted into early onset VAP and late onset VAP. Antibiotics were changed as per sensitivity pattern. Risk factors (steroids, reintubation, H2 blockers, Inotropes/vasopressors, sedation, enteral feeds, paralytic agents, Invasive lines, Immunosuppressant, PaO2/FiO2 on day 2) were studied and compared between 2 groups – VAP and non-VAP. The outcome of the disease was measured by duration of mechanical ventilation, length of ICU stay and mortality.

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 16 software package. Independent sample Z test was used for numerical data and expressed as mean ± SD. Chi square test was done for categorical data. Relative risk was calculated using univariate analysis. P values < 0.05 were considered statistically significant.

RESULT

Out of 102 patients, 70 (68.62%) patients were males and 32 (31.38%) were females. Patients were from 19 years to 80 years of age, with a mean age of 39.6 ± 13.12. The incidence of VAP in our study was 38.23% (39 out of 102). Incidence of late onset VAP (61.53%) exceeded the early onset VAP (38.47%)

Use of steroids, reintubation, H2 blockers and vasopressors were identified as major risk factors (P value < 0.05) as shown in Table 1.

Acinetobacter calcacaetricus baumannii complex, Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus were found to be the major causative organisms of VAP as shown in Table 2. Of the 39 cases with VAP, 29 (74.36 %) were culture positive for organisms, however in 10 (25.64%) cases organisms were not isolated and VAP was diagnosed on the basis of CPIS.

The outcome of the disease was measured by the duration of mechanical ventilation, length of ICU stay and mortality. VAP group had significantly longer duration of ICU stay, days on ventilator and higher mortality rate (P-value <0.005).

Table 1: Univariate analysis of risk factors associated with VAP

Risk factors	VAP(N = 39) N(%)	Non-VAP (N=63) N(%)	P-value	Relative risk	RR (95% CI)
1. Use of steroids	15(38.46)	3(4.76)	0.001*	8.07	2.497 – 26.116
2. Reintubation	3 (7.69)	1 (1.58)	0.122	2.04	1.095 – 3.805
3. H2 blockers	1(2.56)	1(1.58)	0 .729	1.62	0.104 – 25.091
4. Inotropes/vasopressors	32(82.05)	37(58.73)	0.014*	1.40	1.084 – 1.801
5. Sedation	34(87.17)	44(69.84)	0.044*	1.25	1.019 – 1.527
6. Enteral feeds	35(89.74)	46(73.01)	0.042*	1.23	1.023 – 1.477
7. Paralytic agents	12(30.76)	16(25.39)	0.554	1.21	0.643 – 2.282
8. PaO2/Fi02 <200 on day 2	3(7.69)	5(7.93)	0.964	0.97	0.245 – 3.832
9. Invasive lines (CVP/arterial)	31(79.48)	56(88.89)	0.192	0.89	0.745 – 1.072
10. Immunosuppressant	1(2.56)	0			

*P value < 0.05

Table 2: Causative organisms of VAP

Organism	Early onset	Late onset	Total	%
Acinetobacter calcacaetricus baumannii complex	3	8	11	37.93
Pseudomonas aeruginosa	0	6	6	20.69
Klebsiella pneumionae	3	2	5	17.24
Staphylococcus aureus	2	1	3	10.34
Escherichia coli	1	0	1	3.45
Staphylococcus epidermidis	1	0	1	3.45
Proteus	0	1	1	3.45
Citrobacter	0	1	1	3.45
Total	10	19	29	100

Table 3: Outcome of the disease

	VAP	Non VAP	P value*
Duration of MV in days (mean±SD)	16.05 ±8.87	6.95± 2.35	0.0001
Duration of ICU stay in days (mean ± SD)	19.07 ± 8.53	8.14 ±2.48	0.0001
Mortality %	53.84% (21/39)	7.93% (5/63)	0.000001

*ANOVA

DISCUSSION

VAP is a major threat to the recovery of patients receiving mechanical ventilation (MV). It is one of the most important ICU acquired infections in mechanically ventilated patients. The incremental risk of pneumonia was virtually constant throughout the entire ventilation period, with a mean rate of 1% per day.[9] Incidence of VAP may be reduced by studying incidence and risk factors causing VAP.

The incidence of VAP in our study is high similar to previous studies.[10,11,12] However, there are slight variations in incidence which may be due to the difference in study population, ICU setup, difference in nurse patient ratio and the criteria used for diagnosis of VAP. There are no definite criteria for VAP diagnosis. However, using various criteria the incidence of VAP is high. Martin-Loeches did a multicenter study and reported incidence of VAP to be 23 % i.e. 689 out of 2960.[13] The lower incidence could be due to the ICU setup, the VAP bundle they follow and adequate nursing staff i.e. 1: 1 patient nurse ratio. In our study, 38.47% of cases were early onset VAP and 61.53% were late onset VAP comparable with other studies.[9,10,11] Strict follow of VAP bundle in our ICUs might have led to lower incidence of early onset VAP in our study. However, increase in duration in mechanical ventilation might have increased the risk of development of late onset VAP.

In our study, use of steroids, reintubation, H2 blockers, vasopressors were found to be the major risk factors associated to VAP. The major risk varies in different studies.[10,11,12] Ranjit found that reintubation, invasive lines, H2 blockers and low $PaO_2/FiO_{2\ ratio}$ were the major risk factors.[11] This variation might be due to the different ICU setup, the different causes of ICU admission and different ICU treatment modalities.

Acinetobacter calcacaetricus baumannii complex was the commonest organism isolated similar to other studies[11, 12, 14] followed by Pseudomonas aeruginosa, Klebsiella pneumoniae and Staphylococcus aureus. In both the early and late onset VAP groups, organisms isolated consisted of Acinetobacter spp and Klebsiella pneumonia. The rampant use of antibiotics, absence of

guidelines regarding the use of empiric antibiotics and may be inadequate antibiotic coverage before their transfer to the ICU be the cause for the development of early onset VAP. Mishra found Klebsiella pneumoniae to be the commonest organism associated with VAP.[10] This variation may be due to the difference in the cause for ICU admission and initial choice of antibiotics.

The mean length of stay on mechanical ventilator and the mean length of stay in ICU were significantly higher in VAP group than in non-VAP group similar to other studies.[10, 11] There is higher mortality among VAP group in our study and other studies. However, there exists the difference in mortality rates among various studies done.[10,11] Two independent factors make it difficult to assign responsibility unambiguously. The first is difficulty in establishing a firm diagnosis, that is, to clearly identify patients with VAP; thus, the widely diverging VAP mortality rates reported might reflect not only differences in the populations studied but also differences in the diagnostic criteria used. Secondly, numerous studies have demonstrated that severe underlying illness predisposes patients in the ICU to the development of pneumonia and their mortality rates are, consequently, high.[8] Therefore, it is difficult to determine whether such patients would have survived if VAP had not occurred.

CONCLUSION

The incidence of VAP is high in our study. Acinetobacter calcacaetricus baumannii complex was the most common organism isolated followed by Pseudomonas aeruginosa, Klebsiella pneumoniae and Staphylococcus aureus. Use of steroids, reintubation, use of H2 blockers and use of Inotropes/ vasopressors were found to be the major risk factors. There is a trend towards increased mortality in the VAP group. Duration of mechanical ventilation and ICU stay is long in the VAP group compared to non VAP group.

LIMITATION

Multispecialty ICUs were used for the study purpose so there may be bias in patient care and outcome.

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