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Ventilator associated pneumonia: incidence and risk factors in a tertiary care hospital

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ABSTRACT

Background: The objective of this study is to find the occurrence and contributing risk factor of ventilator associated pneumonia (VAP) in 2 months-5 years age group.

Methods: This was a prospective, observational, hospital-based study carried out in a tertiary care setting hospital. All patients between 2 months-5 years age admitted in the ICU who had undergone MV were included in the study. Inclusion criteria includes patients who developed pneumonia after the 48 hours of mechanical ventilation and those patients were excluded who developed pneumonia within 48 hours of mechanical ventilation and having respiratory system findings /involvement prior to the MV. After recruiting patients baseline clinical characteristics (age, sex, diagnosis, duration of MV) were taken, monitored and diagnosed VAP using CDC guidelines until they were discharged or deceased. The parameters such as fever, oxygenation, leucocytosis, other risk factors. chest X-ray and ETA>10⁵CFU/ML or microscopy (grain stain>l bacteria/>10 polymorphonuclear cells) were collected every 48 hours.

Results: This study was done in 133 patients while 42 patients (31.58%) developed VAP during their ICU stay. Early onset VAP occurred in 34 (80.9%) while late onset VAP was observed in the remaining 8 (19.1%) patients. In ETA culture CFU>10⁵ Klebsiella (38%) was the predominant isolate followed by Pseudomonas (23%), Acinetobacter (17%), Staphylococcus (13%) and Citrobacter (10%) are offending organism responsible for VAP in MV patient in present study. On analysis (univariate) reintubation, altered sensorium at intubation and use of antacid are found significantly associated risk factors with the development of VAP. Multivariate analysis revealed that reintubation was an important risk factor for the development of the VAP.

Conclusions: The various risk factors can be minimized for better outcome of patients undergoing mechanical ventilation. Risk factors such as reintubation, altered sensorium at intubation and use of antacid are associated with VAP and also the physician treating must have knowledge and awareness about prevention of these risk factor to improve the outcome of patients.

Keywords: ETA, Mechanical ventilation, Outcome, VAP

INTRODUCTION

Pneumonia has been a major cause of mortality and morbidity in children under 5 years age accounting for 5.8% prevalence1 and 1.9 million deaths each year. ^{1,2} In the modern era the increased rate of hospitalization due

any cause and exposure to hospital micro-flora leads to hospital acquired infections (HAI). These infections are those that manifest in patients more than 48 hours after admission but that was not incubating at the time of admission. These infections are directly related to the procedures involved in diagnostic/ therapeutic/

interventions performed and also to the resident microbial flora existing in the particular unit.³ And important one of them is hospital acquired pneumonia (HAP). Hospital acquired infections are a major concern especially in critical care units worldwide and are associated with higher mortality/ morbidity, increased duration and cost of care. A smaller subset of these infection (pneumonia) occurs in patients who undergo mechanical ventilation (MV) via tracheal/ tracheostomy tube is called Ventilator associated pneumonia (VAP).4 The incidence of VAP is 7.6 cases per 1000 patient ventilator days and the mortality rate among these ranges from 16-20% according to the National nosocomial infection surveillance program.^{5,6} In mechanically ventilated patients the most common infection that is occurring in almost one third (28-32%) of all hospital acquired pneumonias is VAP.⁷⁻⁹

The incidence varies could be explained because of the difference in the various diagnostic criteria used. Development of VAP <96 hours of MV is classified as early onset; more than 96 hours is termed as late onset. ¹⁰ Intubation alone carries the highest weightage among all risk factors. ¹¹ This increased occurrence of VAP is attributed to either microbial colonization or aspiration of the respiratory tract during/following intubation. ^{12,13}

To diagnose VAP in patient undergoing mechanical ventilation was led by center for disease control and prevention (CDC). ¹⁴ Despite availability of newer drugs/equipment's the treatment of such nosocomial pneumonia has proved to be difficult. Due to the difference in the resident micro flora in among various clinical setup the presentation and prognosis varies. This study is planned to conclude the incidence and risk factor of VAP in order to have better outcome of these patients.

METHODS

The present study was conducted in Department of Pediatrics at a tertiary care center from September 2012-August 2013. Following college ethical committee approval, informed consent was taken from the patient's guardian.

The study was conducted in inpatient of Department of Pediatrics aging from 2 months to 5 years. Written and informed consent was obtained from the parents or legal guardians prior to study.

Inclusion criteria

 Inclusion criteria includes patients who developed pneumonia after the 48 hours of mechanical ventilation.

Exclusion criteria

• Patients were excluded who developed pneumonia within 48 hours of mechanical ventilation and having

respiratory system findings /involvement prior to the MV.

After recruitment baseline clinical characteristics (age, sex, established disease/diagnosis days after admission and duration of MV) were taken and monitored for the development of VAP (48hourly) by CDC established criteria and treated till their final outcome (discharge or death).On Microbiological assessment the presence of a single colony on the blood agar after inoculating 0.01 ml of 1/1000 times diluted EA was interpreted as more than 10⁵CFU/ ml and the isolates were identified. 15,16 The findings such as fever, O₂ saturation, Leukocytosis, other risk factors, chest X-ray and ETA >105CFU/ML or microscopy (gram stain >1bacteria/ polymorphonuclear cells) were collected every 48 hourly.¹⁷⁻¹⁹ The diagnosis of VAP was established on basis of clinical and microbiological criteria led by CDC.14

Stastical analysis

Complete data was analyzed by using statistical software (SPSS 16.0, SPSS Inc). Continuous variables were compared using Student's t test, to compare the risk factors in patients with and without VAP the univariate analysis was done using chi-square or Fisher's test. On logistic regression Odd ratios with their 95% confidence intervals were obtained. All P values <0.05 were considered statistically significant.

RESULTS

Over the period of 12months (September 2012 to August 2013) the total 156 patients were admitted in our ICU. Out of which 23(14.74%) were excluded as per the norms of this study and rest 133 (55.25%) were enrolled. Of the 133 patients, 42 (31.58%) developed VAP during their ICU stay. Early onset VAP developed in 34 (80.9%), while rest of 8 (19.1%) patients developed late onset VAP. Ninety-two percent (39 out of 42) of VAP cases occurred within the first week of MV. We found incidence of VAP was 53.25 per 1,000 ventilator day in present study. Of the 133 study patients, 82 were male (6 1.6%) and 51 (38.4%) were female. The mean \pm SD age of patients receiving MV was 3.6 \pm 1.3 years (2 months to 5 years). The age and sex wise distribution of the patients with and without VAP is compared (Table 1).

Table 1: Age-sex wise distribution of cases.

Parameter	VAP (n=42)	Non VAP (n=9l)	P value
Age (Mean±SD)	3.5±1.6	3.8±1.1	0.61
Male	29 (69.1%)	53 (58.3%)	0.54
Female	13 (30.9%)	39 (41.7%)	

The diagnosis of the patient included were snake envenomation, hepatitis A/B, typhoid, CNS

infection/tubercular meningitis, and head trauma. The most frequent diagnosis was CNS infection tubercular meningitis (31.2%). Authors found that them exist no significant difference among the diagnosis of the patients with and without VAP (Table 2).

In ETA culture CFU>105 the Klebsiella (38%) was predominant isolate followed by Pseudomonas (23%), Acenitobactor (17%), Staphylococcus (13%) and Citrobactor (10%) are offending organism responsible for VAP in MV patient in present study. On analysis (univariate) reintubation, altered sensorium at intubation and use of antacid are found significantly associated risk factors with the occurrence of VAP. Multivariate analysis

revealed that reintubation was an independent risk factor for VAP (Table 3).

Table 2: Primary diagnosis of cases among study group.

Primary diagnosis	VAP (n=42)	Non VAP (n=91)	P value
CNS infection (TBM)	7 (16.6%)	3 (14.3%)	0.69
Meningoencephalitis	23 (54.8%)	69 (75.8%)	0.44
Hepatitis A/B	3 (7.2%)	3 (3.2%)	-
Infection-typhoid	1 (2.3%)	1 (1.1%)	-
Head trauma	5 (11.9%)	2 (2.1%)	-
Snake envenomation	3 (7.2%)	3 (3.2%)	-

Table 3: Univariate analysis of the risk factor for VAP.

Clinical features	VAP (r	VAP (n=42)		Non-VAP (n=91)		RR (95% Confidence	
	N	%	N	%	Intern	al)	P-value
GCS <8 at intubation	19	45.24	21	23.1	1.95	(2.55-1.35)	0.06
Continuous sedation	08	19.0	28	30.8	0.63	(0.84-0.42)	< 0.05
Given ryles tube feed	о3	07.14	10	10.9	0.71	(1.10-0.32)	< 0.05
Given antisecretory drug	04	09.52	07	07.7	1.2	(1.91-0.49)	< 0.05
Re-intubation	13	30.9	03	03.3	3.14	(4.68- 1.6)	0.064
Antacid given	11	26.19	03	03.3	3	(4.57-1.43)	0.07
Absent head elevation	02	04.76	08	08.8	0.63	(1.02-0.24)	< 0.05

DISCUSSION

Only clinical grounds are not sufficient enough to correctly diagnose VAP because while ventilating many febrile/raised WBC counts conditions occurs and commonly gram-negative bacilli found indwelling the respiratory tract without causing pneumonia. Authors found the incidence of VAP is 31.58% which is comparable to the observations of other studies. A study from Greece done in 4 ICU setups had reported incidence of 32%. Studies from various country had reported varying incidence of VAP, Boston studies observed 10.2% per 1000 ventilator days, Indian study by Gupta A and coworkers reported 28.0% while studies from South India reported 18.6%. 10.20

Based on duration of mechanical ventilation our observation is that early onset VAP developed in 34 (80.9%), while late onset VAP in 8 (19.1%) patients. Various studies observed that the early-onset subtype of VAP were almost more than half of all VAP cases.^{21,22}

Authors observed that during the first week ventilation ninety-two per cent (39 out of 42) VAP cases occurred. Similar findings were there in study by Apostolopoulon et al, concluded that there was an increased risk of developing VAP during the first two weeks of MV, the higher incidence within initial days of MV can be attributed to multiple risk factors.⁴

In present study the primary diagnosis found significantly associated with the development of VAP was CNS infections; similar observation are there in study from south india. Another study concluded intra-abdominal diseases and multiple injury were significantly predispose for VAP.

On evaluation risk factor associated with VAP development authors found that on univariate analysis Reintubation, altered Sensorium at intubation and use of antacid are found significantly associated and on multivariate analysis revealed that reintubation carries highest weightage among all risk factor; Similar conclusion was there in Patra PK et al, study similarly Awasthi S et al, in same context concluded the reintubation within 72 hours of extubating as a single most important risk factor for the development of VAP.^{23,24} Sharma H et al, observed that the use of H₂ blockers (ranitidine) was significantly related with VAP, as they decrease the gastric acidity and thus facilitate the microbial growth which can lead to VAP on aspiration.²⁵ The association between altered sensorium at the time of intubation (GCS<8) and development of VAP was statistically significantly; could be explained in a way that it reduces the protective mechanism thus increases the risk of aspiration of the gastric contents similar observation in the study form south india concluded that patients suffering from neurological disorders and CNS infections were significantly predisposed for the development of VAP.¹⁰ Tullu et al, conducted study in their study found that altered sensorium did not increase the incidence of VAP while the Shrinivasan's study on multivariate analysis concluded that use of sedative drugs (narcotic medications) were associated with VAP and mortality subsequently on comparison to non-sedated patients.^{26,27}

The understanding about these risk factors is very important as these can be reduced with appropriate preventive steps/measure and thus can improve the outcome of the patients. From various study the risk factor associated with VAP were pointed out as emergency intubation. reintubation. impaired consciousness, tracheostomy, and nasogastric tube insertion were found to be independent risk factors for VAP3.Other risk factor like prolong MV (>5days) ,head trauma, supine head position, use of antacid, burns, steroid therapy were also observed as important risk factors in various studies.^{3,21} So, by having the knowledge about these risk factors helps us to reduce the occurrence of VAP, cost and duration of hospital stay.

CONCLUSION

VAP as an important hospital acquired infections in patients undergoing mechanical ventilation and is an important outcome affecting entity. The physician treating must have knowledge about various aspects of mechanical ventilation and its prevention. The limitation of this study is that the smaller sample size, but the findings/factors pointed out in this study are important risk factor which can be minimized to reduce occurrence of VAP and subsequent outcome, so that the measure meant for life saving does not become a threat to the life.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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