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Original Research Article

Incidence and outcomes of ventilator associated pneumonia in pediatric patients: an observational study

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ABSTRACT

Background: Ventilator associated pneumonia (VAP) is very common in pediatric intensive care unit (PICU) intubated patients and also responsible for major morbidity and mortality. Usually, it develops after 48 hours of mechanically ventilated patients, its incidence increases as the duration of time increases and it is a major risk factor for VAP. The present study was carried out to know the overall incidence of VAP in mechanically ventilated patients in PICU.
Methods: The study was carried out in PICU of the department of pediatrics, B. R. D. Medical College, Gorakhpur from October 2020 to October 2021. Patients aged between 1 year to 15 years were included in the study.
Results: There were 50 (59.5%) patients' male and 34 (40.5%) patients' female under investigation. The clinical pulmonary infection score (CPIS) values ranged from the mean value of 4.38±2.30 at 36th hours to 7.33±1.92 at 96th hours of intubation. VAP was present in 23 (27.3%) patients while 62 (73.8%) patients were having no VAP. Among VAP associated patients, 14.3% were *Acinetobacter* positive, 5.95% were *Klebsiella* positive and 3.57% were *E. coli* positive.
Conclusions: Parameters of CPIS associated with VAP revealed that *Acinetobactor* was comparative more common organism and the age group of 1 to 5 years was more sensitive. VAP can be reduced by decreasing the duration of mechanical ventilation.

Keywords: Clinical pulmonary infection score, Ventilator associated pneumonia, Pediatric intensive care unit, ETA

INTRODUCTION

Ventilator associated pneumonia (VAP) refers to nosocomial pneumonia occurring 48 hours or more after initiation of mechanical ventilation.[1] It has been found that VAP is most common hospital-associated infection (HAI) among adult patients and as many as 15 to 45% patients in intensive care units (ICUs) develop VAP. During other studies the incidence of VAP ranged from 3% to 50% of ventilated PICU patients.[2-4] As such, the variation in incidence of VAP also depends on geographical distributions.[5] Methodology is also an important factors that influences its occurance.[6] Microbiological criteria versus non-microbiological criteria and the use of VAP prevention bundle programs also play a vital role.[2,7] The VAP bundle is composed of various interventions like head-of-bed elevation between 30° and 45°, a daily sedation vacation and a readiness-to-wean assessment, peptic ulcer disease prophylaxis, deep vein thrombosis prophylaxis and daily oral care with chlorhexidine mouthwash.

Being the most common cause of nosocomial infection after bloodstream infections, VAP accounts for high mortality, morbidity and healthcare.[8] This incidence of

VAP in pediatric studies has been reported from a number of developed and developing countries including India.[9] Two studies from India have shown VAP rates of 32.5% and 20% in children ventilated in PICU.[10] The onset of VAP can be divided into: early which occurs 72 hours before intubation and late which occurs after more than 72 hours of intubation. Early and late VAP differ in their pathogenesis, micro-organisms, antibiotic sensitivity, outcome and treatments.

Diagnosis of VAP is not straight forward and relies on a combination of clinical, radiological and microbiological parameters. Commonly associated organisms for VAP are *Acinetobacter* spp., *Pseudomonas*, *Klebsiella* species, *E. coli*, and *Staphylococcus aureus.* Early diagnosis, timely initiation of antibiotics, meticulous clinical monitoring and optimization of antibiotics based on culture reports are crucial in the treatment of VAP. A preventive approach such as a VAP bundle in a multidisciplinary fashion reduces the problem.[11]

The present study was carried out with an objective to study the overall incidence of VAP in mechanically ventilated patients in PICU and to study the risk factors and immediate outcomes of VAP among hospitalized intubated patients.

METHODS

Study design

A hospital-based cross-sectional observational study was conducted at B. R. D. Medical College, Gorakhpur, the incidence of ventilator associated pneumonia in mechanically ventilated patients.

Study place

The study was performed in PICU of the department of pediatrics, B. R. D. Medical College, Gorakhpur situated in Tarai Region of Eastern Uttar Pradesh, India.

Study period

Study conducted for one-year period of time from October 2020 to October 2021.

Sample size

A total of 84 intubated patients admitted in PICU of the age group of 1 year to 15 years were enrolled for study and analyses.

Selection criteria

Guardians/parents who gave their consent to carry on the study on their children admitted in the hospital of the medical college were included for study. All invasively ventilated patients were taken who were free from pneumonia or their chest X-ray (CXR) was initially radiologically normal and the duration of ventilation was then 48 hours.

Exclusion criteria

Guardians/parents who did not give their consent to carry on study on their children admitted were excluded from the study. Duration of ventilation less than 48 hours and CXR showing radiological pneumonia were also excluded.

Laboratory investigations

Patients under study were undertaken to routine investigations like complete blood count (CBC), total leucocyte count (TLC), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), serum (S.) electrolyte, liver function test (LFT), kidney function test (KFT) and arterial blood gas (ABG) along with chest X-ray and ET tip aspirate (ETA) culture. The samples were delivered to the microbiology laboratory within 15 minutes after collection. 1.5 ml of ETA was mixed with 1.5 ml of physiological saline and mechanically crushed for 1 minute followed by transfer to a culture bottle received from the microbiology department. Computed tomography (CT) scan of thorax was carried out when required. Daily monitoring was done regarding the clinical condition and lab investigation of the admitted patient till their discharge. Daily monitoring of new signs and symptoms and any complications were recorded on working proforma. Collected data was calculated following clinical pulmonary infection score (CPIS).

Statistical analyses

Data entry and analyses were carried out using statistical package for the social sciences (SPSS) version 22 software.

RESULTS

Out of 84 patients coming to PICU, 18 were from the age group of 1 year, 30 of 1 to 5 years, 20 of 6 to 10 years and 16 of 11-15 years. In total there were 50 participants were male and 34 participants were female. Their per cent distribution is presented in Figure 1.

Only 3 patients at 3 months and one patient at 6 months received steroid along with other drugs as a bridging therapy but as the number is too small it cannot be used in analysis.

Of all the 84 intubated patients taken under study, clinical assessment of signs and symptoms of some of the parameters viz. body temperature, leukocyte count, tracheal secretion, oxygenation PaO_2/FiO_2, pulmonary infiltration in chest X-ray, progression in pulmonary infiltration and pathogenic bacteria in tracheal aspirate culture were carried out during experimentation with reasonable variables and the score achieved are detailed in Table 1.

It was recorded that there was no significant difference in VAP development in male and female patients. Different components of clinical pulmonary infection score revealed that in tracheal secretion 'score 1' had high percentage about 82.1% and 'score 0' was in minimum 7.1%. In leucocyte count scoring system 'score 1' had high percentage of 60.7% whereas 'score 2' had the minimum 15.5%. For PaO_2/FiO_2 the highest percentage score gain was 'score 0' which was 70.2%. Likewise, temperature component of clinical pulmonary infection score was highest in 'score 1' which was 63.1%. The chest X-ray component of clinical pulmonary infection score was highest 'score 1' 63.1%. Likewise, percentage of bacteria in VAP was 8.3% for *Acinetobactor*, 6% for *Kleibseila*, 4.8% for *Staphylococcus*, 3.6 % for *E. coli* and 3.6% for other uncommon organisms. Tracheal secretions were found an important component of CPIS. On the basis of total score, 'score 1' has maximum score 82.1 % followed by 'score 2' 10.7% and 'score 0' 7.1 % (Table 1).

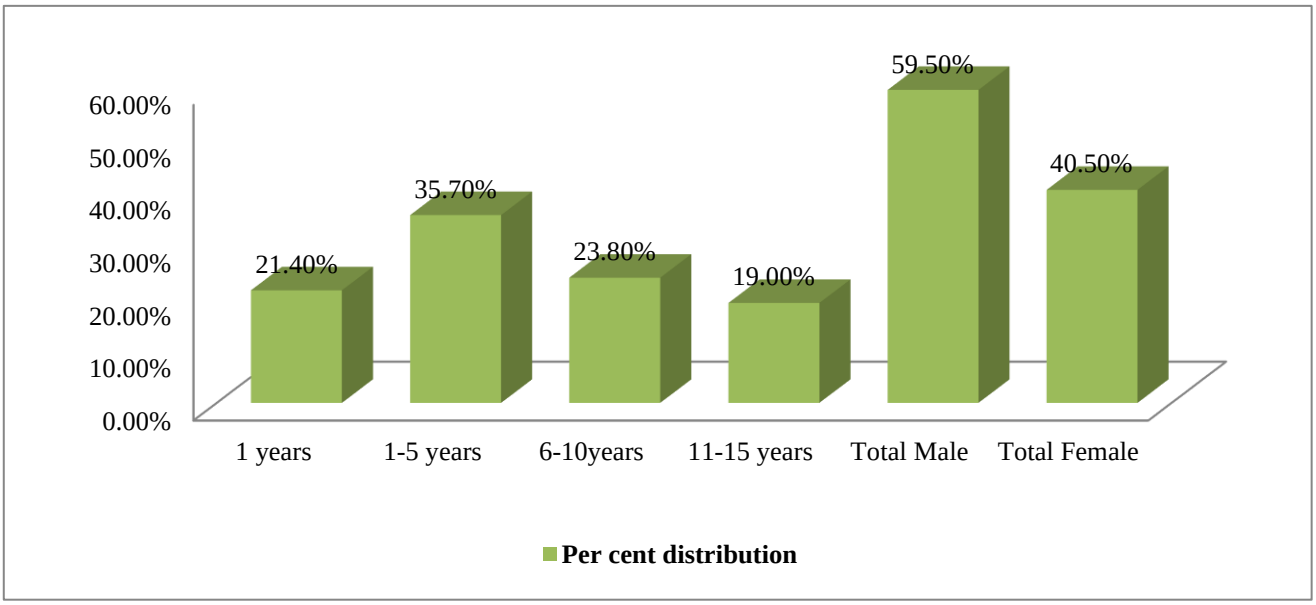

Figure 1: Age and sex distribution (n=84).

Table 1: Details of CPIS score the patients undertaken for study.[16]

S. no.	Parameters	Score point
1	Body temperature ≥36.5 or ≤38.4	0
	≥38.5 or ≤38.9	1
	≥39 or <36.5	2
2	Leukocyte count, microscopy ≥4000 or ≤11.000	0
	<4000 or >11.000	1
	Rod form ≥ % 50	+1
3	Tracheal secretion tracheal secretion (-)	0
	Tracheal secretion with less purulence	1
	Abundant purulent secretion	2
4	Oxygenization PaO_2/FiO_2, mmHg >240 or ARDS (ARDS: PaO_2/FiO_2 <200, PaO_2/FiO_2 <200, bilateral acute infiltration)	0
	PaO_2/FiO_2, mmHg ≤240 or ARDS	2
5	Pulmonary infiltration in chest X-ray no infiltration	0
	Diffuse infiltration	1
	Localized infiltration	1
6	Progression in pulmonary infiltration radiographic progression (-)	0
	Radyografic progression (+) (after the exclusion of HF and ARDS)	2
7	Pathogenic bacteria in tracheal aspirate culture no or few pathogenic bacteria	0
	Moderate or high levels of pathogenic bacteria	1
	Pathogenic bacteria to be seen in Gram staining	+1

CPIS: clinical pulmonary infection score

Table 2: Distribution of CPIS values of the patients under investigation.

Hours of intubation	No. of patients	Range (min-max)	CPIS		Death	Dis-charged	Endo tracheal tip culture
			Mean±SD	VAP			
36	40	0-5	4.38± 2.30	-	-	-	Sterile 63 (73.8%)
48	25	1-9	6.90±4.06	12	4	8	*Acinetobacter* 12 (14.3%)
72	13	1-10	3.94±1.80	8	1	7	*Klebsiella* 5 (5.95%)
96	3	2-10	7.33±1.92	3	1	2	*E. coli* 3 (3.57%)
Total (%)	84	-	-	23 (27.3)	6 (7.14)	17 (20.23)	-

CPIS: clinical pulmonary infection score

The observational details of the distribution of CPIS values, VAP values, patients not recovered from the illness and the patients discharged after treatment following intubation period of 36 hours, 48 hours, 72 hours and 96 hours is given in Table 2. Likewise, endo tracheal tip culture revealed that 12 patients showed the growth of Acinetobacter following 48 hours of intubation while 72 hours of intubation resulted the growth of *Klebsiella* in 5 patients and 96 hours of intubation resulted the growth of *E. coli* in 3 patients. Statistical analyses of the results of each intubation periods are detailed in Table 2

During the present study 36.3% patients developed early ventilator associated pneumonia and 63.6% patients developed late ventilator associated pneumonia. Likewise, the most common organism associated with ventilator associated pneumonia was *Acinetobactor* in 31.8% cases and *Kleibsela* in 22.7% patients

DISCUSSION

During the study presented in this article, 26.2% patients developed ventilator associated pneumonia which is in concomitance to the work of Amanati et al where the incidence of ventilator associated pneumonia was 22.9% and that of Sankar et al where the incidence of VAP was 24.4%.[13,14] During the present study most common organism associated with ventilator associated pneumonia was *Acinetobactor* which substantiate the findings of Sankar et al where *Acinetobactor* was in 47% cases followed by *Pseudomonas* in 28% patients.[14]

Nevertheless, Aelami et al have reported the incidence of ventilator associated pneumonia in 31% cases and the most common organism was *Pseudomonas* in 47.7% patients followed by *Acinetobactor* in 18.2% patients.[15]

Limitations

Small sample size, use of a broad spectrum of antibiotics may lead to false negative cases and specified duration of mechanical ventilation were some of the limitations of the work presented in this paper.

CONCLUSION

CPIS criteria including tracheal secretions, leukocyte count, chest X-ray, PaO_2/FiO_2, temperature and microbial culture played important role. *Acinetobactor* was the common organism and the common age group participated in this study was 1 to 5 years. Ventilator associated pneumonia can be reduced by decreasing the duration of mechanical ventilation. VAP bundle approach was commonly used to reduce the chances of VAP. A uniform protocol for medicinal practices in the PICU is also necessary to reduce nosocomial infections.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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