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Does Re-intubation Increased Risk of Ventilator- Associated Pneumonia (VAP) in Pediatric Intensive Care Unit Patients?

*Bilan Nemat [1], Parinaz Habibi [2]

[1]Pediatric Pulmonologist, Pediatric Health Research Centre, Tabriz University of Medical Sciences, Tabriz, Iran.
[2] Pediatrician, Tabriz University of Medical Sciences, Tabriz, Iran.

Abstract

Introduction

Ventilator- Associated Pneumonia (VAP), as defined by the Centers for Disease Control and prevention (CDC), is a pneumonia that occurs in a patient receiving mechanical ventilation that develops 48 hours or more after initiation of ventilation. Re-intubation which occur within 72 hours of planned extubation may be effective in VAP incidence. The aim of this study was to determine VAP incidence in re-intubated patients in comparison to patients underwent intubation without re-intubation to highlight re-intubation as a risk factor for VAP.

Methods and Materials

A total of 1230 intubated patients, admitted to Pediatric Intensive Care Unit (PICU) department were enrolled in this cohort observational study consecutively from May 2010 to May 2014. VAP was clinically suggested and confirmed by chest X-ray. Patients demographic data, underlying disease, duration of mechanical ventilation length of PICU stay and re-intubations were recorded prospectively.

Results

In this study 336 intubated patients out of 1230 patients admitted to PICU department developed VAP (27%) with higher incidence in re-intubated patients (30% vs. 12%).

Conclusion

VAP developed in nearly one third of intubated patients in our study. Re-intubation was significant risk factor for development of VAP.

***Key words*:** Endotracheal intubation, Re-intubation, Ventilator- associated pneumonia.

****Corresponding Author***:

Nemat Bilan, MD, Professor of Pediatric Pulmonology, Pediatric Health Research Centre, Tabriz University of Medical Sciences, Tabriz, Iran.
Email: bilannemat@yahoo.co.uk

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Introduction

Ventilator- Associated Pneumonia (VAP), as defined by the Centers for Disease Control and prevention (CDC), is a pneumonia that occurs in a patient receiving mechanical ventilation that develops 48 hours or more after initiation of mechanical ventilation. It is the second most common Hospital Associated Infection (HAI) after bloodstream infection for the pediatric population(1,2).VAP accounts for about 20% of all HAI among patients in PICU and has a rate of (2.9-21.6)/1000 ventilator days (3,4,5).

Further more some data suggested higher mortality rate for mechanically ventilated pediatric patients with VAP compared with those without VAP(6). Hospital costs and the length of Intensive Care Unit (ICU) stay were significantly increased for pediatric patients with VAP compared with those without VAP (7). The epidemiology, pathogenesis, and outcome of VAP are well described in adults, however, few data exist regarding VAP in pediatric patients. Because of different anatomy, physiology and underlying illnesses from adults, it is important to identify specific prevention for this population in preventing VAP. To date, there have been some researches about risk factors of VAP in PICU, however, these results indicated that risk factors were varied or contradictory(8,9,10).

Re-intubation which occur within 72 hours of planned extubation is mentioned in different studies as a risk factor for development of VAP (5, 11). The aim of this study was to determine VAP incidence in re-intubated patients in comparison with patients underwent intubation without re-intubation to highlight re-intubation as a risk factor for VAP development.

Methods and Materials

The present cohort observational study was conducted in the PICU ward of referral hospital in Tabriz, South west of Iran, from May 2010 to May 2014. A total of 1230 intubated patients admitted to PICU were enrolled consecutively into the study. Demographic data, underlying disease, duration of mechanical ventilation, re-intubations and length of PICU stay were recorded prospectively. The exclusion criteria were: patients extubated or who died within 72 hours of admission; pneumonia diagnosed prior to intubation.

Portable chest X-ray (AP view) were obtained in all patients with clinical suspicion of VAP that include : new onset of purulent sputum or change in character of sputum, increased temperature, increased or decreased white blood cell count, organism cultured from blood or isolation of an etiologic agent from a specimen obtained by bronchial brushing or biopsy. New or progressive infiltrates, consolidations, cavitation or pleural effusion on chest radiographic examination were suggestive of VAP.

The statistical analysis was performed by SPSS version 16. Data was presented as the mean and standard deviation, t-test and Mann- whitney U test were used for parametric and nonparametric data respectively.

Results

In this study 336 intubated patients out of 1230 patients admitted to PICU department developed VAP (27%) in this study. A total 180 patients (14.6%) underwent re-intubation. The VAP incidence in re-intubated patients and intubated patients

without re-intubation was 30% and 12% respectively. The baseline characteristics of patients are shown in (Table.1).

Table 1: Baseline characteristics of patients

Characteristic	Re-intubated patients	Intubated without re-intubation	P -value
Age (month)	17±12	19±11	0.07
Male/Female	45/55	49/51	0.08
Mechanical ventilation duration(d)	15±2	9±3	0.04
Length of PICU stay	14±4	8±2	0.04
VAP	30%	12%	0.01

Discussion

The present study was a cohort observational study focusing on the comparison of VAP development in two groups: who underwent re-intubation vs. patients who were intubated and not been re-intubated in the PICU setting. The overall incidence of VAP in this study was 27%. According to literatures the overall incidence of VAP is 3-30%(5,12). Differences in study methodology and case mix can influence the reported incidence of VAP. In pediatric populations, the published data are unmatched for severity of illness and univariate but suggest that pediatric patients with VAP may have excess mortality and length of PICU and NICU stay.

The European Multicenter Trial examined the epidemiology of hospital-acquired infections in 20 units (5 PICUs, 7 neonatal units, 2 hematology-oncology units, and 8 general pediatric units) in eight countries, with a total of 14,675 admissions (710 admission in PICUs) (13). Those investigators found the infected patients had a longer mean length of stay in the PICU (26.1± 17.3 vs. 10.6 $\pm$ 6 days; $P < 0.001$) than uninfected patients. The mortality rate was 10% for PICU patients with nosocomial infections. The mortality and length of stay associated specifically with VAP were not reported, although VAP accounted for 53% of the nosocomial infections in PICU patients. Mortality among uninfected PICU patients was not reported. Similarly, PICU length of stay in a 9-month prospective cohort study in an academic tertiary care center revealed that patients with VAP (n = 30) had a mean PICU length of stay of 27 days versus 6 days for uninfected patients (n = 595) ($P = 0.001$) (14). In that same study, the mortality rates with and without VAP were 20% and 7%, respectively ($P =0.065$). Outcomes between patients on mechanical ventilation for more than 8 days with VAP (n = 30) and those without VAP (n =62) were also compared. PICU length of stay was longer for VAP patients (27.53±20.09 vs. 18.72± 35 days), as was hospital length of stay (52.63± 37.43 vs. 33.77± 49.51 days), but no differences in mortality rates for VAP (20%) or uninfected patients (21%) were found.

Almuneef et al. (15) determined in a prospective cohort study (n= 361) that PICU lengths of stay with (n = 37) and without (n =324) VAP were longer for patients with

VAP (33.70± 30.28 vs. 14.66± 17.34 days; P= 0.001). Statistically significant differences in mortality rates between patients with VAP and those without VAP were not found (P =0.362).

VAP has also been shown to increase hospital costs. The cost of VAP was analyzed in a 2-year study of PICU patients (n= 1919) with a single admission (16). The direct cost for patients with VAP (n= 56) was $38,614, and that for patients without VAP was $7,682.

In a multivariate analysis controlling for other predictors of cost including age, severity of illness, underlying disease, and ventilator days, VAP was independently associated with a direct cost of $30,931, 95% confidence interval (CI), $18,349 to $82,638 (16). Several factors have been identified as being risk factors for VAP in NICU and PICU patients. Many of these factors reflect a risk for aspiration such as that which may occur during re-intubation, physical movement out of the ICU, and bronchoscopy. In addition, neuromuscular weakness and immunodeficiency may predispose a patient to VAP, as does prolonged mechanical ventilation.

Our data suggest that re-intubation increase VAP incidence in comparison with single time intubation (30% vs. 12%) that is in parallel with other studies reviewed in the previous systemic review. Rate of re-intubation in our setting was 14.6%. The increased incidence of VAP following re-intubation was probably related to enhanced risk of aspiration of colonized or oropharyngeal contents during each episode of intubation.

Conclusion

VAP is the second most common hospital acquired infection among PICU patients. Re-intubation is mentioned as a risk factor in already done studies which is in parallel with our result. So a precise and stepwise plan for extubation should be performed to prevent extubation failure.

Conflict of interests: None

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