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Incidence of Ventilator-Associated Pneumonia and its Related Risk Factors in Patients Admitted to Neonatal Intensive Care Unit

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Abstract

Background and Objectives: Ventilator-associated pneumonia (VAP) is defined as inflammation of the lung parenchyma due to infectious agent activity 48 hours after the start of mechanical ventilation in patients who have tracheal intubation and did not have pneumonia at the time of intervention. Due to the lack of local information available and the high mortality rate, this study was designed to investigate the incidence of VAP and its related risk factors in patients admitted to neonatal intensive care unit (NICU) in Ardabil city hospital.

Methods: This descriptive cross- sectional study was performed on 100 neonates admitted to NICU of Bu-Ali hospital in Ardabil city in 2018. For each neonates, necessary information were collected by a checklist including incidence of VAP and the related risk factors. Collected data were analyzed by statistical methods in SPSS version 19.

Findings: In this study, 100 neonates admitted to NICU of Ardabil city hospital, 61% of them were boys and the rest were girls. Out of all neonates, 48% had VAP. There was a significant relationship between duration of mechanical ventilation time and the incidence of VAP. Also, there were no significant relation between gender, gestational age (GA), receiving surfactant, steroids, vasoactive, enteral nutrition, re-intubation, blood transfusion and having nasogastric tube (NGT) with incidence of VAP.

Conclusions: Results showed that the incidence of VAP in this study was increasing and we have to have strategic planning to reduce this rate in this area.

Keywords: Ventilator related pneumonia, Mechanical ventilation, Neonatal intensive care unit

Background and Objectives

Health care related infections occur in nearly 12% of patients who admitted to pediatric intensive care units. Pneumonia is the second most common nosocomial infection that accounts for 22.7% of healthcare related infections. Ventilator-associated pneumonia (VAP), occurs in 9%-27% of intubated patients. The risk of VAP increases by about 1%-3% per day when using mechanical ventilation. Also, mortality rates for patients with VAP are reported about 33%-71% which is a high rate.[1,2] In addition, some research has shown that mortality in children with VAP is significantly higher than in children without the disease.[3] Also, hospital costs and length of stay in the neonatal intensive care unit (NICU) are significantly higher in patients with VAP compared to patients without the disease.[4]

Up to this time, many researchers have conducted studies on VAP risk factors in patients admitted to NICU but the results of these studies have been varied and inconsistent. For example, Elward et al in a study, identified genetic syndromes, re – intubation and outpatient care as risk factors related to VAP.[5] Almuneef et al showed that arbitrary antibiotic therapy, continued enteral nutrition and bronchoscopy are the independent predictive risk factors for VAP.[6] The epidemiology and prognosis of VAP for adults is well described but little information have about the disease specially for children , its risk factors and outcomes such as mortality, morbidity and costs.[7] Because of the different anatomy and physiology of adults, identification of specific prevention methods for ventilator associated pneumonia in the pediatric population is essential.[5]

In addition, the information available is mainly related to studies in developed countries. The incidence of

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ventilator associated pneumonia has been significantly reduced since 1990 due to improved clinical knowledge and the use of preventive methods and strategies but the incidence of the disease is still high.[8]

Because of these uncertainties, the lack of available information, the high mortality rate and the necessities mentioned, the aim of this study was to investigate the incidence of VAP and its related risk factors in patients admitted to NICU in Ardabil city hospital.

Methods

Study Design and Participants

This descriptive cross-sectional study was performed on 100 neonates under mechanical ventilation who admitted to NICU of Bu-Ali hospital in Ardabil city in 2018.

Exclusion Criteria

In cases of neonatal death occurring before pneumonia, occurrence of pneumonia at 48 hours after starting mechanical ventilation and non-using of mechanical ventilation neonates, neonates were excluded from the study .

Data Collection Method

Information for each neonates were collected by a checklist containing infant gender, gestational age (GA), length of mechanical ventilation time, occurrence of VAP and related risk factors such as receiving or non-receiving of steroids, surfactants, vasoactive, enteral nutrition, blood transfusion, NGT and re-intubation.

Statistical Analysis

Data were analyzed using descriptive analytical statistics in SPSS version 19. Chi-square and *t* test were used to examine the relationship between the variables.

Ethical Approval

The study was approved by the ethics committee of Ardabil University of medical science and registered by code IR.ARUMS.REC.1397.102.

Results

In this study we investigated the incidence of VAP. Out of 100 neonates, 48% had VAP. Of the total neonates, 61% were boys and 39% were girls . The incidence of VAP in girls with 52.1% was more than boys with 47.9% but the relation between gender and incidence of VAP was not significant.

The average GA was about 33.1± 3.5 weeks in range 24 to 40 weeks. In the VAP cases, the average GA was 33 and in others was 33.4 and the difference was not significant. The average intubation time in neonates with VAP significantly higher than neonates without VAP (7.4±3.8 vs. 4.2±2, *P*=0.001). The difference between infants with incidence of VAP mechanical and intubation time was significant (Table 1).

Of all neonates, 76% received surfactants that 58% of whom had VAP. Also, 16.7% of those who did not receive surfactants, developed VAP. There was no significant relationship between surfactant receiving and incidence of VAP.

Of all neonates, 33% received steroids that 88% of them had VAP. Also, 38.4% of neonates who did not take steroids, developed VAP, too. There was no significant relationship between incidence of VAP and receiving steroids.

Of all neonates, 56% received vasoactive drugs. Of them, 53.6% develop VAP. Also, 41% of those who did not receive the vasoactive developed VAP too and there was no significant relationship between vasoactive drug receipt and incidence of VAP.

Of all neonates, 15% had enteral nutrition of which 73.3% had VAP. Also, 43.5% of those who did not eat Enteral had VAP. There was no significant relationship between receipt of enteral nutrition and incidence of VAP.

Of all neonates, 14% had NGT that 71.4% of them had VAP and also 44.2% of those who did not use NGT developed VAP and there was no significant relationship between them.

Of all neonates, 19% had re-intubation that all of them had VAP. Also, 35.8% of infants who have not been intubated again and have only been infected once, had

Table 1. Relation Between Demographic Variables and Incidence of VAP

Some Related Variables		Incidence of VAP				P Value
		+		-		
		No.	%	No.	%	
Gender	Girls	25	52.1	14	27	0.26
	Boys	23	47.9	38	73	
Gestational Age (wk)		33±3.2		33.4±3.8		0.57
Duration of mechanical ventilation (days)		7.4±3.8		4.2±2		0.001

VAP. There was no significant relationship between re-intubation and the incidence of VAP.

Of all neonates, 47% had blood transfusions that 61.7% of them VAP. Also, 35% of those who did not have blood transfusion, developed VAP. There was no significant relationship between blood transfusion and the incidence of VAP (Table 2).

Discussion

In this study of all neonates, 48% had VAP. In the study of Albert et al only 6.5% of neonates had VAP that this high statistical difference may be due to the lack of appropriate conditions in our study for infants and the NICU problems in our study center. These findings suggest that the NICU system in our study requires more stringent preventive measures, further investigations on the type of risk factors study quality and efficiency of the used devices. Examination of the relationship between gender and ventilator associated VAP and our study results were similar to previous studies in this topic.[9] Also due to the lack of studies on gender and incidence of VAP it is recommended to conduct more specific studies in this area with larger sample size as a case-control studies. The study on the incidence of VAP and GA showed no significant relationship between them. Although this is contrary to our expectation and it is not comparable to other studies due to lack of similar studies in this regard. Surveys showed that, 76% of patients received surfactants, 33% received steroids and 56% received vasoactive drugs and there were no significant relationship between the use of these drugs with the incidence of VAP. Liu et al similar to our study showed that taking steroids is a strong risk factor for pneumonia.[10] Kusahara et al suggested that the use of vasoactive drugs as an independent risk factor for ventilator associated pneumonia which is inconsistent with our study results.[11] It is recommended to study a meta-analysis and systematic review about the upper risk factors. Although in our study no communication was found between gastric tube and incidence of VAP, in the study of Kusahara et al gastric nasal tube was identified as a risk factor for pneumonia and this conclusion need for more studies in future. Liu et al similarly to our study showed that re-intubation as a risk factor for ventilator- associated pneumonia.[10] This suggests that re-intubation should be avoided as much as possible. It is recommended that more attention be given to extubating of neonates and that the clinical and paraclinical conditions of neonates should be carefully evaluated during extubating.[11]

Results showed that 15% of infants had enteral nutrition of which 73.3% had VAP. Also, 43% of those who did not eat enteral nutrition had VAP too. There was no significant relationship between receipt of enteral nutrition and incidence of VAP. In the study of Lee et al, a link was found between enteral nutrition and the incidence of pneumonia so that the beginning of enteral nutrition reduced the incidence of pneumonia but in the study of Albert et al this relation was not significant.[12] In a study by Almuneef et al, continued enteral nutrition was identified as a risk factor for pneumonia.[6]

Results are different based on the type of nutrition in

Table 2. Relation between some related risk factors and Incidence of VAP

Risk Factors		Incidence of VAP				*P* Value
		+		-		
		No.	%	No.	%	
Receiving surfactant	Yes	44	58	32	42	0.35
	No	4	16.7	20	83.3	
Receiving steroids	Yes	29	88	4	12	0.56
	No	19	38.4	48	71.6	
Receiving vasoactive	Yes	30	53.6	26	46.4	0.21
	No	18	41	26	59	
Having NGT	Yes	10	71.4	4	28.6	0.08
	No	38	44.2	48	55.8	
Enteral nutrition	Yes	11	73.3	4	26.7	0.32
	No	37	43.5	48	56.5	
Re-intubation	Yes	19	100	0	0	0.51
	No	29	35.8	52	64.2	
Blood transfusion	Yes	29	61.7	18	38.3	0.26
	No	19	35.8	34	64.2	

neonates who hospitalized in the NICU. Although in our study no relation was found between NGT and the incidence of VAP, in the study by Kusahara et al, NGT defined as a risk factor for pneumonia.[11] The study by Liu et al in contrast to our study strongly showed re-intubated as a factor for VAP.[10] There were 47 cases of blood transfusions; 61.7% of them were infected. Also, 35% of those who did not have blood transfusions, developed the VAP. These findings showed a significant relationship between blood transfusion and VAP.

The average intubation time in neonates with VAP significantly higher than neonates without VAP(7.4±3.8 vs. 4.2±2, *P*=0.001). The difference between infants with incidence of VAP mechanical and intubation time was significant. Lee et al and Kusahara et al similar to our study showed a significant relationship between mechanical ventilation time and the incidence of VAP.[11,12] Also a study by Vijayakanthi et al showed that prolonged mechanical ventilation time causes to ventilator related pneumonia.[13] All of these studies confirm that mechanical ventilation time is more likely to be a strong risk factor for pneumonia and it is recommended not to prolong infant intubation as long as possible. According to similar studies, steroids, re-intubation, and length of stay in the NICU are factors that have been identified as important risk factors for ventilator associated pneumonia but in our studies these factors not confirmed to have role in the incidence of VAP. So, in hospitalized time of infants in NICU, these factors should be taken into account and infants with all three factors should be classified as high risk pneumonia patients .

Conclusions

Given the association between ventilator associated pneumonia and steroid and surfactant receipt re intubation and intubation time it is recommended to reduce the above factors to reduce the morbidity and mortality caused by ventilator associated pneumonia. Since surfactants and intubation are necessary for preterm infants and steroid administration for extubation, it is recommended to be more careful in measuring the indications of the above measures. It is recommended to be more careful in measuring the indications of the above measures, also reduce the birth rate of premature infants and give steroid to the prenatal mother to accelerate lung maturation to minimize infant intubation and minimize complications, including ventilator associated pneumonia. Studies on the subsequent complications of ventilator- associated pneumonia, the type of native tag causing neonatal pneumonia, the use of steroids and VAP, and the re-intubation of VAP could be used as a more comprehensive view of the importance of this issue and of the native treatment strategy for community health decision makers and hospital system managers.

Authors' Contributions

MM and AA contributed to study design, clinical examination and data collection. MB, HZ and ME contributed in data collection and sampling, interpretation of the results and drafting the manuscript. All authors read and approved the final manuscript.

Competing interests

None

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