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Original Article

Incidence and risk factors of ventilator associated pneumonia in neonatal intensive care unit in AL-Ahrar teaching hospital.

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ABSTRACT

Background: Mechanical ventilation (MV) is an important part of the neonatal intensive care unit (NICU). MV, nevertheless, is linked to higher risks of ventilator associated pneumonia (VAP). The 2nd most frequent hospital acquired infection is VAP, which develops in mechanically ventilated cases after 2 days of MV.

Aim: The aim of this study was to determine the incidence of VAP and to assess risk factors of VAP in neonatal intensive care unit in Al-Ahrar teaching hospital.

Methods: This study was a prospective observational study which conducted at the neonatal intensive care unit in Al-Ahrar teaching hospital on 84 neonates on MV during six months from January 2019 to June 2019. All patients were subjected to full history taking. Full clinical examination and laboratory investigations were done and included complete blood count (CBC), C-reactive protein (CRP), liver function tests, kidney function tests, serum albumin level and blood culture. Chest radiograph was done on admission and repeated as required.

Results: The percentage of VAP was (54.8 %). There was a statistically significant decrease in gestational age, weight, and serum albumin among VAP than non-VAP cases.

Conclusion: The high prevalence of VAP in the intubated neonates poses a serious risk. Diagnosis, risk factor identification, precautions, and empirical treatments are all important strategies for VAP. VAP was found in a high percentage of mechanically ventilated newborns.

Keywords: VAP, NICU, Nosocomial, Pediatrics

INTRODUCTION

Ventilator-associated pneumonia (VAP) is a common and serious complication of admission in intensive care units (ICUs). It is associated with prolonged ICU stay and rise in morbidity and mortality rates in patients in ICUs**. [1]**

Throughout the initiation and progression of VAP, two significant mechanisms are included: bacterial invasion of the aerodigestive tracts and aspiration of polluted secretions into the lower respiratory tract. Furthermore, there is a growing belief that the biofilm created on the endotracheal tube (ETT) surface could act as a reservoir where the bacteria are grown into the lower airway. **[2]**

VAP is associated with a high rate of mortality and morbidity, as well as longer hospital stays and higher costs. Despite antibiotic therapy, it is related to a death rate of 20 percent to 71 percent. It's possible that this is due to the pathogens' virulence. **[3]**

Tracheal intubations are the most significant risk factor for neonatal pneumonia (NP). The efficiency of the management is improved when the causative agent of VAP is identified. Identifying the causative agent of VAP aids in the modification of primary antibiotics based on culture and sensitivity testing, avoiding the development of resistant strains. As a result, the length of ventilation, NICU stay, and hospital costs are significantly reduced. **[4]**

AIM AND OBJECTIVES

To determine the incidence of VAP and to assess risk factors of VAP in neonatal intensive care unit in Al-Ahrar teaching hospital.

SUBJECTS AND METHODS

Technical design: This prospective observational study was done at the neonatal intensive care unit in Al-Ahrar teaching hospital on 84 neonates on

MV during six months from January 2019 to June 2019. Inclusion criteria included all neonates aged up to one month, both sexes, having mechanical ventilation for more than 48 hours and showing deteriorating gas exchange (Oxygen desaturation, increase ventilation or need for supplemental oxygen) with 3 or more of the following; temperature instability of unknown cause, leukopenia or leukocytosis, change in sputum amount, color, or character, apnea, tachypnea, nasal flaring with retraction of chest wall, or grunting, wheezing, rales, or cough, tachycardia (more than 170 beats/minute) or bradycardia (less than 100 beats/minute), 2 or more serial chest X-rays with either onset of progressive and persistent infiltration, consolidations or cavitations of pneumatoceles. Exclusion criteria involved the cases out the mentioned age group or with concomitant surgical problem. We also excluded the cases without informed consent.

Methods: All patients were subjected to full medical history and thorough clinical examination. Laboratory investigations were performed involving complete blood count (CBC), C-reactive protein (CRP), liver function tests, kidney function tests, serum albumin level and blood culture. Chest radiograph was done on admission and repeated as required. Arterial blood gas (ABG) was monitored. The ventilator settings were also monitored including peak inspiratory pressure (PIP), peak end expiratory pressure (PEEP), respiratory rate (RR), inspiratory time (Ti) and fraction of inspired oxygen (FIO2).

Administrative considerations: Written informed consent was obtained from the care givers and all parents of the participants after clear explanation of the study and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University (Institutional Research Board "IRB"). The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis:

The collected data were tabulated and analyzed using SPSS version 24 software (Spss Inc, Chicago, ILL Company). Categorical data were presented as number and percentages. Chi square test (X2), or Fisher's exact test (FET) were used to analyze categorical variables. Quantitative data were tested for normality using Kolomogrov Smirnove test assuming normality at P>0.05. Quantitative data were expressed as mean ± standard deviation, median and range. Student "t" test was used to analyze normally distributed variables among 2 independent groups, or Man Whitney U test for nonparametric ones. The accepted level of significance in this work was stated at 0.05 (P <0.05 was considered significant). P value >0.05 is non-significant (N-S).

RESULTS:

Table (1) shows that the percentage of the VAP was (54.8 %) while Non-VAP was (45.2 %). Table (2) demonstrated that there was no statistically significant difference between VAP and Non-VAP regarding Sex. There was a statistically significant decrease in gestational age, weight, and mode of delivery among VAP than Non-VAP. A statistically significant decrease in serum albumin among VAP than Non-VAP is cleared in Table (3). Table (4) showed that there was no statistically significant difference between VAP and Non-VAP regarding blood culture on admission but there was a statistically significant difference between VAP and Non-VAP regarding blood culture after MV. A statistically significant difference between VAP and Non-VAP regarding X-RAY is revealed in Table (5). Table (6) shows that there was a statistically significant increase in length of stay on MV among VAP than Non-VAP.

Table (1): Incidence of VAP among the studied sample.

		No.	%
Incidence of VAP	**VAP**	46	54.8
	Non-VAP	38	45.2

Categorical data were presented as number and percentages.

Table (2): Comparison between VAP and Non-VAP regarding demographic data.

			VAP	Non-VAP	t. test	P. value
Gest. age	**Rang**		28 - 39	31 - 39	-5.126-	.000
	Mean ± SD		32.61 ± 2.304	35.13 ± 2.171		
Weight	**Rang**		1.4 - 3.6	1.7 - 3.8	-5.036-	.000
	Mean ± SD		2.155 ± 0.405	2.66 ± 0.513		
Sex	**Male**	**No.**	27	20	X^2 0.31	.5770
		%	58.7%	52.6%		

			VAP	Non-VAP	t. test	P. value
	Female	No.	19	18		
		%	41.3%	47.4%		
Mode of delivery	CS	No.	36	20	X^2 6.151	.013
		%	78.3%	52.6%		
	NVD	No.	10	18		
		%	21.7%	47.4%		

Quantitative data were expressed as mean ± standard deviation, median and range. Student "t" test was used. The accepted level of significance in this work was stated at 0.05 (P <0.05 was considered significant). P value >0.05 is non-significant (N-S).

Table (3): Comparison between VAP and Non-VAP regarding Serum albumin.

		VAP (No.= 46)	Non-VAP (No.= 38)	t. test	P. value
Serum albumin	Rang	2.5 - 3.8	3 - 4.5	- 11.656-	.000
	Mean ± SD	3.2 ± 0.275	3.95 ± 0.316		

Quantitative data were expressed as mean ± standard deviation, median and range. Student "t" test was used. The accepted level of significance in this work was stated at 0.05 (P <0.05 was considered significant). P value >0.05 is non-significant (N-S).

Table (4): Comparison between VAP and Non-VAP regarding Blood culture on admission and Blood culture After MV.

			VAP	Non-VAP	X^2	P. value
Blood culture on admission	No growth	No.	42	37	1.905	.386
		%	91.3%	97.4%		
	staph	No.	2	1		
		%	4.3%	2.6%		
	strept	No.	2	0		
		%	4.3%	.0%		
Blood culture After MV	No growth	No.	24	30	8. 99	.024
		%	52.2%	78.9%		
	e coli	No.	1	1		
		%	2.2%	2.6%		
	klep	No.	5	1		
		%	10.9%	2.6%		
	pseudo	No.	2	1		
		%	4.3%	2.6%		
	candida	No.	3	1		
		%	7.5%	2.6%		
	staph	No.	9	4		
		%	19.6%	10.5%		
	strept	No.	2	0		
		%	4.3%	.0%		

Chi square test (X2) was used. The accepted level of significance in this work was stated at 0.05 (P <0.05 was considered significant). P value >0.05 is non-significant (N-S).

Table (5): Comparison between VAP and Non-VAP regarding X-RAY.

			VAP	Non-VAP	X^2	P. value
X-RAY	Positive	No.	44	2	68.629	.0000
		%	95.7%	5.3%		
	No abnormal detected	No.	2	36		
		%	4.3%	94.7%		

Chi square test (X2) was used. The accepted level of significance in this work was stated at 0.05 (P <0.05 was considered significant). P value >0.05 is non-significant (N-S).

Table (6): Comparison between VAP and Non-VAP regarding Length of stay on MV.

		VAP (No.= 46)	Non-VAP (No.= 38)	t. test	P. value
Length of stay on MV	**Rang**	7 - 41	5 - 20	2.18	.000
	Mean ± SD	21.63 ± 9.253	11± 1.99		

Quantitative data were expressed as mean ± standard deviation, median and range. Student "t" test was used. The accepted level of significance in this work was stated at 0.05 (P <0.05 was considered significant). P value >0.05 is non-significant (N-S).

DISCUSSION

The incidence of VAP in this study was (54.8 %). Our results are less than study done by Petdachai in Thailand, who studied 170 infants aged less than one month, requiring mechanical ventilation for longer than two days and VAP incidence was (70.3%).**[5]**

Weighing our results against data from other Arab countries, we observed an incidence of VAP was 47% in Lebanon **[6]**, 38.1% in Jordan, **[7]** and 25.2% in Saudi Arabia **[8]**.

This variation may be due to difference in infection control policies, diagnostic criteria used, variable sensitivity and specificity of diagnostic tests and different guidelines of treatment.

In our study the demographic characteristics of neonates with and without VAP did not significantly differ as regard sex and cause of admission. This agrees with the study done by Duke and colleagues. **[9]**

We found a statistically significant decrease in gestational age among VAP than Non-VAP. This is attributed to the fact that the airways of preterm newborns are smaller in diameter, resulting in a greater resistance to flow. The risk of airway collapse or distension increases as airway compliance rises. This was in line with the findings of Foglia and colleagues, who found that VAP rates were elevated significantly as gestational age decreased. **[10]**

Also, the mean birth weight of the VAP group was also significantly lower than the non VAP group. This result was near to the results obtained by Petdachai who reported that the mean birth weight in the group diagnosed as VAP was 1.8 kg whereas, in the non VAP group was 2.2kg. **[5]**

Stover and colleagues reported in a cross-sectional survey that VAP rates were highest for the 1-1.5 kg birth weight categories. This could be explained by the greater risk of infection in low birthweight babies, as well as the increased length of stay in the NICU, leaving them prone to VAP. **[11]**

In our study, there was a statistically significant increase in cesarean section among VAP patients. This result disagreed with Tripathi and colleagues who reported that there is no statistically significant association between VAP and mode of delivery. **[12]**

In the current study, statistically significant increase in length of stay on MV among VAP than Non-VAP. Our results agree with Koksal and colleagues who mentioned that prolonged duration of ventilation generally increases the risk of VAP. **[4]**

Exposure to other devices like nebulizers, humidifiers, and ventilator circuits, that have been shown to be major sources for pathogens when ventilation is extended. **[12]**

In the current study, a statistically significant decrease in serum albumin among VAP than Non-VAP was found. Hypoalbuminemia, that is a sign of poor dietary habits, was found to be a major risk factor for VAP. This is in agreement with Alp and Voss, who stated that in severe diseases, albumin production is reduced due to a preference for hepatic production of acute phase proteins like globulins, fibrinogen, and haptoglobin. **[13]**

In this study, microorganisms associated with blood culture in VAP diagnosed group were, staph aureus (19.6%), klebsiella (10.9), candida (7.5%), pseudomonas (4.3%), strept (4.3%), e-coli (2.2%), while (52.2%) of obtained blood cultures in VAP patients were sterile. This result may be explained by that our studied newborn infants enrolled in this study were already under antibiotics therapy. Staphylococcus was predominant organism in in our study. This is not in agreement with Zhu and colleagues who reported that gram negative bacilli were higher than gram positive coccus in their VAP patients. **[14]**

It could be attributed to that the redistribution of microorganisms varies from one NICU to the next in terms of infection control equipment, as well as from a period of time to the next inside the same location. **[15]**

CONCLUSION AND RECOMMENDATIONS

This study concluded that, the high prevalence of VAP in the intubated neonates poses a serious risk. VAP was found in a high percentage of mechanically ventilated newborns. Prematurity, decreased birth weight, and long ventilation were the most significant risk factors for VAP in our

unit. The most common bacteria found in the cultures were Staph aureus and Klebsiella pneumonia. More research is needed to conduct strategies to face neonatal VAP.

REFERENCES

1) **Lee PL, Lee WT and Chen HL.** Ventilator-Associated Pneumonia in Low-Birth-Weight Neonates at a Neonatal Intensive Care Unit: A Retrospective Observational Study. Pediatrics. 2016;10.6-1016.
2) **Melsen WG, Rovers MM, Koeman MI and Bonten MJ.** Estimating the attributable mortality of ventilator-associated pneumonia from randomized prevention studies. Crit Care Med. 2011;39(12):2736-42.
3) **Abdel-Gawad TA, El-Hodhod MA, Ibrahim HM and Michael YW.** Gastroesophageal reflux in mechanically ventilated pediatric patients and its relation to ventilator-associated pneumonia. Crit Care. 2009;13(5):1-5.
4) **Köksal NI, Hacimustafaoğlul MU, Çelebi SO and Ozakin CU.** Nonbronchoscopic bronchoalveolar lavage for diagnosing ventilator-associated pneumonia in newborns. Turk J Pediatr. 2006;48(3):213-20.
5) **Petdachai WI.** Ventilator-associated pneumonia in a newborn intensive care unit. Southeast Asian J Trop Med Public Health. 2004;35:724-9.
6) **Duke TA.** Neonatal pneumonia in developing countries. Arch Dis Fet Neo Ed. 2005;90(3):F211-F219.
7) **Kanafani ZA, Kara LI and Hayek SA.** Ventilator-associated pneumonia at a tertiary-care centre in a developing country; Incidence, Microbiology, and susceptibility. Patterns of Isolated Microorganisms. Infect control Hos Epidemil. 2003;24:11:864-9.
8) **Khuri-Bulos NA, Shennak MA and Agabi SI.** Nosocomial infections in the intensive care units at a university hospital in a developing country: comparison with National Nosocomial Infections Surveillance intensive care unit rates. Am J Infect Control. 1999;27(6):547-52.
9) **Memish ZA, Cunningham GA and Oni GA.** The incidence and risk factors of ventilator-associated pneumonia in a Riyadh Hospital. Infect Control Hosp Epidemiol. 2000;21:271-273.
10) **Foglia EL, Meier MD and Elward AL.** Ventilator-associated pneumonia in neonatal and pediatric intensive care unit patients. Clin microbiol rev. 2007;20(3):409-25.
11) **Stover BH, Shulman ST, Bratcher DF, Brady MT, Levine GL and Jarvis WR.** Nosocomial infection rates in US children's hospitals' neonatal and pediatric intensive care units. Am Infect Cont J. 2001;29:152-7.
12) **Tripathi SH, Malik GK, Jain AM and Kohli NE.** Study of ventilator associated pneumonia in neonatal intensive care unit: characteristics, risk factors and outcome. Int J Med Upd. 2010;5-89(1).
13) **Alp EM and Voss AN.** Ventilator associated pneumonia and infection control. Annals of clinical microbiology and antimicrobials. Ann Clin Microbiol Antimicrob. 2006;5(1):1-1.
14) **Zhu XL, Zhao LI, Yang JC, Chen XI and Wu XH.** Etiology and high-risk factors of neonatal ventilator-associated pneumonia. Chin J Contem Pediatr. 2007;9(6):549-52.
15) **Shaw MJ.** Ventilator associated pneumonia in critically ill patients. Am J Respir Crit Care Med. 2005;163:1520-23

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