DOI: https://doi.org/10.53350/pjmhs20221612369

ORIGINAL ARTICLE

Ventilator Associated Pneunomia in Neonatal Intensive Care Unit: Occurrence and Risk Factors

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ABSTRACT

Objectives: To examine the occurrence of pneumonia linked with a ventilator in the neonatal intensive care unit and to determine the related risk factors.

Purpose of study: To better identify the associated morbidity and mortality, pathophysiology, and recommended measures to avoid this disease, paediatric VAP diagnosis methods must become more standardized and exact.

Study design: A cross-sectional study

Place and Duration: This study was conducted at Aga Khan University hospital from May 2021 to May 2022

Methodology: This study includes a total of 70 participants admitted in neonatal intensive care unit. All the patients were put under the ventilator for more than 2 days. At the time of admission, the X-ray of the chest was performed, and it was also performed every day. When certain organisms were present on the tracheal aspirate, ventilator-associated pneumonia (VAP) was diagnosed. After 2 days of ventilation, microbial analysis and gram staining were done for tracheal aspirates. They were later examined to determine the occurrence of nosocomial pneumonia and what are the risk factors linked with it. A Chi-square test and t-test were conducted to examine all the data. A confidence level of 0.05 was set.

Results: Pneumonia associated with the ventilator occurred in 31.4% of the participants where a large number had developed it between 4-14 days after intubation. There were certain risk factors that were determined in our research. They include the use of H2 blockers, invasive lines, low PaO2/FiO2, and re-intubation. There were two things (use of steroids and enteral feeding through nasogastric) that were not linked with the occurrence of this pneumonia. The patients who were in the group of ventilator-associated pneumonia were having a longer time period of stay and mechanical ventilation.

Practical implication: In newborn and paediatric intensive care units, VAP continues to be a significant and unresolved problem. The results of this study will highlight the numerous elements that significantly contribute to ventilator-associated pneumonia.

Conclusion: The occurrence of pneumonia associated with ventilators is high. Those patients who were having above mentioned risk factors should require pay special attention towards prevention.

Keywords: pneumonia, ventilators, ventilator associated pneumonia, neonatal intensive care unit

INTRODUCTION

It is very common in NICU that nosocomial infections occur. The 2nd most common nosocomial infection in the ICU setting is ventilator-associated pneumonia (VAP) [1] . One of the major causes of morbidity and mortality in hospitals is VAP [2,3] .The reported rates are much higher in underdeveloped nations, ranging from 16.1 to 89 incidents per 1,000 ventilator days [4, 5, 6].

People who are intubated have a risk of occurrence of pneumonia associated with ventilators and as the time of ventilator support prolongs, this risk increases [7]. The risk associated with mechanical ventilation is around 1 to 3 percent per day [8]. But the occurrence of this disease is dependent upon which type of ICU is available, what criteria are used to diagnose this, or the resources available in the hospital. The occurrence of VAP in developing countries of the world is around 15 to 30% [9].

The pathogens were colonized in the nasopharynx, oropharynx, dentition, and sinuses. This was done during the mechanical ventilation. The secretions were pooled into the subglottic space. Later, pneumonia is developed when these secretions are moved through a micro-leak in the endotracheal tube cuff and reach the respiratory tract. Moreover, access to aspirate is allowed because the vocal cords that are held by the endotracheal are left open. The risk factors that are linked with VAP include enteral feeding, high APACHE score, re-intubation, immunosuppression, multiple invasive lines that are done through paralytic agents, H2 blockers, supine head position, sedation, antacids, and nasogastric tube [10]. The main purpose of this research is to examine the occurrence of pneumonia linked with a ventilator in the ICU and to determine the related risk factors. The lack of comprehensive information on the characteristics of VAP in neonates at the regional and national levels necessitates specialized research on the risk factors and aetiology of VAP.

METHODOLOGY

In this cross-sectional study, seventy neonates who underwent intubation for mechanical ventilation were included. The consent of each and every participant and their relatives was taken before putting them on a ventilator. Overall, 100 patients went under intubation for mechanical ventilation. Out of these hundred patients, 70 became the participants in this study. Those patients who left against medical advice or died before 2 days of ventilation were not included in this research. Moreover, those patients who were having any infiltrations seen in the chest X-ray before intubation were also not a part of this research.

Data was gathered which included the demographics of the patients, mechanical ventilation indication, diagnosis at the time of admission, and oxygenation which was done before the VAP was determined. CDC criteria were used to diagnose the VAP [11]. Those participants who were developing infiltrations in the chest and were ventilated for more than 2 days had any 2 of the below-mentioned list: Purulent tracheal aspirate, Fever or Leukocytosis

At the time of admission, the X-ray of the chest was performed, and it was also performed every day. When certain organisms were present on the tracheal aspirate, VAP was diagnosed. After 2 days of ventilation, microbial analysis and gram staining were done for tracheal aspirates. If the results were negative, this was repeated again after 2 days. The causative agent was determined through the detection of organisms on the tracheal aspirate. As the sensitivity was changing, the medications were changed. After 2 days repetitively, the total leukocyte was determined.

The participants were divided into 2 categories. One category was those patients in whom the VAP occurred within 4 days of mechanical ventilation. They were called early-onset VAP.

The other category was of those patients in whom the VAP occurred after 4 days. They were called late-onset VAP.

Several strategies related to mechanical ventilation were applied to the patients routinely. These strategies include sedation, active and passive chest physiotherapy, analgesia with midazolam and morphine, semi-recumbent position at 45 degrees, deep vein thrombosis prophylaxis, and fentanyl titrated to tube tolerance. There was no patient who got paralyzed during this research.

Every surrogate variable was evaluated, and the occurrence of VAP was recorded. The risk factors were enteral feeding, inotropes being used, invasive lines, re-intubation, peptic ulcer, and use of steroids. These factors were all a part of surrogate variables. The patients were divided into 2 groups (non-VAP and VAP) and each of the above-mentioned factors were recorded. The APACHE score was not collected in our research because the participants of our study were not able to bear all the costs of the research. Due to this reason, there were limited investigations done.

There were two things, the stay period in the ICU and the time of the mechanical ventilation, which were used to determine the results of the disease. All the data were recorded in Microsoft Excel. The website http://www.graphpad.com was used to conduct the analysis of the data. A Chi-square test was conducted to do the univariate analysis of the recorded data. A T-test was also conducted to compare the data. The p-values that were below 0.05 were taken as significant.

RESULTS

Overall, 100 patients went under intubation for mechanical ventilation. Out of these hundred patients, 70 became the participants in this study. The ones who were excluded from the research either died before 2 days of ventilation, were diagnosed with early pneumonia, or left against medical advice. Out of the 70 patients who were involved in this research, 60% (n=42) were females and 40% (n=28) were males. The average age of patients was 32.6 years. The average PaO2 was 287 (non-VAP) and 210 (VAP). A total of 31.4% (n=22) of patients developed VAP. Table number 1 shows the demographics of the participants. Table number 2 shows the clinical spectrum of the participants. The common cases were poisoning of organophosphate. VAP showed high occurrence in the patients with COPD (Chronic Obstructive Pulmonary Disease), laparotomy, and poisoning. Some participants were diagnosed with more than 1 diagnoses that is why the total number of patients is exceeding the actual total.

Table number 3 shows the risk factors that were linked to VAP. The occurrence of VAP was higher in the participants who required invasive lines, inotropes, and re-intubation. Eighteen patients required re-intubation and most of them developed VAP. The occurrence of VAP was low in those patients who required enteral feed.

Table 1: demographics of the participants

	Non-VAP	VAP	Total
Female	29	13	42
Male	18	10	28
Average	43.3	32.6	

Table 2: clinical spectrum of the participants

Diagnosis	Non-VAP	VAP	Total
Poisoning	16	7	23
COPD	4	4	8
Fat embolism	1	0	1
Pneumothorax	2	0	2
Neurological	5	1	6
Abdominal surgery	8	4	12
Septicemia	10	3	13
Metabolic disorders	3	1	4
Trauma	2	2	4
Pulmonary embolism	1	0	1

Acinetobacter baumannii was found to be the most common causative organism from the tracheal aspirate. More than 1 organism was detected in 4 reports. Microbes were mostly gram negative. In the early onset VAP, Klebsiella sp. was common. As a total of 32 patients had VAP, thirteen of them required tracheostomy. A total of 22 percent was the rate of mortality for the VAP group and 21 percent was the rate of mortality for the non-VAP group. Hence, there was not a significant difference seen between the two groups.

Table 3: risk factors that were linked to VAP

Risk factors	Non-VAP	VAP	Total
Steroids	14	7	21
CVP/arterial lines	20	21	41
Inotropes	12	13	25
H2 blocker	12	12	24
Re-intubation	6	12	18
Enteral feed	28	19	47
PaO2/FiO2	9	10	19

DISCUSSION

The number of days of mechanical ventilation, the re-intubation, and the age of patients more than 70 years, the emergency surgery, the intraoperative inotropic support, and the transfusion are said to be the factors for the detection of VAP [12]. In our study, the use of steroids was not determined to be a risk factor but there are several researchers who determined this as a risk factor in their studies [13, 14].

Although enteral feed was determined as a risk factor because of increased volume, regurgitation, and gastric pH, the nutritional status of our patients was improved due to the enteral feed that was given through the nasogastric tube. The gut translocation was also decreased and the VAP was also prevented by the same risk factor [15, 16]. Some researchers have determined the use of pro-kinetics, avoiding gastric over distension, and intermittent as the factors that decrease the occurrence of VAP [17, 18].

According to several researchers, tracheostomy was one of the major risk factors for VAP [19, 20]. But there are several studies that argue with this statement and state that early tracheostomy helps in the prevention of VAP in patients with mechanical ventilation [21]. In our study, the tracheostomy was studied as a result of VAP because the patients had late tracheostomies.

The rate of mortality was same in both groups despite the fact that the stay for ICU and morbidity was more in the VAP group. This was also determined in several studies. The late onset VAP was linked with pseudomonas aeruginosa, gram-negative bacteria, and Acinetobacter baumannii [22]. In our research, the most common one was Acinetobacter.

A qualitative approach of tracheal aspirate (TA) was used in this research. A quantitative approach of bronchoalveolar lavage (BAL) could be used but we did not use it due to the cost-effectiveness, ease, and sensitivity. According to Daren Heyland, the results would conclude whether the VAP is developed by BAL or TA [23].

CONCLUSION

In our research, we concluded that the occurrence of VAP is high. The most common organism in the late onset VAP was gram-negative bacteria. If mechanical ventilation was needed for more than 4 days, it would increase the risk of the occurrence of VAP. Those patients who were having above mentioned risk factors in the research should require paying special attention towards prevention. They should pay attention to their hygiene, early tracheostomy, and weaning protocol.

Funding source: None
Conflict of interest: None
Permission: It was taken from the ethical review committee

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