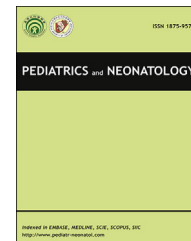


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ORIGINAL ARTICLE

Ventilator-Associated Pneumonia in Low Birth Weight Neonates at a Neonatal Intensive Care Unit: A Retrospective Observational Study

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Background: Ventilator-associated pneumonia (VAP) is one of the most common healthcare-associated infections among ventilated patients. The aim of this study was to determine the clinical characteristics and risk factors for the development of VAP in intubated low birth weight (LBW) neonates in a neonatal intensive care unit.

Methods: LBW infants (<2.5 kg) admitted to the neonatal intensive care unit of Kaohsiung Medical University Hospital from January 2005 to December 2009 were enrolled. We retrospectively analyzed perinatal and neonatal data of the enrolled intubated LBW infants by chart review.

Results: Six hundred and five LBW infants were analyzed. One hundred and fourteen of the infants were intubated for >48 hours, 15 (13.2%) of whom had VAP. Of these 15 patients, the average age at onset of VAP was 24.0 ± 11.2 days, the average postmenstrual age was 30.6 ± 1.8 weeks, and the mean gestational age was 27.1 ± 2.3 weeks, which was significantly lower than the mean gestational age in the group without VAP (30.2 ± 3.5 weeks). The mean birth body weight was 944.4 ± 268.4 g in the VAP group and 1340.1 ± 455.4 g in the group without VAP ($p < 0.001$). Longer duration of intubation (odds ratio: 1.35, 95% confidence interval: 1.12–1.62) and parenteral nutrition (odds ratio: 1.32, 95% confidence interval: 1.14–1.51) were found in the VAP group after adjusting for gestational age and birth weight.

Conclusion: VAP was a problem for the LBW infants with intubation for >48 hours in our neonatal intensive care unit. VAP most frequently occurred at a postmenstrual age of 30–32 weeks in this study. Longer duration of tube placement and parenteral nutrition were

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found in the VAP group. Early removal of the endotracheal tube and adequate enteral nutrition may decrease the occurrence of VAP in LBW infants.

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1. Introduction

Ventilator-associated pneumonia (VAP) is a common and severe complication of critical illnesses in intensive care units (ICUs). It is associated with longer durations of hospital and ICU stay and high rates of morbidity and mortality in patients in an ICU. Several studies have reported on VAP in pediatric patients; however, few studies have focused on neonates, especially those with a birth weight <2.5 kg (low birth weight, LBW).^{1–5} The leading causes of death in neonates are disorders related to short gestation and LBW.⁶ Respiratory distress syndrome is the most common respiratory diagnosis in preterm LBW neonates requiring respiratory support.⁷ In addition, the incidence of respiratory distress syndrome has been reported to be higher among infants with a lower gestational age and lower birth weight.⁸ To rescue these smaller preterm infants, respiratory support including intubation and the use of mechanical ventilation is crucial after birth. Neonatal pneumonia is also a common cause of respiratory distress in neonates, and it also necessitates mechanical ventilation after birth.⁹ Although the survival of preterm LBW neonates has improved with improvements in the techniques of neonatal mechanical ventilation and advancing neonatal care, a longer duration of mechanical ventilation can still lead to respiratory morbidity including VAP and bronchopulmonary dysplasia.^{10,11} Therefore, VAP in preterm infants, and especially LBW infants, is an important issue.

To evaluate the condition of VAP in our neonatal ICU (NICU), we enrolled intubated LBW infants undergoing mechanical ventilation for >48 hours from January 2005 to December 2009. The aim of this study was to determine the clinical characteristics and risk factors for the development of VAP in LBW neonates in our NICU.

2. Methods

2.1. Patients

From January 2005 to December 2009, all intubated LBW infants (birth weight <2.5 kg) admitted to the NICU of Kaohsiung Medical University Hospital were enrolled. We retrospectively analyzed perinatal and neonatal data of the intubated LBW infants undergoing mechanical ventilation for >48 hours. The perinatal data included gestational age, body weight, percentage of small for gestational age, Apgar score at 1 and 5 minutes, National Therapeutic Intervention Scoring System (NTISS) scores, endotracheal intubation, and length of hospital stay. Small for gestational age was defined as a weight below the 10th percentile for the gestational age.¹² Death was regarded as death before

discharge from the hospital. The NTISS score was recorded within 48 hours of admission. The neonates intubated for >48 hours were divided into two groups: those with VAP (VAP group) and those without VAP (no-VAP group). Clinical symptoms, laboratory findings, radiological signs, and microbiological findings of the VAP patients were recorded. The diagnosis of VAP was made on the basis of new or progressive respiratory symptoms and infiltrates/patches on chest X ray. According to Centers for Disease Control and Prevention (CDC) diagnostic criteria for VAP in infants younger than 1 year, the diagnosis should be based on all of the three items of radiologic signs, clinical signs and symptoms, and microbiological findings.¹³ Tracheal aspirate in each enrolled patient was obtained for microbiological data. VAP was documented from the chart review. X rays were interpreted by the authors.

2.2. Statistical analysis

Categorical data are presented as numbers (%) and continuous data as the mean \pm standard deviation. The characteristics of the patients with and without VAP were compared using Student *t* tests for numerical data and χ^2 tests for categorical data. Univariate and multivariate analyses were performed to explore the risk factors related to VAP. JMP version 10 (SAS Institute Inc., Cary, NC, USA) was used for all statistical analyses. The level of statistical significance was defined as $p < 0.05$.

2.3. Ethics

This study was approved by the Institutional Review Board of Kaohsiung Medical University Hospital: KMHIRB–20140028.

3. Results

From January 2005 to December 2009, 662 LBW neonates were admitted to the NICU of Kaohsiung Medical University Hospital. One hundred and fifteen (17.4%) of the LBW neonates required intubation after birth; one of whom was excluded from this study because of an intubation period <48 hours. Of the remaining 114 patients who received ≥ 48 hours of mechanical ventilation, 15 patients (13.2%) met the criteria of VAP and had received antibiotics for at least 7 days. The characteristics of the intubated LBW neonates with and without VAP are detailed in Table 1. The mean gestational age was 27.1 ± 2.3 weeks in the VAP group, which was significantly lower than that in the no-VAP group (30.2 ± 3.5 weeks). The mean birth body weight was 944.4 ± 268.4 g in the VAP group compared with

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