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Observational Study

Need for oxygen therapy and ventilatory support in premature infants of a hospital in Southern Brazil

Oxygen therapy and ventilatory support in premature infants

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Abstract

BACKGROUND

Prematurity in newborns is a condition that is associated with worse hospital outcomes when compared to birth to term. A preterm infant (PI) is classified when gestational age (GA) < 37 wk.

AIM

To analyze prognostic indicators related to the use of oxygen therapy (O2), non-invasive ventilation (continuous positive airway pressure - CPAP) and mechanical ventilation (MV) in PI.

METHODS

This is a retrospective cohort. The sample was composed of PIs from a private hospital in southern Brazil. We included neonates with GA < 37 wk of gestation in the period of 01/01/2018 to 31/12/2018. For data collection, electronic records were used in the Tasy Philips™ system, identifying the variables: maternal age, type of birth, prenatal information, GA, APGAR scale, birth weight, neonatal morbidities, vital signs in the 1st hour at birth, need for O2, CPAP and MV, hospitalization in the Neonatal Intensive Care Unit (NICU), length of stay, discharge or death.

RESULTS

90 PIs records were analyzed. The median (p25-p75) of GA was 34.0 (31.9-35.4) weeks, being 45 (50%) boys. The most common morbidity among PIs was the acute respiratory discomfort syndrome, requiring hospitalization in NICU in 76 (84.4%) cases. The utilization rate of O2, CPAP and MV was 12(13.3%), 37(41.1%) and 13(14.4%), respectively. The median (p25-p75) length of stay was 12.0 (5.0-22.2) days, with 10(11.1%) deaths. A statistical association was observed with the use of MV: GA < 28 wk, lower maternal age, low birth weight, APGAR < 8 and neonatal deaths.

CONCLUSION

The identification of factors related to the need for MV in prematurity may help in the indication of a qualified team and technologies to promptly meet the unforeseen events that may occur after birth.

Key Words: Premature; Continuous Positive Airway Pressure; Artificial Respiration; Non-Invasive Ventilation

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Core Tip: This is an observational study evaluating the need for oxygen therapy and ventilatory support in preterm infants. In our analysis, we present the odds ratio of the use of mechanical ventilation when compared to maternal and preterm epidemiological parameters.

INTRODUCTION

Prematurity in newborns is a condition that is associated with worse hospital outcomes when compared to birth to term. However, in recent years there has been an increase in survival rates, due to the improvement in neonatal intensive care, supported by technological evolution and the qualification of professionals in the field[1]. Even with all these progressions, prematurity rates at the present time remain high, reaching 10.94% of live births in 2018 in Brazil[2].

The determining gestational age of a preterm birth (PTB) is less than 37 wk, related to some resultants that generate the anticipation of childbirth[3]. Obstetric complications can interfere with the natural process of pregnancy, causing premature delivery, some of which are infections, hypertensive diseases, diabetes, and hemorrhages that are more common [4]. According to DATASUS in Brazil in 2018 its last census, the duration of pregnancy between 22 and 36 wk was 322,234 Live births, among them single, double, and triple births, in the South region there were 43,313 live births[2].

Among the factors related to the clinical evolution of the PTB are gestational age (GA), APGAR scale, weight at birth, congenital malformations/morbidities and vital signs. The APGAR scale is a tool for systematic assessment of the newborn, created by Virginia Apgar in 1953, for this reason the name APGAR. It uses a numerical score from 0 to 10, which have five variables, heart rate, respiratory effort, color, muscle tone and reflex irritability, used as indicators of fetal distress less than 5 on the scale, where oxygen therapy is offered to reduce respiratory difficulty and collaborate in hemodynamic stabilization[5]. Newborns under 2,500 kg have an increased risk of death in the first year of life, of developing infectious diseases, respiratory diseases, growth retardation and development[6]. Constant monitoring and early initiation of appropriate therapy prevent possible complications of disease and prematurity[7].

In Brazil, 24,061 Live births and 268 neonatal deaths were named, with a neonatal mortality rate of 11.1 deaths per thousand live births. Causes of neonatal death prevailed in the prematurity group, accounting for about 1/3 of the cases, followed by

congenital malformation (22.8%), infections (18.5%), maternal factors (10.4%) and asphyxia/hypoxia (7%)[8].

At risk birth, as in PTB, a physiological and/or hemodynamic imbalance occurs, where the extrauterine environment generates numerous adaptations involving morphophysiological and biochemical maturation of the lung parenchyma[9]. The inability to achieve effective breathing, lack of a powerful respiratory drive, reduced muscle strength, lack of surfactant and high compliance of the chest wall are contributing factors to respiratory failure[10]. As a result of these factors, premature babies need respiratory assistance to perform and/or adapt gas exchange and establish consistent functional residual capacity[10].

Several methods are used to provide respiratory support to premature infants, including intubation, prophylactic surfactant, oxygen therapy and non-invasive ventilation. Intubation requires all airway control, reducing support according to tolerance, with as little intubation time as possible, avoiding related morbidities. Surfactant administration is prophylactic, preventing lung damage and respiratory implications[11].

Due to the importance in early recognition of PTBs that will need ventilatory support, this work sought to analyze prognostic indicators related to the need for invasive mechanical ventilation in PTB[8,12]. The use of maternal and newborn epidemiological parameters, as well as physiological signs of the premature infant in the first 24 h can be used as indicators for respiratory failure. In this sense, the general objective of this study was to analyze factors related to the need for ventilatory support in PTB year 2018 in a hospital in southern Brazil.

MATERIALS AND METHODS

This is a retrospective cohort type study. The sample was composed of premature infants in a private hospital in the city of Tubarão, Santa Catarina, Brazil. It has 08 beds in neonatal ICU, 10 adult ICU, 50 adult inpatient beds and 21 adult and pediatric beds as required.

The following criteria were adopted for inclusion: newborns of both sexes, preterm born with less than 37 wk of gestation in the period from 01/01/2018 to 31/12/2018. The exclusion criteria were incomplete medical records, newborns transferred to another hospital. Electronic records were used in the Tasy Philips™ system for data collection.

This research project was approved by the Ethics Committee in Human Beings of UNISUL under the number of the opinion 3.529.438, CAAE: 17573519.2.0000.5369.

The following variables were extracted from the electronic records: gestational age, APGAR scale, birth weight, congenital malformations/morbidities, vital signs at the first hour of birth, maternal age, type of delivery, previous adequate prenatal, mother's morbidity, number of gestations, use of oxygen therapy (O2), non-invasive ventilation (continuous positive airway pressure - CPAP) and mechanical ventilation (MV), need for admission to the neonatal ICU, length of stay, discharge or death.

The data were stored in a database created with the Excel® software and later exported to the SPSS 20.0® software. They were presented through absolute numbers and percentages, measures of central tendency and dispersion. A logistic regression analysis was performed to obtain the odds ratio in comparison to the use of mechanical ventilation. Considering the 95% confidence interval, with a 5% statistical significance level.

RESULTS

We analyzed 90 PTB records and their maternal antecedents. Of these, 81 were cesarean deliveries, being 45 (50%) boys. The median (p25-p75) of the mother was 31.0 (28.0-35.0) years, the most common comorbidity was Premature rupture of membranes (PROM) and other comorbidities such as fetal malformations and little fluid in the amniotic sac. The highest frequency of prenatal visits was 4 to 7, where 64 women performed.

The median gestational age was 34.0 (31.9-35.4) weeks, where the most common morbidity among the PTB was the respiratory distress syndrome. The APGAR in the 1st and 5th minute were higher than 8 in the majority, where 37 needed CPAP and 13

needed orotracheal intubation. The need of admission in neonatal ICU occurred for 76 patients, where the median length of hospital stay was 12.0 (5.0-22.2) days, of which 10 deaths occurred, totaling 11.1% of the PTB.

According to table 1 and 2, which demonstrate the information from maternal data and PTB.

Table 1 - Maternal data

Table 2 – Preterm infant data

In the present study, lower mother's age, lower gestational age, lower birth weight, APGAR< 8 and death were statistically significant and were associated with patients who required MV compared to those who did not require oxygen support (Table 3)

Table 3 - Comparison of data according to the need for mechanical ventilation

DISCUSSION

Prematurity all over the world is an evident problem in perinatal health, and in Brazil it is one of the major causes of infant mortality. Since PIs are at increased risk of adapting to life in the extra-uterine environment, mainly due to the immaturity of the physiological and anatomical system[9,13].

The main findings of the study showed that the need for mechanical ventilation is associated with extreme prematurity with gestational age < 32 wk, a lower maternal age, low birth weight, APGAR < 8 in the first and fifth minutes of life, and neonatal deaths compared to PIs who did not use oxygen therapy. More than half of the studied

preterm infants required some form of oxygen support, whether helmet or incubator oxygen therapy, CPAP, or mechanical ventilation.

PROM is determined by the loss of amniotic fluid before birth, according to Hackenhaar's study[14], that rupture may be associated with a pregnant woman's age above 29 years, explains that it may be related to endogenous changes in the fetus and its annexes. In the present study we noticed that 1/3 of the pregnant women had PROM as a comorbidity and that a little more than half of the women were older than 30 years.

Prenatal care should be initiated in the first trimester of pregnancy; a total of at least six consultations should be performed. During the consultations, physical examinations should be performed, and if necessary, specific tests should be performed. The early initiation of prenatal care provides access to diagnostic and therapeutic methods to prevent possible pregnancy complications[14]. More than half of the pregnant women had 4 to 7 consultations, showing that consultations do not prevent prematurity, but that a more thorough follow-up can prevent maternal and child complications.

Cesarean delivery was predominant in more than 85% of PIs, and most pregnancies were uniparous, according to the Miranda-Flores study[15]. Cesarean section is indicated in pregnancies from 26 to 31 wk + 6 days, and vaginal delivery in pregnancies under 26 and over 31, depending on maternal and fetal conditions, in which the cesarean section represents a higher percentage[15].

The median gestational age found was similar the study by Galleta *et al*[16]. It is during this period that the formation of surfactant takes place, by the type II pneumocytes, responsible for preventing the alveoli from collapsing when in contact with air. ARDS remains one of the most frequent complications in infants weighing 1500g or less.

The data in relation to neonatal death in this study are similar the works of Lansky *et al*[8] and Andegiorgish *et al*[17]. In the study by Myrhaug *et al*[18] infants born alive, the survival rate increased from 74.0% for infants born at 25 wk GA to 90.1% for those born at 27 wk GA. As the study by Glass *et al*[19] reported the morbidity and mortality of 1,765 preterm infants (birth weight 500-1500 g) in the period after implementation of NICUs and mechanical respiratory support. In a meta-analysis evaluating the outcome in

preterm infants, survival improved significantly with each week of GA and for each 100-gram increase in birth weight. Specifically, survival in the 500-600 g group was only 20% compared to 56% in the 700-800 g birth weight group. It can be observed that in the studies there was a higher survival rate in infants with lower gestational age who had a support in neonatal ICU where more and more medical and technological advances are showing in favor of a better prognosis regarding the prediction of ventilatory support18. In this study, it was observed that lower GA and low birth weight were associated with the use of MV, and this in turn was related to death.

The main morbidity found in PIs was ARDS; according to Sweet *et al*[20], ARDS is a significant problem for premature infants where they sought to maximize survival with the creation of guidelines for better management of these patients. CPAP should be initiated from birth in all infants at risk of respiratory distress, such as those at < 30 wk GA who do not require intubation for stabilization. After stabilization, MV should be used in infants with respiratory distress when other methods of respiratory support fail. The duration of MV should be minimized whenever possible. To achieve the best outcomes for preterm infants with respiratory distress, optimal supportive care with monitoring of physiological variables is important. In the NICU, there should be access to continuous pulse oximetry, ECG monitoring, and monitoring of PaCO2 levels.

Regarding vital signs in the first hour, no association was observed with the need for ventilatory support. According to the study by Kumar *et al*[21] where clinical assessment and nursing observation are very important, some vital signs data are not used and the update in the medical records can still be improved. Vital signs monitoring is constantly monitored on monitors at the incubator bedside. Short and long term monitoring can predict sepsis risks, neurological and respiratory problems, as slowing heart rate may be indicative of some pathology, lower SpO2 (85-89%) has a higher incidence of intermittent hypoxemia compared to higher SpO2 (91-95%) during the first 3 days of life, respiratory rate monitoring is important for detection of apnea associated with decreased HR and SpO2. Perhaps, dynamic monitoring of vital signs could provide more prognostic information than those assessed only at the first hour.

The comparison of data from premature infants with low APGAR scores at the fifth minute, birth weight less than 1500g, are closely linked to the need for mechanical ventilation and neonatal mortality, corroborating the study by Dalili *et al*[22]. The study by Oliveira *et al*[23] states that mortality increased for those with APGAR scores 4-7 in relation to PIs weighing between 1500 g and 2999 g. Showing that the lower the birth weight, the higher the mortality. The Apgar score was the best known and oldest form of measurement of neonatal asphyxia. New knowledge, such as the determination of fetal blood pH, among others, has changed this concept, and the score of 6 or less at the 5th min has become the most important reference in the diagnosis and prognosis of asphyxia, along with the proposal not to wait for the 1st minute score to start resuscitation maneuvers. Despite this, the 1st minute score still seems to have importance in the prognosis of mortality[21,22].

Limitations found in this study were the small sample size, and research conducted in a hospital that provides health care only to health insurance companies/private entities, not being able to generalize the findings to other hospitals.

CONCLUSION

We conclude that the need for mechanical ventilation is associated with extreme prematurity with gestational age < 28 wk, lower maternal age, low birth weight, APGAR < 8 at the first and fifth minutes of life, and neonatal deaths. ARDS is the most frequent morbidity in premature infants, where more than half of those studied required some form of oxygen support, whether oxygen therapy, CPAP or mechanical ventilation. The identification of factors related to the need for MV in prematurity may help in the indication of a qualified team and technologies to promptly meet the unforeseen events that may occur after birth.

ARTICLE HIGHLIGHTS

Research background

Prematurity may be associated with some degree of respiratory failure.

Research motivation

Clinical recognition of premature infants at risk is important for appropriate management of ventilatory support.

Research objectives

Assess maternal and newborn factors related to the need for ventilatory support.

Research methods

Retrospective cohort conducted in a private hospital in southern Brazil, consisting of preterm infants with gestational age < 37 wk.

Research results

Were evaluated 90 premature infants, with gestational age (GA) of median(p25-p75) 34.0 (31.9-35.4) weeks. The utilization rate of oxygen therapy, continuous positive airway pressure and mechanical ventilation (MV) was 12(13.3%), 37(41.1%) and 13(14.4%), respectively. The median (p25-p75) length of stay was 12.0 (5.0-22.2) days, with 10(11.1%) deaths. A statistical association was observed with the use of MV: GA < 28 wk, lower maternal age, low birth weight, APGAR < 8 and neonatal deaths.

Research conclusions

The need for mechanical ventilation in premature infants was related to low birth weight, extreme prematurity and low APGAR.

Research perspectives

Other clinical indicators for predicting ventilatory support in premature infants can be used, such as monitoring vital signs and their variability measures.

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