

Incidence of Bronchopulmonary Dysplasia in Pre-Term Newborns submitted to mechanical ventilation: a retrospective study of 1192 Pre-Term Newborns

Incidência de displasia broncopulmonar em prematuros submetidos à ventilação mecânica: um estudo retrospectivo de 1192 recém-nascidos prematuros

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Abstract

Objective: To determine the incidence of preterm newborn infants in mechanical ventilation who developed bronchopulmonary dysplasia in a public hospital at Fortaleza/CE. **Method:** Descriptive, retrospective and longitudinal quantitative analysis with 1192 pre-term infants admitted to the Intensive Care Unit, Dr. César Cals General Hospital, at Fortaleza, from July 2006 to June 2007. Data collection occurred during two months, with visits to units twice a week, where the medical records were done. These samples included newborns that were in mechanical ventilation and developed bronchopulmonary dysplasia. The gestational average was 28.6 weeks; the mean weight of infants was 1125.33 grams, born vaginally or cesarean section, of both sexes and with various primary diseases such as respiratory distress syndrome, jaundice and neonatal infection. **Results:** In the sample, from the total admissions, 34.48% were for mechanical ventilation and 3.48% developed bronchopulmonary dysplasia. **Conclusion:** Despite the low prevalence, bronchopulmonary dysplasia is an important complication of prematurity, directly related to the duration of mechanical ventilation, thus the team must be committed on weaning and extubation of those as soon as possible, preferably within the first week of life.

Keywords: Infant, Newborn. Mechanical Ventilation. Respiration artificial. Bronchopulmonary Dysplasia.

Resumo

Objetivo: Detectar a incidência de recém-nascidos, pré-termo, em ventilação mecânica que evoluíram com displasia broncopulmonar em um hospital público de Fortaleza/CE. **Métodos:** Análise quantitativa de caráter descritivo, retrospectivo e longitudinal de 1.192 recém-nascidos prematuros internados na Unidade de Terapia Intensiva do Hospital Geral Dr. César Cals, na cidade de Fortaleza, entre julho de 2006 a junho de 2007. A coleta de dados ocorreu durante dois meses, com visitas às Unidades duas vezes por semana, ocasião em que foi feito o levantamento dos prontuários. Foram incluídos na pesquisa os recém-nascidos que foram para ventilação mecânica e evoluíram com displasia broncopulmonar. Dessa amostra, a média gestacional foi 28,6 semanas, o peso médio dos prematuros foi de 1.125,33 gramas, nascidos de parto normal ou cesariano, de ambos os sexos e com doenças primárias variadas, como síndrome do desconforto respiratório, icterícia e infecção neonatal. **Resultados:** Do total de internações 34,48% foram para ventilação mecânica, e, dessa amostra, 3,48% evoluíram com displasia broncopulmonar. **Conclusão:** Apesar da baixa prevalência, a displasia broncopulmonar é uma complicação importante em prematuros, relacionada diretamente ao tempo de ventilação mecânica, devendo a equipe estar empenhada no desmame e extubação destes o mais rápido possível; preferencialmente na primeira semana de vida.

Palavras-chave: Recém-Nascido. Ventilação Mecânica. Respiração artificial. Displasia Broncopulmonar.

INTRODUCTION

The technology and scientific knowledge have significantly increased the survival of pre-term newborns (PN), which resulted in an increased incidence of bronchopulmonary dysplasia (BPD). Currently, the BPD is a disease most frequently observed in newborns (NB) < 1200g¹, the etiology is not established and is considered a chronic and progressive disease resulting from multiple factors that act on the immature pulmonary systems which aggravates the

lung parenchyma and airways as a result of prolonged use of mechanical ventilation and toxicity of high concentrations of oxygen continuously for a period greater than or equal to 28 days, with radiological changes²⁻⁴.

The characteristics of BPD in these premature infants, recently called "new" BPD, are quite different from the classic described by Northway, Junior Rosan and Porter⁵. The

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most common use of prenatal steroid, surfactant therapy and better respiratory care has changed the presentation of BPD⁵. The “new” BPD has a multifactorial etiology, such as barotrauma, atelectatic trauma, toxicity, oxygen and nasal continuous positive airway pressure area, however, new types of mechanical ventilation (MV) and gentle ventilation have been used to try to lessen the severity of lung injury⁶.

According to Oliveira³ MV in intensive care units has been a landmark that promotes more conditions to the survival rates of NBs, not just as life support, but also as ‘prophylaxis’, which has led to the development of pulmonary sequelae, such as BPD and neurological diseases. The best indicator to its use is the patient’s condition.

According to Burg, Yoder and Burg⁷, the prevention of BPD is not yet within our reach. However, it is believed that a multidisciplinary approach, using different ventilation strategies, replacement, improvement of surfactant, new anti-inflammatory and antioxidants agents, as well as the prevention of prematurity, will lead to a reduction in the incidence of BPD in pre-term newborns.

The typical pathological findings of this disease are an inflammatory and reparative cellular response to an unresolved acute lung injury. NB with BPD are characterized clinically by chronic respiratory dysfunction, retention of carbon dioxide (hypercapnea), decrease in blood concentrations of oxygen (hypoxaemia) and a change in chest radiograph⁸.

The pathogenic factors are prematurity, oxygen therapy, mechanical ventilation, pulmonary edema, and infection. Treatment is based on good oxygenation, fluid restriction, nutritional support, diuretics, betamimetic drugs, xanthines, and steroids⁹.

In Brazil, the Brazilian Neonatal Research Network has a life expectancy of 66-73% for premature infants in the range of 750-1000g, and 9-44% in the range of 500-749g¹⁰. The incidence is estimated at 4% to 40%, reaching values up to 83% in newborns with birth weight below 1000g and requiring mechanical ventilation for longer than two weeks⁸.

Tapia *et al.*¹¹, held one study based on a large South-American population from 16 centers that vary in size, populations served and resources, from a total of 2,785 born during the study period weighing 500 to 1,500 g, but only, one thousand, eight hundred and forty infants survived (73.8%). The incidence of BPD in survivors averaged 24.4%, with a range of 8.6 to 44.6%.

Treatment of bronchopulmonary dysplasia patients demands a multidisciplinary team, including the neonatologist, pulmonologist, cardiologist, ophthalmologist, neurologist, physiotherapist, dietician, speech therapist and possibly other professionals⁴. It is believed that physiotherapy treatment directed to PN is capable of providing a correct positioning, muscle relaxation, hemodynamic stability, respiratory and

body temperature, keeping the circulation functional in brain of NB¹². The bronchial hygiene maneuvers (postural drainage, manual chest pressure, facilitation of cough and aspiration of upper airway), are indicated when signs of atelectasis, infiltrates or secretions, they are used to mobilize and remove secretions in airways in order to improve lung function¹²⁻¹⁴.

This study is important to the construction the knowledge the physiotherapist and to a basis for its therapeutic attention.

The general measures, which may contribute to a lower incidence of BPD are related to the reduction of time on MV, the use of possible lower parameters of pressure on the MV and to the use of higher frequencies. Evidently, all these pipes rest on the provision of adequate nutrition to the real needs of NBs.

The main objective of this study is to analyze the incidence of preterm infants who developed bronchopulmonary dysplasia because of prolonged mechanical ventilation.

METHODS

This research is characterized by a quantitative analysis of a retrospective, longitudinal and descriptive character. It was performed at the General Hospital Dr. César Cals in the city of Fortaleza, Ceará, Brazil.

The study followed the ethical aspects that involve research with human beings, as a guarantee of confidentiality, anonymity, non-use of information at the expense of individuals and the use of the information only for the purposes specified in the survey.

Data collection occurred according to what is approved by the Ethics Committee in Research of the Hospital Geral Dr. César Cals (Protocol: 113/2007), and followed the standards of Resolution 196/96 of the national board of health - research involving humans¹⁵ as well as the Federal Council of Physical Therapy and Occupational Therapy (COFFITO) resolution 10/78 (Code of Ethics of Physical Therapist)¹⁶.

The study included all records of pre-term infants who required mechanical ventilation and developed bronchopulmonary dysplasia July 2006 to June 2007, in the hospital under study, regardless of sex, nationality, economic class and race. Data collection occurred during two months (August at September to 2007) with twice a week visits to units, where the medical records were kept.

The incidence of BPD, ventilation mode, type of deliveries, gender, average of gestational, weight, primary disease and survival rate were collected

A descriptive statistical analysis, using the software Microsoft Office Excel® 2007 was carried out and the results are presented in graphics and tables.

RESULTS

It was evidenced that during the study period there have occurred the births of 1192 PTNB who were hospitalized in Intensive Care Units 1 and 2 (Figure 1).

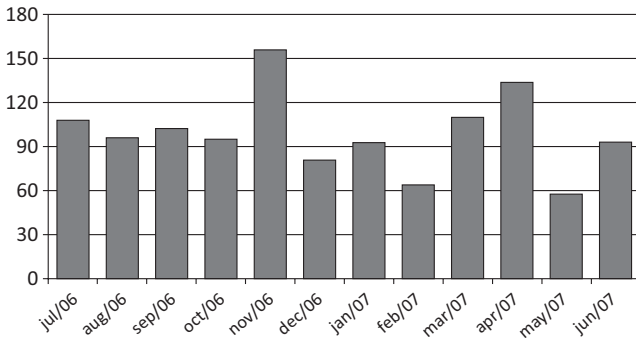


Figure 1 Distribution of data according to the hospitalization of pre-term infants during the study period in intensive care units 1 and 2. Fortaleza-CE, Brazil.

Among them 34.48% (n=431) were intubated and placed on mechanical ventilation (Figure 2) and 3.48% (n=15) of this sample developed BPD (Figure 3).

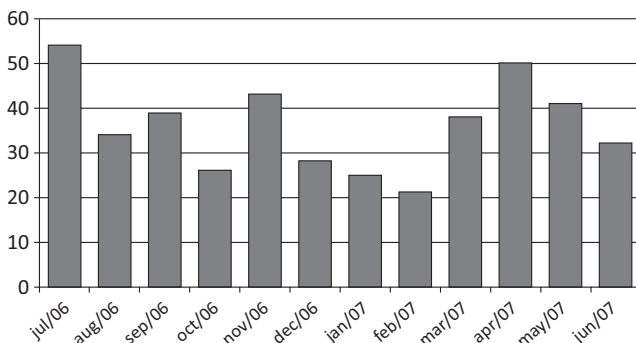


Figure 2 Distribution of data according to pre-term newborns were intubated and placed on mechanical ventilation. Fortaleza-CE, Brazil.

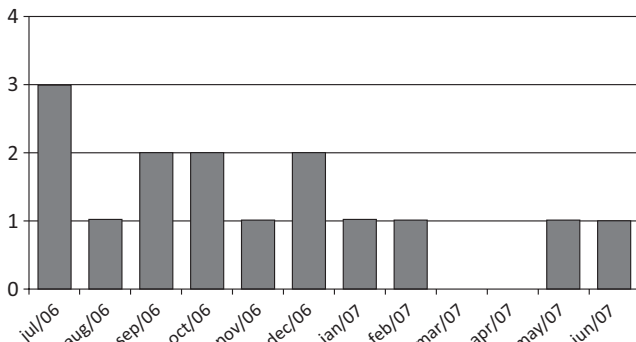


Figure 3. Distribution of data according to pre-term newborns were intubated and placed on mechanical ventilation and developed the bronchopulmonary dysplasia. Fortaleza-CE, Brazil.

It was also demonstrated that 100% (n=15) of the sample of preterm newborns who were in the in MV and developed BPD were in the ventilation mode of intermittent mandatory ventilation (IMV).

According to the data collected, 66.66% (n=10) of mothers of preterm newborns and who developed BPD had caesarean sections and 33.33% (n=5) normal deliveries. Regarding the gender of PTNB that were part of the sample, 53.33% (n=8) were boys and 46.66% (n=7) were girls.

The average of gestational age (GA) was 28.6 (± 4.23) in a range from 21 to 36 weeks, whereas there was a birth weight range 465-2490g, an average of 1125.33 (± 552.01) g (Table 1).

Table 1 – Distribution of data by values the gestational age and birth weight in pre-term newborns. Fortaleza-CE, Brazil.

	Nº	Minimum	Maximum	Mean	Standard Deviation
GA	15	21	36	28.6	± 4.23
Birth weight range	15	465g	2490g	1125.33g	± 552.01g

The sample consisted of 60% (n=9) newborns who had birth weight below 1000g, showing an extremely preterm, 20% (n=3) newborns with very low birth weight, or birth weight less than 1500g and 20% (n=3), low weight, characterized with a birth weight below 2500g (Figure 4).

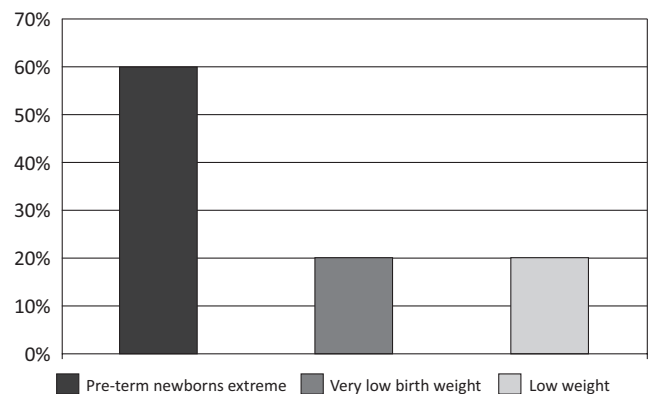


Figure 4. Distribution of the sample according to the classification do birth weight. Fortaleza-CE, Brazil.

Preterm infants who went to MV and who developed BPD, 86.6% (n=13) had primary disease and the respiratory distress syndrome (RDS), 40% (n=6) sepsis, 13.3% (n=2) neonatal infection and 33.33% (n=5) had jaundice (Figure 5).

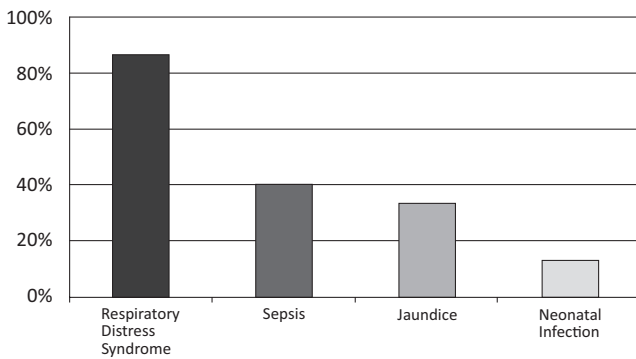


Figure 5. Distribution of the sample according to the primary disease among pre-term newborns. Fortaleza-CE, Brazil.

Regarding the survival rate, about 66.66% (n=10) who had BPD of PN survived and 33.33% (n=5) died.

DISCUSSION

The incidence of BPD is estimated at 4% to 40%, reaching values of up to 83% in newborns with birth weight below 1000 g and requiring mechanical ventilation for longer than two weeks¹². This can be explained by the heterogeneity of the populations studied, the type of care provided to newborns or the diagnostic criteria used¹⁷.

According to Jardim and Filho⁸, the exact etiological mechanism that leads to BPD is not well established. BPD is the result of the action of multiple factors on an immature pulmonary system, which depends on the defense mechanism, the nature of the lesion and the appropriate response of the PTNB to the harmful process.

The effects of MV in reducing the occurrence of BPD remain controversial despite in recent years it has reduced the mortality with the development of new therapies¹⁸. However, the incidence of BPD is increased when invasive forms of ventilation are used, such as intermittent mechanical ventilation¹⁹.

According to Carvalho *et al.*²⁰ intermittent mandatory ventilation is the most commonly used ventilatory mode in patients diagnosed with BPD. Ammari *et al.*²¹ reported a very low incidence of BPD in infants who were initiated and maintained on nasal continuous positive airway pressure (CPAP) from the moment of birth even when extremely premature, Meneses, Bhandari and Alves²², add that the noninvasive ventilation has been increasingly used as a strategy to minimize or avoid MV in an attempt to decrease the incidence of BPD.

Then our results were confirmed by Cunha, Mezzacappa and Ribeiro²³ who adds that the gestational age and birth weight were inversely proportional to the incidence of BPD. It is estimated that after 31 weeks of GA, for each

decreasingly week, the chance of BPD increases by approximately two times²⁴. Once developed the disease, the newborn required longer periods of ventilatory support and hospitalization, with inadequate weight gain and higher mortality rates than infants without BPD.

Cunha, Mezzacappa and Ribeiro²³ found an incidence of BPD from 26.6% in the evaluation of 124 children with birth weight below 1500 g who survived 28 days of life between the years 2000 and 2002.

The collected data were confirmed by Gonzaga *et al.*²⁵ who reported that the possibility of a PTNB with birth weight <1500 g develop BPD was 11 times higher than those who remained on MV for 14 days and this further increased the chance that were ventilated for more than 15 days and the team that provides care to patients at high risk of extubation be committed to newborns during their first week of life.

The results can be confirmed by Carvalho *et al.*²⁰, who affirm that BPD is more commonly observed after treatment of RDS in which there is need for MV with high concentrations of oxygen in the inspired gas.

Pursey *et al.* 1969 apud Monte *et al.*⁴, states that the diffuse lung disorders are related to prolonged MV in PTNB with lung disease of various etiologies including those who do not have RDS, suggesting that this was not necessarily a forerunner to BPD.

Through the results of this study, it can be seen at the end, that the remarks made earlier by the authors in the references came to support our results.

It can be seen through this study that BPD is practically a complication of MV, since its main cause is prematurity, oxygen toxicity, barotrauma, pulmonary edema, pulmonary infection, inflammation, malnutrition and increased airway resistance.

The correct indication and appropriate management of mechanical ventilation are important tools in supporting the premature newborn. However, mechanical ventilation is not without adverse effects and may cause lung damage, with consequences on the outcome of these patients. Thus, one should seek to reduce the time of ventilation in order to reduce lung injury and preventing BPD in hospitalized premature babies in neonatal intensive care units²⁶.

Preventive measures must be taken to reduce the incidence of this pathology. The prevention of BPD, according to Jardim and Filho⁸, has been investigated extensively over time, but has not yet been defined a scheme capable to reduce significantly the disorder. Probably this is a consequence of this multifactorial disease, is unlikely to prevent them from a single approach, as has been shown to most studies.

Bronchopulmonary dysplasia is a complex disorder and remains the most common complication of PTNB²⁷. Considering the success of prevention and treatment

of respiratory complications, as result of physiotherapy assistance, the physiotherapist is recognized as an indispensable member of multi-professional team, neonatal physiotherapy can cause positive impact on treatment of premature neonates of low birth weight, contributing to minimize the complications, especially of the respiratory type. Moreover, it can reduce hospital stay and ameliorate the neonate morbidity¹².

On the Physical Therapist, Pneumologist, and Pediatrician's perspective, children with BPD that reach teenage and adult age are a new group of patients that require greater attention and care, through special programs, aiming smoking prevention, the incentive of regular sport practice, and with structured programs of pulmonary rehabilitation and regular clinical follow-up²⁸.

It has been detected that the incidence of BPD in pre-term infants who required MV was low this year of research. The study was limited to analysis of BPD in preterm infants on

a single public hospital in the city of Fortaleza/CE, even so, it is emphasized that the initial purpose of this descriptive and retrospective study was reached.

CONCLUSION

We can conclude that bronchopulmonary dysplasia is a complication in premature infants and is directly related to the time of mechanical ventilation, it was observed in this study that most preterm infants were boys, were born by cesarean delivery, were extreme preterm, had primary disease such as the respiratory distress syndrome, all (100%) used as the IMV ventilation mode and evolved bronchopulmonary dysplasia while 33.33% died.

The team that provides care for patients at high risk must be committed to weaning and extubation of neonates as soon as possible.

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