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Outcome and characteristics of infants with acute viral bronchiolitis submitted to mechanical ventilation in a Brazilian pediatric intensive care

Evolução e característica de lactantes com bronquiolite viral aguda submetidos à ventilação mecânica em uma unidade de terapia intensiva pediátrica brasileira

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Received from: Pediatric Department, School of Medicine at Pontificia Universidade Católica do Rio Grande do Sul - PUCRS - Porto Alegre (RS), Brazil and Pediatric Intensive Care Unit at Hospital São Lucas, Pontificia Universidade Católica do Rio Grande do Sul - PUCRS - Porto Alegre (RS), Brazil.

The above authors declare that they do not have any potential conflict of interest in this study. This research was partially supported by the Brazilian Research Council (CNPq).
The present study was approved by the Ethics Research Committee at PUCRS – University (CEP-06/03068).

Submetido em 17 de Abril de 2009
Aceito em 29 de Maio de 2009

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ABSTRACT

Objective: To describe the characteristics and the outcome of infants with acute viral bronchiolitis submitted to mechanical ventilation.

Methods: We performed a retrospective study enrolling all infants (less than 12 months old) admitted with the diagnosis of acute viral bronchiolitis and submitted to mechanical ventilation in an university affiliated Brazilian pediatric intensive care unit between March, 2004 and September, 2006 (3 consecutives winters). The mechanical ventilation parameters' employed on 1st, 2nd, 3rd, 7th day and before extubation were evaluated as well as the evolution (mortality rate, presence of acute respiratory distress syndrome and the prevalence of complications). The groups were compared using the Student t test, the Mann-Whitney U test and the Chi-square test.

Results: Fifty-nine infants were included (3.8 ± 2.7 months old, 59% male), with 9.0 ± 9.4 days on mechanical ventilation. Prior mechanical ventilation, non invasive ventilation was instituted in 71% of children. Anemia was observed in 78% of the sample. In 51 infants (86.5%) the lower airway obstructive pattern was maintained up to tracheal extubation with a nil mortality and low prevalence of pneumothorax (7.8%). Acute respiratory distress syndrome occurred in 8 infants (13.5%), with higher mortality and a higher prevalence of pneumothorax (62.5%).

Conclusions: The declining mortality in acute viral bronchiolitis is observed even in non developed regions, involving children with high rates of anemia and premature labor. The low mortality is associated with the maintenance of the lower airway obstructive pattern during the period on mechanical ventilation. The development of acute respiratory distress syndrome is associated with increased mortality and higher prevalence of complications, representing the actual challenge in the management of children with severe acute viral bronchiolitis.

Keywords: Bronchiolitis, viral/therapy; Respiration, artificial; Intubation, intratracheal; Acute respiratory distress syndrome

INTRODUCTION

Acute viral bronchiolitis (AVB) is the most frequent lower airway infection in the first two years of life. The disease is much more severe in young infants, premature newborns and in children with underlying diseases such as bronchopulmonary dysplasia, immunodeficiencies and congenital heart defects.[1-8] AVB has a seasonal pattern, predominating in the autumn and winter seasons.[5-7,9] The respiratory syncytial virus (RSV) is the main etiological agent being followed by adenovirus, parainfluenza, influenza, rhinovirus, metapneumovirus, coronavirus and mycoplasma.[1,9-13]

Despite of the medical advances, the rate of hospitalization in children with AVB has increased during lasts years.[5,6,13] Between 1 and 3% of the infants with AVB are hospitalized and up to 15% of them are admitted to the pediatric intensive care unit (PICU).[2,5,13,14] In the last decade the non invasive ventilation (NIV) as well as the continuous positive airway pressure (CPAP) applied either by nasal prongs or through facial mask have been increasingly used in young children with AVB.[15-18] Some studies demonstrated that mechanical ventilation (MV) could be substantially reduced when CPAP or NIV are offered to infants with severe AVB.[18] However this possible benefit is still matter of debate in consequence of the paucity of well designed randomized studies as well as the non uniform indications for mechanical ventilation in the different parts of the world.[2,7,9, 13 -21] Nevertheless MV is still provided to 1% to 15% of the hospitalized children with AVB being higher among infants with cardiac or chronic respiratory diseases.[2,16-28] The mortality rate in children with AVB submitted to MV ranges between 1 and 7%, as well as is associated with high rate of complications (pneumothorax, secondary lung infection, sepsis, progressive respiratory failure and multiple organ failure).[9,14,18-20,24,25,28]

Typically, AVB presents as a lower airway obstructive lung disease (hyperinflation, wheezing and respiratory distress). However few patients might develop a restrictive lung disease pattern compatible with acute respiratory distress syndrome (ARDS), that has higher mortality and a higher prevalence of complications.[13,26,29-31]

Most of studies describing the outcome of children with AVB on mechanical ventilation are based on European and/or North American reports.[9,18,20,22,23,32,33] To our knowledge there are no published studies conducted in Latin America describing the outcome and the pattern of MV provided to infants with AVB. We hypothesize that the outcome of Latin-American children with AVB submitted to MV would be affected by some typical aspects of this region (e.g.: high prevalence of anemia and low numbers of pediatric intensive care beds available, which delays and restricts children admission to the PICU).[34] The purpose this study was to evaluate the evolution of infants with AVB and submitted to MV in one referral Brazilian PICU, describing the characteristics (parameters) of MV and relating it to the outcome (survival, ARDS, complications) and to the age.

METHODS

A retrospective observational study was conducted including all infants (less than 12 months old), admitted to the PICU at Hospital São Lucas from Pontificia Universidade Católica do Rio Grande do Sul (PUCRS) - Brazil, with the diagnosis of AVB and submitted to MV between March 1, 2004 and September 30, 2006 (covering three consecutive winters). The study was approved by the Ethics and Research Committee at PUCRS.

This university affiliated PICU is located in Porto Alegre (southern region of Brazil) and has 12 beds, with an average annual admission of 450 patients (0 to 15 years old), 55% of them are submitted to MV and the general mortality rate ranges between 7 and 9%. It is a referral PICU for medical and surgical diseases including advanced programs of kidney transplant, neurosurgery and cardiac surgery.

Children with severe AVB not responding to oxygen delivered by mask or nasal prongs are submitted to nasal CPAP (pressure up to 10 cmH_2O) or bi-level non-invasive ventilation (5 and 10 to 15 cmH_2O). MV support is indicated at the discretion of the PICU medical staff and is based on the lack of response to CPAP or NIV as well as on clinical aspects (apnea, severe respiratory distress, refractory hypoxemia). The patients are ventilated preferably in the controlled pressure mode, with synchronized intermittent mandatory ventilation plus pressure support using the Siemens Servo I or Siemens Servo 300 ventilators.

Infants (less than one year old) on MV with a clinical diagnosis of AVB defined by the first episode of wheezing associated with the presence of signs and symptoms of acute viral infection and signs of respiratory distress were included. All children included in this study, had samples of nasopharyngeal secretions collected to perform direct immunofluorescence test to identify the most common virus (*Respiratory Syncytial Virus*, *Adenovirus*, *Parainfluenza* and *Influenza*).

We excluded children with previous tracheostomy, chronic pulmonary disease (eg.: bronchopulmonar dysplasia, confirmed or possible diagnosis of cystic fibrosis) oxygen-dependent patients, severely compromised central nervous system and a prior history of MV beyond the neonatal period.

A single researcher (FB) reviewed the medical charts and collected all data selected for this study: age, weight, length of stay in the PICU, main indication for MV, length of MV, outcome in the 48 hours after extubation, PICU outcome (survival or death), the etiological virus agent, associated diagnosis with bronchiolitis, medication used before start MV (antibiotics, corticosteroids, nebulizations with ß2-agonist), transfusions performed throughout the PICU stay, moment of the first blood transfusion and hemoglobin level at that time. In this

study anemia was defined as hemoglobin serum levels below than 10 g/dl.

In this PICU every patient submitted to MV has a specific flow sheet where the MV settings are reported. Every change in the MV parameters is reported in this flow sheet with the respective time. Some of these MV parameter's (peak inspiratory pressure (PIP), positive end-expiratory pressure (PEEP), fraction of inspired oxygen (FiO_2) and respiratory rate (RR)) were evaluated sequentially: at the end of the first 6 hours on MV, at 2nd, 3rd and 7th days and 6 hours before tracheal extubation. The higher values reported during the specific day were included in the study.

Two researchers (FB and JP) evaluated independently the medical charts and the chest x-ray looking for the clinical evolution of the lung disease. It was necessary 100% of agreement to classify the children in two groups: a) Obstructive group - children that maintained the lower airway obstructive pattern up to tracheal extubation. The inclusion criteria were: signs of lung hyperinflation in all chest x-ray up to the extubation and MV with a FiO_2 equal or inferior to 60%; b) ARDS group - children that presented the arterial oxygen partial pressure(PaO_2)/FiO_2 ratio below 200 mmHg, with a diffuse pulmonary infiltrate without hyperinflation in the chest x-ray and absence of cardiogenic pulmonary edema (or fluid lung overload).[9,13,26,29,33]

Statistical analysis: The continuous variables were expressed by means with the respective standard deviation and were compared using the Student t test (when demonstrate normal distribution) or the U Mann-Whitney test for asymmetrical distribution. Categorical variables were expressed as percentage and were compared with the Chi-square test or exact Fisher test.

RESULTS

During the 30 months of the study (covering three consecutive winters), 1204 children were admitted to the PICU, being 59 infants (less than one year old) with AVB submitted to MV (4.9% of all PICU admissions and 9.2% of patients on MV). The mean time on MV was 9.0 ± 9.4 days, with a median of 12 days in the PICU. The mean age was 3.8 ± 2.7 months old, the mean weight was 5.5 ± 2.2 kg and 59% of them were male. Prior MV, NIV or nasal CPAP were instituted in 71% of children (Table 1). The causes for indicating MV were: fatigue (73%), hypoxemia (15 %) and apnea (12%). There wasn't any indication of MV due to cardiorespiratory arrest. RSV was the main etiological agent (69.5%) followed by parainfluenza (20%) and adenovirus (5%).

Transfusion with packed red cells was indicated in 46 children (78%) during the MV support, being the hemoglobin levels before transfusion of 7.5 ± 1.0 g/dL. The initial transfusion of packed red cells occurred at 4.0 ± 4.3 days of MV with an average of 16.5 ±10.8 ml/kg per patient.

The mortality rate in this series was 6.8% (4/59). In the survival group (55 patients), the extubation failure was observed in 4 patients (7.3%), being fatigue the main reason for reinstitution the MV in the first 48 hours after tracheal tube withdrawn. The mean age in the extubation failure group was 3.8 ± 2.8 months (versus 3.7 ± 2.7 months in the "extubation success" group; p= 0.97).

Table 1 - Characteristics of 59 children with acute viral bronchiolitis submitted to mechanical ventilation

	Infants with AVB on MV (N=59)
Male	35 (59)
Age (months)	3.8 ± 2.7
Weight (kg)	5.5 ± 2.2
Prior use of corticosteroids	23 (39)
Prior use of β2-agonist	44 (74.5)
Prior use of antibiotics	29 (49)
Prior use of NIV/Nasal CPAP	42 (71)
Main reason for MV	
Fatigue	43 (73)
Apnea	7 (12)
Persistent low arterial saturation	9 (15)
Virus	
Negative	9 (15)
RSV	41 (69.5)
Parainfluenza	12 (20)
Adenovirus	3 (5)
Influenza	1 (1.7)
Transfusion of red packed cells	46 (78)
Pneumothorax	9 (15)
ARDS	8 (13.5)
Deaths	4 (6.7)

AVB - acute viral bronchiolitis; NIV - non invasive ventilation (delivered by face mask); Nasal CPAP - continuous positive airway pressure (delivered by nasal prongs); ARDS - acute respiratory distress syndrome; RSV - *Respiratory Syncytial Virus*; MV - mechanical ventilation. Results are expressed as N (%) or mean ± standard deviation.

In 51 infants (86.5%) the lower airway obstructive pattern was maintained during all the time they were submitted to MV (obstructive group), without any deaths in this group. On the other hand, there were 8 infants (13.5%) that developed acute respiratory distress

syndrome between the 3rd and 7th day of MV (ARDS group), and the four deaths occurred in this group.

In the obstructive group, 42 infants (82.3%) had a positive virology result being the RSV the most frequent agent (88%). Children with positive and negative virology had no differences regarding demographic characteristics, treatment or outcomes; being analyzed as a unique group. Stratifying the 51 infants of the obstructive group according to their age (older and younger than three months old), we observed that the younger infants stayed longer time in the PICU (p= 0.039), but without differences regarding the length on MV. Fatigue was the main reason for indicating MV in both groups of age; nevertheless apnea was identified just in young infants (20%). The prevalence of RSV, prematurity, cardiac disease, prior treatment with NIV or nasal CPAP and incidence of pneumothorax or extubation failure was the same in younger and older infants (Table 2).

The peak inspiratory pressure (PIP) in the obstructive group remained close to 30 cmH_2O during days 1,2,3,7 and even on the extubation day, without difference between the younger and older infants. The only difference occurred on the first 6 hours of MV, when infants older than 3 months used slight higher PIP (32.3 ± 3.9 cmH_2O *versus* 30.2 ± 3 cmH_2O; p= 0.032). In figure 1 it is shown that the groups did not present differences regarding the FiO_2 levels (which remained constant between 0.3 and 0.4), the respiratory rate, which varied from 16 to 20 rpm, with a mean of 11 rpm at the 6th hour before extubation, independent of age group analyzed.

The eight infants with AVB who developed ARDS (Table 3) were older than the 51 infants in the obstructive group (5.4 *versus* 3.6 months; p=0.01). Although the initial hemoglobin level was not different between the two groups on the day of the first transfusion, the ARDS group received, on average, a greater volume of packed red cells during MV (28.8 ± 9.9 ml/kg *versus* 13.9 ± 9.2 ml/kg; p<0.01). Compared to the obstructive group, the MV parameter's in the ARDS group were different just on the 7th day of MV, when presented higher PIP, PEEP, respiratory rate and FiO_2, as well as, higher prevalence of pneumothorax (62.5% *versus* 7.8%, p=0.001).

Table 2 - Comparison between young and older infants with acute viral bronchiolitis submitted to mechanical ventilation

	0 – 3 months (N=30)	Older than 3 months (N=21)	p Value
Weight (Kg)	4.5 ±1.5	6.9 ± 2.4	< 0.0001[a]
Age (months)	1.8 ± 1	6.1 ± 2.4	<0.0001[a]
Male	19 (63)	11 (52)	0.43[c]
PICU length of stay (days)	23.4 ± 56.4	10.3 ± 6.3	0.039[b]
Prior treatment with NIV/Nasal CPAP	19 (63.3)	17 (81.0)	0.29[d]
Cause of MV			
Fatigue	19 (63)	20 (95)	0.009[c]
Hypoxemia	5 (16.6)	1 (4.8)	0.38[d]
Apnea	6 (20)	0	-
MV length of time (days)	7.7 ± 4.4	6.7 ± 4.9	0.16[b]
Deaths	0	0	-
Extubation failure	2 (6.6)	2 (9.5)	1.00[d]
Virus			
Negative	5 (16)	4 (19)	1.00[d]
RSV	22 (73)	15 (71)	0.80[c]
Parainfluenza	5 (16)	2 (9.5)	0.68[d]
Adenovirus	1 (3.3)	1 (4.7)	1.00[d]
Influenza	1 (3,3)	0	-
Premature infants	10 (33)	7 (33)	1.00[c]
Congenital heart disease	2 (6.6)	1(4.8)	1.00[d]
Prior treatment			
Use of steroids	3 (10)	16 (76)	<0.0001[d]
Use of Beta2-agonists	16 (53)	21 (100)	-
Pneumothorax	2 (6.6)	2 (9.5)	1.00[d]

NIV - non invasive ventilation (delivered by face mask); Nasal CPAP - continuous positive airway pressure (delivered by nasal prongs); MV - mechanical ventilation; RSV - *Respiratory Syncytial Virus*; PICU - pediatric intensive care unit. Results are expressed as N (%) or mean ± standard deviation. [a] Student T test; [b] Mann-Whitney U test; [c] Chi-square test; [d] Exact Fisher test.

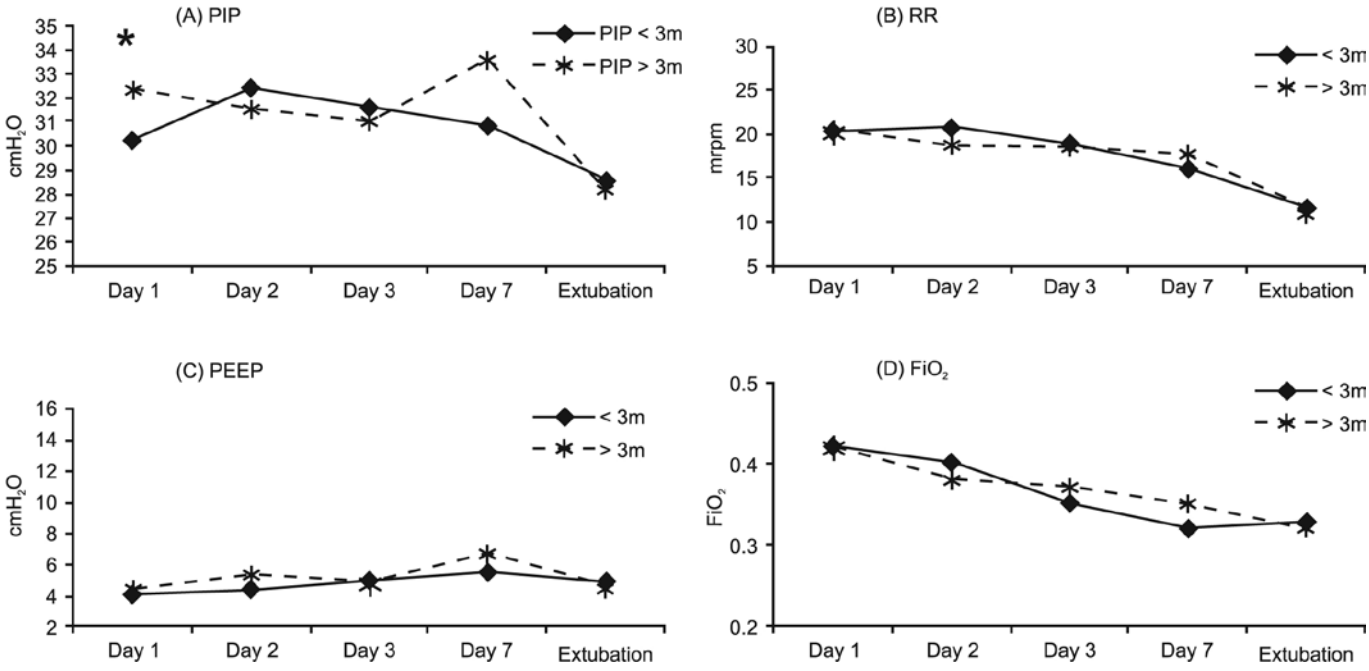

Figure 1 - Comparing old and young infants with acute viral bronchiolitis concerning the parameters of mechanical ventilation. The only difference was observed on the 1st day of mechanical ventilation when peak inspiratory pressure was higher in infants older than 3 months old (32.3 ± 3.9 cmH_2O vs 30.2 ± 3 cmH_2O; p=0.032).

Table 3 - Comparing infants admitted with acute viral bronchiolitis who developed acute respiratory distress syndrome (ARDS) to those infants that maintained the lower airway obstructive pattern (no ARDS)

	ARDS (N=8)	No ARDS (N=51)	p Value
Weight (Kg)	5.9 ± 2.1	5.5 ± 2.2	0.65[a]
Age (months)	5.4 ± 1.7	3.6 ± 2.8	0.01[b]
Male sex	5 (62.5)	30 (58.8)	1.00[c]
PICU Length of stay (days)	29.0 ± 23.7	18.0 ± 43.6	0.067[b]
Prior treatment with NIV/Nasal CPAP	6 (75)	36 (70.6)	1.00[c]
Cause of MV			
Fatigue	4 (50)	39 (76.4)	0.19[c]
Hypoxemia	3 (37.5)	6 (11.8)	0.09[c]
Apnea	1(12.5)	6 (11.8)	1.00[c]
Length of time on MV (days)	20.2 ± 20.6	7.3 ± 4.6	0.06[b]
Deaths	4 (50)	0	-
Virus			
Negative	0	9 (17.6)	-
RSV	4 (50)	37 (72.5)	0.23[c]
Parainfluenza	5(62.5)	7 (13.7)	0.006[c]
Adenovirus	1 (12.5)	2 (3.9)	0.36[c]
Influenza	0	1	-
Premature infants	4 (50)	17 (33.3)	0.43[c]
Infants with cardiac diseases	1 (12.5)	3 (5.9)	0.45[c]
Transfusion of packed red cells	8 (100)	38 (74.5)	-
ml/kg	28.8 ± 9.9	13.9 ± 9.2	<0.001[b]
Pneumothorax	5 (62.5)	4 (7.8)	0.001[c]

ARDS – acute respiratory distress syndrome; NIV - non invasive ventilation (delivered by face mask); Nasal CPAP - continuous positive airway pressure (delivered by nasal prongs); MV - mechanical ventilation; RSV - *Respiratory Syncytial Virus*; PICU - pediatric intensive care unit. Results are expressed as N (%) or mean ± standard deviation. [a] Student T test; [b] Mann-Whitney U test; [c] Chi-square test; [d] Exact Fisher test.

DISCUSSION

In the Southern of Brazil AVB occurs as epidemic outbreaks being one of the main reasons for PICU admission and MV support in infants (respectively 4.9% and 9.4% in this study). The magnitude of these numbers could be even higher, considering that in this study we didn't include children with AVB older than 12 months.

Aside the known public health problems in this region,[1,35] this group of infants with AVB on MV have unquestionable associated risk factors such as: high rate of anemia (78%) requiring blood transfusion, one third were preterm newborns and two thirds didn't respond to the prior treatment with CPAP or NIV.[3,4,7,13,18,21,22] Even considering such risks, it is appealing that the observed mortality during MV (6.7%) was similar what has been reported in developed countries.[13,20,22-25,27] More intriguing is that the mortality in infants with AVB on MV seems be strongly associated with the pulmonary pattern response. Our results demonstrate that a benign evolution with a nil mortality and low rate of complications is expected when the lower airway obstructive pattern is maintained during all course of MV. On the other hand, higher mortality and elevated rate of complications are concentrated on those cases that develop ARDS.

In the last few years several studies have demonstrated that CPAP/NIV could avoid MV in infants with severe AVB.[15-18,36-38] Unfortunately, the response to this treatment is unpredictable and a substantial number of infants with AVB still need be submitted to invasive MV. The ventilatory strategy in this group is based on the respiratory physiologic changes.[2,13,32,39] AVB affects preferentially lower airways with variable intensity. The inflammatory process cause non homogeneous obstruction, leading air trapping and lung hyperinflation. The high airway resistance prolongs the time constant, enlarging the length of time to empty and inflate the alveoli. The PIP should be sufficient to overcome the high airway resistance and be accomplished with a low respiratory rate to respect the prolonged inspiratory and expiratory times.[2,13,20,32,39,40]

Similarly to our results, several studies have reported PIP between 25 and 35 cmH_2O and respiratory rate lower than 30 rpm for ventilating infants with AVB.[20,36,39,40] In AVB, PIP could opening the obstructed lower airways (recruiting collapsed bronchioles), decreasing the FiO_2 needs.[2,36,39,40] On the other hand, as we demonstrated, levels of PIP close to 30 cmH_2O weren't associated with higher incidence of pneumothorax, even when ventilating young infants with AVB. As shown in other pulmonary obstructive diseases, the use of high PEEP doesn't avoid the lower airway obstruction neither the progressive alveolar hyperinflation.[41] Maintaining PIP close to these values, even in the weaning phase, possibly overcome both the thoracic wall resistance and airway resistance, delivering an adequate tidal volume.[2,13,20,36,39,40] We presume that the low rate of extubation failure in our study might be explained on the beneficial of this weaning strategy.

A small group of patients with AVB changes the natural course and progress to ARDS manifested by reduced pulmonary compliancy due to alveolar and interstitial involvement.[26] Similarly what was reported previously, we observed that 13.5% of children with AVB developed ARDS between the 3rd and 7th day of MV, with high rate of complications and elevated mortality. In such circumstances, the ventilatory strategy is based on high PEEP (proportional to the FiO_2 requirements), low PIP and low tidal volumes (to avoid alveolar hyperdistension). Nevertheless the mortality rate is still high oscillating between 30 and 50%.[26,30,31] Aside the protective ventilatory strategy, some other adjunct therapy should be better evaluated in this condition as: exogenous surfactant administration, support ventilation with high frequency oscillation, corticosteroids and other therapies.[13,14,29,38,42,43]

The ARDS pattern in children with AVB submitted to MV could be primarily associated with: a) The specific virus agent Influenza virus, rhinovirus and adenovirus have been associated with worst evolution and poor outcome;[1,7,10,11,13,19,21,23,24] b) Factors involved with the individual immune response have been associated with poor outcome (genetic predisposition, pro/anti-inflammatory imbalance response); [13,19,21,23,26] c) Ventilator-induced lung injury can´t be ruled as an isolated or associated factor with ARDS pattern in the course of MV in this group of children with AVB.[9,20,31,33] While we do not identify the exact mechanism causing ARDS in children with AVB we will not be able to offering the effective strategies to decrease the crude mortality in this challenge situation.

We are aware that we could have some bias in this retrospective study based on data extraction from single referral center and without the strict standardization to manipulate the respirator parameters. Another aspect that is inherent to the vast majority of studies evaluating MV relays on the subjective basis for indicating and withdrawing the MV.[2,9,13-18,26,33,36] In the present study, this aspect could be responsible for the excellent outcome observed in the group that maintained the lower obstructive pattern. However, when comparing with similar studies the other variables were quite similar (indications for MV, MV parameters, length of MV and lack of response to prior CPAP and NIV).[2,9,13-18,26,33,36] Consequently, even considering these

methodological aspects, we strongly believe that our results reflects the local reality as well as are quite comparable what has been reported in other regions of the planet.

CONCLUSION

We demonstrate that the declining mortality rate in AVB (between 1 and 7%)[13,20,22-25,27] is observed even in non developed regions, involving children with high rates of anemia and premature labor. Another important finding in this study is that the low mortality in children with AVB is associated with the maintenance of the lower airway obstructive pattern during the period on MV. On the contrary, those children that developed ARDS had an increased mortality rate and higher prevalence of complications, representing the actual challenge in the management of children admitted to the PICU with AVB.

RESUMO

Objetivo: Descrever as características e a evolução de lactantes com bronquiolite aguda submetidos à ventilação mecânica.

Métodos: Estudo retrospectivo desenvolvido entre março 2004 e setembro 2006 (três invernos consecutivos), recrutando todos os lactantes (menos de 12 meses de idade) com diagnóstico de bronquiolite viral aguda e submetidos à ventilação mecânica em uma unidade de terapia intensiva, brasileira, ligada a uma universidade. Os parâmetros de ventilação mecânica adotados no 1°, 2° 3° e 7° dia e antes da extubação foram avaliados, assim como a evolução (taxa de mortalidade, presença da síndrome de desconforto respiratório agudo) e prevalência de complicações. Os grupos foram comparados usando o teste t de Student, o teste U de Mann-Whitney e o teste Qui-Quadrado.

Resultados: Foram incluídos 59 lactantes ((3,8 ± 2,7 meses de idade, 59% de sexo masculino) com 9,0 ± 9,4 dias em ventilação mecânica. Antes da ventilação mecânica, ventilação não-invasiva foi instituída em 71% dos lactantes. Foi observada anemia em 78% da amostra. Em 51 lactantes (86,5%), o padrão obstrutivo de vias aéreas inferiores foi mantido até extubação intratraqueal, com mortalidade nula e baixa prevalência de pneumotórax (7,8%). A síndrome de desconforto respiratório agudo, ocorreu em 8 lactantes (13,5%) com mortalidade mais elevada e alta prevalência de pneumotórax (62,5%).

Conclusões: O declínio na mortalidade em crianças com bronquiolite viral aguda tem sido observado mesmo em regiões não desenvolvidas, com altas taxas de anemia e partos prematuros. A baixa mortalidade está associada à manutenção o padrão obstrutivo de vias aéreas inferiores durante o tempo em ventilação mecânica. O desenvolvimento da síndrome de desconforto respiratório agudo está associado a uma mortalidade mais elevada e maior porcentagem de complicações representando o desafia atual para o tratamento de crianças com bronquiolite viral aguda.

Descritores: Bronquiolite viral/terapia; Respiração artificial; Intubação intratraqueal; Síndrome do desconforto respiratório do adulto

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