



## Respiratory distress and ideal moment of orotracheal intubation

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### ABSTRACT

#### OBJECTIVE

Evaluate the respiratory distress of patients diagnosed with Acute Viral Bronchiolitis (AVB), using the Respiratory Discomfort Scale (Wood-Downes) - Ferrés and correlate the score of the Wood-Downes-Ferrés respiratory scale at the time of orotracheal intubation.

#### METHODS

This is an observational study with design and quantitative character. The assessment of respiratory distress was performed before the time of tracheal intubation using the Wood-Downes scale according to the modification made by Ferrés. The assessment was carried out through the sum of the items: assessment of wheezing, circulation, respiratory rate (RF), heart rate (HR), ventilation and cyanosis, already containing classification and final severity scores.

#### RESULTS

15 patients were included in the study. Of the patients included, 60% of the sample is female, with a mean age of 4.86 months. RSV etiology was observed in 40% of patients. Four patients included in the study were transferred to another service, due to the lack of pediatric intensive care at the Hospital Geral do Grajau, and it was not possible to collect data on their clinical evolution.

#### CONCLUSIONS

It is concluded that through the scale of respiratory distress (Wood-Downes) - Ferrés, it was possible to analyze the severity of acute respiratory failure in the patients analyzed in this study. It is necessary that a thorough assessment be made by all members of the multiprofessional team so that appropriate conduct is directed.

#### DESCRIPTORS

Bronchiolitis, Acute respiratory failure, Physiotherapy.

### RESUMO

#### OBJETIVO

Avaliar o desconforto respiratório dos pacientes com diagnóstico de Bronquiolite Viral Aguda (BVA), por meio da escala de desconforto respiratório (Wood-Downes) - Ferrés e correlacionar o escore da escala respiratório Wood-Downes-Ferrés no momento da intubação orotraqueal.

#### MÉTODOS

Trata-se de um estudo observacional com delineamento e caráter quantitativo. A avaliação de desconforto respiratório foi realizada antes do momento da intubação traqueal através da escala Wood-Downes de acordo com a modificação feita por Ferrés. A avaliação foi realizada através da somatória dos itens: avaliação de sibilos, tiragens, frequência respiratória (FR), frequência cardíaca (FC), ventilação e cianose, contendo já em sua formação classificação e escores finais de gravidade.

#### RESULTADOS

Foram incluídos no trabalho 15 pacientes. Dos 15 pacientes incluídos, 60% da amostra é do sexo feminino com média de idade de 4,86 meses. A etiologia por VSR foi observada em 40% dos pacientes. Quatro pacientes incluídos no trabalho foram transferidos para outro serviço, por indisponibilidade de assistência intensiva pediátrica no Hospital Geral do Grajau, não sendo possível coleta de dados da evolução clínica deles.

## CONCLUSÃO

Conclui-se que através da escala de desconforto respiratório (Wood-Downes) - Ferrés, foi possível analisar a gravidade da insuficiência respiratória aguda dos pacientes analisados neste estudo. É necessário que seja feita uma avaliação minuciosa por todos os componentes da equipe multiprofissional para que seja direcionado a conduta adequada.

## DESCRITORES

Bronquiolite, Insuficiência respiratória aguda, Fisioterapia.

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## INTRODUCTION

According to the Brazilian Society of Pediatrics (SBP), acute respiratory failure (ARF) is the main responsible for care in pediatric emergency and emergency services with a consequent need for hospitalization. Infants are more susceptible to developing ARF, due to their anatomical, physiological, and immunological characteristics and particularities as an example: the tongue is larger in relation to the oropharynx, thus filling a large part of the oral cavity, and its breathing is predominantly nasal until the sixth month of birth. Thus, pathologies that lead to nasal obstruction can cause significant respiratory distress and apnea crises in this age group<sup>1,2,5</sup>.

ARF is a clinical condition frequently observed in the pediatric population through clinical signs and symptoms, such as: increase respiratory rate (tachypnea), a varying degree of respiratory effort associated with an increase in respiratory rate (tachydyspnea), decreased respiratory rate (bradypnea) or even inspiratory pauses (apnea), head swing, wheezing, flapping of the nose, intercostal circulation, supra / sub sternal, supraclavicular, subcostal, contraction of the accessory muscles of breathing and the paradoxical movement of the abdomen<sup>2,3</sup>.

Acute Viral Bronchiolitis (AVB) is a viral infection of the lower airways, diagnosed before the age of two and is characterized by more severe conditions before the age of six months. It has a seasonal characteristic, with a higher prevalence in Brazil between the months of March to August<sup>3</sup>. Its most frequent etiology is the Respiratory Syncytial Virus (RSV), which can survive for several hours on the hands and in other places that could carry the virus. The viral excretion period is usually three to eight days, but it can last up to four weeks in young adults. The incubation period is usually four to six days. AVB may have other etiologic agents such as the parainfluenza virus, adenovirus, influenza, and rhinovirus. The most common means of transmission of the disease occurs through physical contact between healthy and infected infants and can be confirmed through laboratory tests with analysis of respiratory secretions<sup>4</sup>.

Viral infection causes edema in the bronchiole mucosa, which leads to a large amount of mucus and exudate in the lumen and infiltration of inflammatory cells.

The main consequence is airway obstruction, pulmonary hyperinflation, obstructive emphysema (result of partial obstruction) and areas of atelectasis<sup>5,6</sup>. There is evidence that RSV infection is associated with more severe respiratory conditions and ARF is among the most frequent causes of hospitalization and deaths in children under one year of age. Among these infants hospitalized, 5% to 15% required admission to the Pediatric Intensive Care Unit (PICU) and a reasonable proportion of invasive mechanical ventilation<sup>5</sup>.

The Wood-Downes-Ferrés respiratory distress scale is an assessment instrument validated in Brazil and used to assess signs of respiratory distress in a patient diagnosed with AVB, thus contributing to the direction of multiprofessional conduct and quality patient care, ensuring oxygenation and adequate ventilation, avoiding worsening of the clinical condition<sup>6</sup>.

In this context, the present study aimed to assess the respiratory distress of patients diagnosed with AVB, using the Respiratory Discomfort Scale (Wood-Downes) - Ferrés and correlate the score of the Wood-Downes-Ferrés respiratory scale at the time of orotracheal intubation. In the evaluation of the time of use of mechanical ventilation, in the choice of the cannula with the inflated cuff, in the success of extubation and in the main clinical outcomes.

## METHODS

This is an observational study with a quantitative design and character. The research was carried out at the General Hospital of Grajaú (GHG), located in the South Zone of the Municipality of São Paulo, with reference assistance in urgent and emergency care of medium and high complexity, with public-private administration and certified as a teaching hospital.

Patients who were admitted to the Children's Emergency Room (CER) from August to November 2019 were included, within the inclusion criteria after approval by the Ethics Committee of the University Santo Amaro by CAAE number 12649319.6.3001.5447.

Inclusion criteria were patients who entered the CER with a diagnostic hypothesis of AVB, with indication for tracheal intubation and were transferred to the Pediatric Intensive Care Unit, whose legal guardian signed the Free and Informed Consent Form and the Free Consent Form and Informed for use of medical records.

The exclusion criteria were patients who were admitted to the Children's Emergency Room in which the diagnosis hypothesis is not BVA, polytrauma patients, patients over the age of two years and those whose legal guardian did not authorize participation in the research.

The assessment of respiratory distress was performed before the moment of tracheal intubation using the Wood-Downes scale according to the modification made by Ferrés. The evaluation was carried out through the sum of the items: evaluation of wheezing, circulation, respiratory rate (RF), heart rate (HR), ventilation and cyanosis, already containing classification and final severity scores.

Wheezing was performed by the observer using the Littmann Classic II stethoscope. HR and RF monitoring were used by

pulse oximetry with the Dixtal DX 2022 device.

The respiratory discomfort assessment scale was used for each patient, an assessment form prepared by the author of the study, containing personal data, diagnostic hypothesis, previous history, vital signs, and ventilatory support used at the time of application of the scale.

Regarding the time of tracheal intubation, the following were collected: number of intubation attempts, number of cannulas used, presence or absence of a cuff, and whether the cuff remained inflated or deflated, complications during the procedure and description.

The patient was followed up after the tracheal intubation procedure until hospital discharge, except when transferred to another service because there were no vacancies in the pediatric ICU at that time. Data were collected through electronic medical records related to the patient's clinical evolution, such as: need and reason for cannula replacement, accidental extubation, need for reintubation, date of tracheal extubation, total days of tracheal intubation, failure or success during the tracheal extubation process.

## RESULTS

Fifteen patients were included in the study according to the inclusion criteria. The characterization of the sample is described in Table 1. Of the 15 patients included, 60% of the sample is female, with a mean age of 4.86 months. RSV etiology was observed in 40% of patients.

Table 1. Sample characterization.

Sample Characterization (n),%	
Genre	Female (n= 9),60%
Total (n=15) 100%	Male (n=6),40%
Mean age (months)	4,86 months
RSV positive etiology	(n=6), 40%
Patients transferred to another service	(n=4), 26,66%

RSV: respiratory syncytial virus.

The data collection from the moment before tracheal intubation is described in Table 2. The vital signs collected before tracheal intubation were peripheral oxygen saturation (SpO<sub>2</sub>), with an average of 86.06%, heart rate being 6.66% of patients classified as bradycardia and 20% as tachycardia and respiratory rate, 73.34% of patients classified as tachypneic.

The evaluation using the Wood-Downes-Ferrés respiratory distress scale classified 53.34% of the sample as severe, 40% as moderate and 6.66% as mild in the first physiotherapeutic evaluation of the patient before indication for tracheal intubation. At this time, all patients evaluated had non-invasive ventilatory support with nasal prong, as described in Table 2.

The data related to the moment of tracheal intubation are described in Table 3. The average number of attempts at intubation was 1.66. No patient had cardiorespiratory arrest during the tracheal intubation procedure. During this procedure, 46.67% of the patients used positive pressure ventilation via a silicone resuscitator with an average use time of 9.28 minutes.

The 4.0 mm tracheal cannula was used in 60% of patients. Ten patients used tracheal cannulas without cuffs. The cuffed tracheal tubes (5 patients) were kept deflated in all of them. There were no injuries related to the tracheal intubation procedure, such as dental injury, oral cavity injury and mucosal bleeding, as described in Table 3.

Table 2. Pre-tracheal evaluation.

Pre Tracheal Intubation Assessment (mean, n,%)	
Average peripheral oxygen saturation (SpO <sub>2</sub> )%	86,06%
Heart rate (n = 15), 100%	Bradycardia (n = 1), 6.66% Normocardial (n = 11), 73.34% Tachycardia (n = 3), 20%
Respiratory rate (n = 15), 100%	<30ipm (n=0), 0% 31-45ipm (n=2), 13,33% 45-60ipm (n=2), 13,33% >60ipm (n=11), 73,34%
Classification of discomfort using the Wood-Downes Scale - Ferrés (n = 15), 100%	Light (1-3) points: (n = 1), 6.6% Moderate (4-7) points: (n = 6), 40% Severe (8-14) points: (n = 8), 53.34%
Ventilatory support (n = 15), 100%	Ambient air (n = 0), 0% Oxygen therapy (n = 0), 0% NIV via nasal prong (n = 15), 100%

NIV: Non-invasive ventilation.

Table 3. Data related to tracheal intubation.

Data related to tracheal intubation	
Average number of attempts at tracheal intubation	1.66 attempts
Positive pressure ventilation device before tracheal intubation (n = 15), 100%	Silicone resuscitator: (n = 7), 46.67%
Average time of device use by positive pressure before tracheal intubation (minutes)	9,28 minutes
Tracheal cannula size (n = 15), 100%	Number 3.5 mm: (n = 5), 33.34% Number 4.0 mm: (n = 9), 60% Number 4.5 mm: (n = 1), 6.67%
Presence of cuff in tracheal tube (n = 15), 100%	Yes (n = 5), 33.33% No (n = 10), 66.67%
Cannula with Cuff (n = 5), 100%	Insufflated (n = 0), 0% Deflated (n = 5), 100%

NIV: Non-invasive ventilation.

The description of the use of invasive mechanical ventilation is shown in Table 4. The parameters of the mechanical ventilation were collected immediately after tracheal intubation. The means of fraction inhaled oxygen (FiO<sub>2</sub>), inspiratory pressure (Pinsp) and positive expiratory pressure (Peep) used were 78%, 16.2 cmH<sub>2</sub>O and 7.26 cmH<sub>2</sub>O respectively.

Four patients were transferred to other services due to the lack of pediatric intensive care at the General Hospital of Grajaú. Thus, of the 15 patients collected, eleven patients were followed up and had their clinical outcomes observed.

The mean time of mechanical ventilation was 4.36 days, and all patients (100%) underwent spontaneous breathing tests with supportive pressure. Nine patients used intravenous corticosteroids before tracheal extubation for an average of 1.4 days. After tracheal extubation, 4 patients (36.36%) presented extubation failure, as described in Table 4.

**Table 4.** Characteristics of the use of Invasive Mechanical Ventilation, Conducting Spontaneous Breathing Test.

Data related to tracheal intubation	
Average number of attempts at tracheal intubation	1.66 attempts
Positive pressure ventilation device before tracheal intubation (n = 15), 100%	Silicone resuscitator: (n = 7), 46.67%
Average time of device use by positive pressure before tracheal intubation (minutes)	9,28 minutes
Tracheal cannula size (n = 15), 100%	Number 3.5 mm: (n = 5), 33.34% Number 4.0 mm: (n = 9), 60% Number 4.5 mm: (n = 1), 6.67%
Presence of cuff in tracheal tube (n = 15), 100%	Yes (n = 5), 33.33% No (n = 10), 66.67%
Cannula with Cuff (n = 5), 100%	Insufflated (n = 0), 0% Deflated (n = 5), 100%

NIV: Non-invasive ventilation.

## DISCUSSION

Respiratory infections in pediatrics are responsible for a high number of visits to emergency services and hospitalizations. AVB is the main cause of hospitalization in the Intensive Care Unit, with RSV being its main etiological agent. These data corroborate with data presented in this study, in which 40% of the sample with a positive RSV etiology was observed<sup>11,13</sup>.

A study by Andres et al, in 2012 showed that most patients diagnosed with AVB are male. These data are inconsistent with the findings of this study, in which 60% of the sample was female<sup>1,5,8</sup>.

Regarding age, Kfoury et al, in 2017 and Tumba et al, in 2018, observed that patients under 6 months of age diagnosed with AVB and positive RSV etiology, present more severe clinical conditions. Ferlini et al 2016 concluded in their study that children not breastfed with breast milk and of low socioeconomic status are risk factors for AVB. These data corroborate the findings of this study, in which the mean age of the patients was 4.86 months and 53.33% of the patients were classified as severe in the moment before tracheal intubation using the Wood-Downes-Ferrés1 respiratory distress scale<sup>4,8,12,13</sup>.

Regarding the data collected in the moment before tracheal intubation, the average peripheral oxygen saturation (SpO<sub>2</sub>) by pulse oximetry was 86.06%, describing the severity of the studied sample. Twenty percent of the patients presented tachycardia, which can be correlated with the severity and respiratory distress scale of the patients studied. Respiratory discomfort imposes cardiac overload and increased heart rate to maintain vital functions<sup>4,11</sup>.

The classification of the sample in relation to the Wood-Downes-Ferrés scale score, 53.33% of the patients were classified as severe and 100% of them were on non-invasive ventilatory support via nasal prong at the time of the evaluation. Studies by Morosini et al 2018 and Piva et al 2008 show conflicting data regarding the indication for the use of non-invasive ventilation (NIV) in patients diagnosed with acute viral bronchiolitis despite being widely used in clinical practice. In this study, patients were assessed only before tracheal intubation and not when non-invasive ventilation (NIV) was installed. Some studies suggest that the early use of NIV avoids the use of invasive mechanical ventilation and possible clinical complications<sup>9,10,15</sup>.

A study carried out in 2012 concluded that the early restoration of oxygenation and ventilation in patients with ARF is directly related to their better clinical evolution. Efficient

restoration of oxygenation and pulmonary ventilation can be performed via a silicone resuscitator or NIV. In this study 53.33% of patients used positive pressure ventilation via a silicone resuscitator with an average duration of 8.37 minutes, of which about 62.50% had severe respiratory distress during the procedure and 37.5% moderate respiratory distress. The average time of use of invasive mechanical ventilation was 4.36 days. When we analyzed the patients, who used silicone resuscitators in the pre-intubation moment, we observed that the average number of days in invasive mechanical ventilation was 3.83 days<sup>5</sup>.

Respiratory failure was the main cause of tracheal intubation in this study, with 53.33% of the sample classified as having severe respiratory distress according to the Wood-Downes-Ferrés scale score. In 2018, Cuesta et al assessed the respiratory distress of 100 patients diagnosed with acute viral bronchiolitis using the Wood-Downes-Ferrés scale. The evaluation was carried out in two moments: in the first evaluation, most patients were classified as having severe respiratory distress. After admission to the PICU, patients were coupled to NIV in CPAP mode (continuous positive airway pressure) and reassessed, with many patients classified as moderate respiratory distress. In 2012, Matsuno et al concluded that tachypnea associated with signs of respiratory distress are common findings in clinical cases of acute respiratory failure. These data corroborate the findings of this study, in which 73.34% of the sample had tachypnea, with severe cases associated with signs of respiratory distress<sup>5,6,17</sup>.

The ventilatory parameters used in patients diagnosed with AVB according to the Mechanical Ventilation Consensus published by Piva et al in 2011 are: Inspiratory Pressure (P<sub>insp</sub>) of 25 and 32cmH<sub>2</sub>O and positive expiratory pressure (Peep) of 4 to 6 cmH<sub>2</sub>O. In addition to the ventilatory parameters, the author concludes that AVB is a disease with great resistance of the lower airways, which would justify the use of high ventilatory parameters. In this study, the mean inspiratory pressure (P<sub>insp</sub>) and positive expiratory pressure (Peep) were 16.20 cmH<sub>2</sub>O and 7.4 cmH<sub>2</sub>O respectively and an inspired fraction of oxygen with an average of 76%. Ventilatory parameters were adjusted according to the ideal tidal volume calculated for everyone on their predicted body weight, maintaining from 4 to 6 ml / kg<sup>10</sup>.

A study by Ferlini et al, in 2016, evaluated the ventilatory parameters used in the admission of 66 patients with AVB to the Pediatric Intensive Care Unit. The results showed mean inspiratory pressure (P<sub>insp</sub>) of 32.1cmH<sub>2</sub>O, positive expiratory pressure (Peep) of 5.4cmH<sub>2</sub>O, fraction inhaled oxygen of 40% and tidal volume of 10 and 13mL / kg. These data are inconsistent with the data presented in this study, which can be justified by the sample size<sup>12</sup>.

Regarding extubation failure, the study by Ferlini et al in 2016 showed 9% of extubation failure in patients diagnosed with AVB. In this study, 4 patients (36.36%) had extubation failure. Of these 2 patients were classified as severe and 2 as moderate according to the Wood-Downes-Ferrés scale score. The four patients who presented extubation failure underwent spontaneous breathing test with support pressure. Thus, we can suggest that the performance of the spontaneous breathing tests in this sample was not a predictor of extubation success. Another interesting factor about patients with extubation failure was that the time of use of intravenous corticosteroids before being extubated was shorter (1 day), while patients classified as successful used this medication for 1.4 days<sup>7,12</sup>.

## CONCLUSION

This study concluded that patients with a diagnosis of acute viral bronchiolitis with a positive etiology for RSV and less than



6 months of age have a more severe clinical evolution. The Wood-Downes-Ferrés respiratory distress scale can be used by a qualified professional in clinical practice with the aim of assisting the multiprofessional team in directing conducts. We suggest carrying out future work on the topic with a larger sample size so that clinical practices are always based on scientific evidence.

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