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Evaluation of post-extubation breathing pattern and indication of practices in a pediatric ICU

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ABSTRACT

OBJECTIVE

To use the Wood-Downes Scale and the high discomfort score proposed by Downes & Raphaelly in the evaluation of the respiratory pattern and in the indication of oxygenation and/or ventilatory support devices after orotracheal extubation.

METHODS

This is a cross-sectional, descriptive and quantitative study. The group consisted of 15 infants aged 28 days to 2 years, admitted to the pediatric intensive care unit from August to October 2018 and who met the inclusion criteria, following the ethical aspects of the study.

RESULTS

Of the 15 infants in the sample, 66.66% were female. The mean age was 6.4 ± 6.27 months. The most common score on the Wood-Downes scale at the first moment was moderate, with a mean of 3.4 ± 1.91, changing to mild 1.6 ± 0.89 at the second moment. The high discomfort score at the first moment had a mean of 2.9 ± 1.62 decreasing to 1.7 ± 0.79 at the second moment.

CONCLUSIONS

The use of the Wood-Downes scale and the high discomfort score proposed by Downes & Raphaelly to evaluate the breathing pattern in the present study, proved to be effective in indicating non-invasive ventilatory support, due to the moderate score being the most common. Although the study did not interfere with medical practices, it is believed that the scales used are effective tools for the control and evaluation of acute respiratory failure after extubation of infants.

DESCRIPTORS

Mechanical ventilation. Extubation. Pediatrics. Physiotherapy.

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INTRODUCTION

The main causes of pediatric hospitalizations are respiratory diseases, corresponding to 40% of all diseases that affect children aged 0 to 5 years[1-4].

In a Pediatric Intensive Care Unit (PICU), a resource that is frequently used as ventilatory support is Invasive Mechanical Ventilation (IMV), which aims to maintain the alveolar ventilation of critically ill children until they present clinical and laboratory improvement and are able to resume breathing spontaneously[5-8].

Prolonged IMV in infants can increase the length of stay in the PICU. Thus, it is necessary to perform early ventilatory weaning (VW), while respecting the clinical characteristics. Prior to extubation, thorough assessments are required. The success of the procedure is considered when the patient remains without ventilatory support for 48 hours. After extubation, children may need non-invasive ventilatory support, as some patients only need oxygen therapy[5-12].

The use of a scale to evaluate the respiratory pattern and/or ABI after extubation aids in the best indication of the ventilatory support and/or oxygen therapy device. For the pediatric population, the most commonly used are the Tal scale, Taussing and Westley scale, Wood-Downes scale modified by Ferrés (WDF), and the high discomfort score proposed by Downes & Raphaelly.

The aim of the current study was to use the Wood-Downes-Ferrés respiratory distress scale, and the scale proposed by Downes & Raphaelly for high discomfort in the evaluation of respiratory pattern and indication of oxygenation and/or ventilatory support devices after orotracheal extubation (OTE).

METHODS

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

Fifteen patients admitted to the Pediatric Intensive Care Unit (PICU) from August to October 2018 were included, who met the inclusion criteria, after approval by the Ethics Committee of the University Santo Amaro and Hospital Geral do Grajaú by CAAE number 89411018.2.3001.5447 and Opinion Number: 2,799,735 on August 3, 2018.

Inclusion criteria were infants admitted to the PICU on invasive mechanical ventilation, submitted to a tracheal extubation procedure (OTE), and whose parents or legal guardians approved their participation in the study and signed the Free and Informed Consent Form (ICF) as well as the Informed Consent Form for the use of the medical records. Exclusion criteria were patients with clinical signs or a diagnosis of a neurological disease or syndrome, patients intubated for surgery without pulmonary/respiratory impairment, and patients whose legal guardian did not authorize participation in the study.

Patients were evaluated at two moments: immediately after and one hour after OTE. The data related to the patient's evolution were collected from their medical records, by the physiotherapist responsible for the research and/or by the physiotherapist responsible for the sector. The present research did not alter the evaluation routine or indication of practices in the unit by the multiprofessional team.

The data were collected, at both moments, using an evaluation form prepared by the author of the work. The vital signs of the patients included peripheral oxygen saturation, heart rate, respiratory rate, and mean arterial pressure and were collected using the pulse oximeter and cuff of the Dixtal 2022 monitor.

The respiratory pattern was assessed using two scales, translated, and validated for the Brazilian population. The Wood-Downes scale, according to the modification made by Ferrés, evaluates the following criteria: wheezing, circulation, respiratory rate (RR), heart rate (HR), ventilation, and cyanosis, classifying the patient in relation to the severity of respiratory distress. The classification is performed using the sum of points, generating a final score: mild (0-3 points), moderate (4-7 points), and severe (8-14 points).

The scale proposed by Downes & Raphaelly – the high discomfort score assesses the following criteria: inspiratory sounds, stridor, cough, retractions, nasal wing beat and cyanosis. The scale measures high respiratory distress and classifies the degree of discomfort through the score. The sum of points equal to zero is equivalent to the absence of discomfort; mild (1-3 points); moderate (4-6 points); and severe (≥ 7). The scores of the two scales used were obtained through direct observation of the patients and a Littmann Classic II stethoscope was used to perform pulmonary auscultation.

After applying the scales to assess respiratory distress, patients were classified as mild, moderate, or severe. According to this classification, the following ventilatory aid devices were suggested by the multidisciplinary team: mild discomfort: low and/or high flow devices (nebulization, nasal catheter, Venturi mask), moderate: noninvasive mechanical ventilation (NIMV), and severe: invasive mechanical ventilation (IMV).

The choice and indication of the ventilatory support used after OTE of the included patients was made by the multiprofessional team, so the research did not change the practices and routines performed in the PICU.

The data were treated individually, and numerical descriptive analyses were established.

RESULTS

The mean age of the 15 patients included was 6.4 ± 6.27 months, with a median of 4 (1 - 21) months. Ten patients (66.67%) were female. Regarding gestational age at birth, 9 patients (60%) were classified as term, with 13 patients (86.67%) born vaginally. The diagnostic hypothesis of 80% of the included patients (12 infants) was Acute Viral Bronchiolitis. The characterization of the sample is described in Table 1.

Table 1. Characterization of the Sample.

Characterization of the Sample (n), %	
Sex Total (n=15), 100%	Female (n= 10), 66.67% Male (n=5), 33.33%
Mean age (months)	6.4 months
Gestational age (n=15), 100%	Pre-term (n= 5), 33.33% Term (n= 9), 60% Post- term (n= 1), 6.67%
Type of birth (n=15), 100%	Vaginal (n=13), 86.6% Cesarean (n=2), 13.34%
Diagnostic hypothesis (n=15), 100%	AVB (n=12), 80% Pneumonia (n=1), 6.66% Bronchospasm (n=4), 26.67% Bronchopneumonia (n=4), 26.66% Wheezing infant (n=3), 20% Bronchopulmonary dysplasia (n=1), 6.66%

AVB: acute viral bronchiolitis.

Table 2 shows the results of the post tracheal extubation (OTE) evaluation of the 15 patients included in the study, at two moments: immediately after and one hour after OTE.

Regarding vital signs at the first moment, 12 patients (80%) were classified as tachypneic, 14 (93.34%) patients were clas-

sified as normocardial, 13 patients (86.67%) as hypertensive, and 80% of the sample had a peripheral oxygen saturation greater than or equal to 92%. At the second evaluation moment, 11 (73.34%) patients were classified as tachypneic, 15 (100%) as normocardial, 15 (100%) patients as hypertensive, and 73.34% of the sample had a peripheral oxygen saturation greater than or equal to 92%.

Table 2. Post-Tracheal Extubation Evaluation.

Post Tracheal Extubation Evaluation		
Variables analyzed	Immediately after OTE	One hour after OTE
Respiratory frequency (n=15), 100%	Bradipneic (n=1), 6.66% Normopneic (n=2), 13.34% Tachypneic (n=12), 80%	Bradipneic (n=1), 6.66% Normopneic (n=3), 20% Tachypneic (n=11), 73.34%
Heart rate (n=15), 100%	Bradicardiac (n=0), 0% Normocardiac (n=14), 93.34% Tachycardiac (n=1), 6.66%	Bradicardiac (n=0), 0% Normocardiac (n=15), 100% Tachycardiac (n=0), 0%
Mean Blood Pressure (n=15), 100%	Hypotensive (n=2), 13.33% Normotensive (n=0), % Hypertensive (n=13), 86.67%	Hypotensive (n=0), % Normotensive (n=0), % Hypertensive (n=15), 100%
Peripheral Oxygen Saturation (SpO2) (n=15), 100%	≥ 92% (n=12), 80% ≤92% (n=3), 20%	≥ 92% (n=11), 73.34% ≤92% (n=4), 26.66%

OTE: orotracheal extubation.

Table 3 illustrates the results of the evaluations using the respiratory distress scales. Initially, regarding the discomfort scale using the Wood-Downes-Ferrés Scale, 7 patients (46.66%) were classified as mild, 7 patients (46.66%) as moderate, and 1 (6.67%) as severe. At the same moment, regarding the scale proposed by Downes & Raphaelly – the high discomfort score - 14 patients (93.34%) were classified as mild and 1 (6.66%) as moderate.

At the second evaluation moment, regarding the discomfort scale using the Wood-Downes-Ferrés Scale, 8 patients (53.34%) were classified as mild and 7 (46.66%) as moderate. At the same moment, regarding the scale proposed by Downes & Raphaelly – the high discomfort score, 100% of the sample was classified as mild.

Table 3. Evaluation of respiratory distress after tracheal extubation.

Evaluation of respiratory distress after tracheal extubation		
Scale	Immediately after OTE	One hour after OTE
Classification of distress using the Wood-Downes-Ferrés scale (n= 15), 100%	Mild (1-3) points: (n=7), 46.67% Moderate (4-7) points: (n=7), 46.66% Severe (8-14) points: (n=1), 6.66%	Mild (1-3) points: (n=14), 93.34% Moderate (4-7) points: (n=1), 6.66% Severe(8-14) points: (n=0), 0%
Scale proposed by Downes & Raphaelly - high discomfort score	Mild (1-3) points: (n=8), 53.34% Moderate (4-7) points: (n=7), 46.66% Severe (8-14) points: (n=0), 0%	Mild (1-3) points: (n=15), 100% Moderate (4-7) points: (n=0), 0% Severe (8-14) points: (n=0), 0%

OTE: orotracheal extubation.

Data were collected related to the clinical characteristics of the patients included, as shown in Table 4. Eleven patients (73.34%) had a past history of hospitalization, and two (13.33%) of these required the use of an invasive mechanical ventilation device and had a record of failed previous extubation. Regarding the indication for tracheal intubation, 100% of the patients in the sample were intubated due to acute respiratory failure. Of the 15 patients included and evaluated in this study, 7 (46.66%) were classified as difficult intubation, with a mean number of days on mechanical ventilation of 4.8 ± 3.64 days, with a median of 4 (2 -16) days.

Table 4. Clinical Characteristics of the Sample.

Clinical Characteristics of the Sample	
Previous Hospitalization (n=15), 100%	Yes: (n=4), 26.66% No: (n=11), 73.34%
Previous Tracheal Intubation (n=15), 100%	Yes: (n=2), 13.33% No: (n=13), 86.67%
Failed Previous Tracheal Extubation (n=15), 100%	Yes: (n=2), 13.33% No: (n=13), 86.67%
Reason for current tracheal intubation (n=15), 100%	Acute breathing insufficiency: (n=15), 100%
Difficult tracheal intubation (n=15), 100%	Yes: (n=7), 46.66% No: (n=8), 53.34%
Mean days of Invasive Mechanical Ventilation	4.8 days

NIMV: noninvasive mechanical ventilation; IMV: invasive mechanical ventilation.

Table 5 describes the practices indicated by this study through the evaluation of the 15 patients and the practices performed by the multidisciplinary team after tracheal extubation. After the second moment of evaluation of the included patients, 14 (93.34%) patients were classified as mild, and the treatment indicated was oxygen therapy. Only one patient (6.66%) was classified as severe with indicated use of NIMV. Regarding the practices performed by the team, the 15 patients were connected to NIMV after the tracheal extubation procedure.

Table 5. Indicated vs. Performed Practice.

Indicated x Performed Practice after OTE	
Recommended practice (n=15), 100%	Mild (nebulization, nasal catheter, Venturi mask): (n=14), 93.34% Moderate (VMNI): (n=1), 6.66% Severe (IMV): (n=0), 0 %
Practice carried out by the Multidisciplinary Team (n=15), 100%	Mild (nebulization, nasal catheter, Venturi mask): (n=0), 0% Moderate (VMNI): (n=15), 100% Severe (IMV): (n=0), 0%

OTE: orotracheal extubation; NIMV: noninvasive mechanical ventilation; IMV: invasive mechanical ventilation.

DISCUSSION

Acute viral bronchiolitis is the leading cause of admission to pediatric intensive care units[15]. These data corroborate the data presented in the current study in which 80% of the patients in the sample were admitted with a diagnostic hypothesis of acute viral bronchiolitis and evolved to the need for the use of invasive mechanical ventilation.

The median age of the included patients was 4 (1 -23) months. Gomes et al in 2018 observed that patients diagnosed with AVB under 6 months of age are more likely to develop acute respiratory failure due to the physiological and anatomical characteristics of the respiratory system of this population[16].

Ten patients (66.67%) in the sample are female, disagreeing with the studies by Semple et al and Koehoorn et al who characterize male children as having a greater predisposition for the development of respiratory disorders[17,18]. Prematurity is a risk factor seven times higher for AVB due to positive RSV, in addition to a higher risk of hypoxemia and respiratory failure requiring mechanical ventilation[16]. Five patients (33.33%) were born before 37 complete weeks and 13 patients (86.67%) were born by vaginal delivery.

The respiratory rate assessment at the first moment identified 12 tachypneic patients (80%) and at the second moment, 11 patients (73.34%) classified in the same way. The tracheal extubation procedure is uncomfortable and painful and may justify the tachypnea of these patients even an hour after OTE. This sign is common in clinical respiratory conditions and should be monitored by a qualified team, especially when combined with signs of respiratory distress, such as nasal wing beat, expiratory groan, and runs[15].

Heart rate data collected showed 14 (93.34%) patients classified as normocardial at the first moment and 15 (100%) patients in the same way at the second moment. Through these data we can infer that the patients presented hemodynamic stability, corroborating the scores of the scales for assessing respiratory distress at the two evaluation moments, this being one of the prerequisites for evaluating OTE[15].

Only 1 patient was classified as severe using the Wood-Downes-Ferrés Scale at the first moment of evaluation. This evaluation can be justified due to the risk factors associated with the patient's individual clinical condition: age less than 6 months, current diagnosis of acute viral bronchiolitis due to positive RSV, previous hospital stay, and previous extubation failure[15,16,18].

The mean arterial pressure at both moments was collected and analyzed according to the patient's age and normative data according to the Brazilian Society of Pediatrics. Thus, 13 patients (86.67%) were hypertensive at the first moment and 15 (100%) patients were classified in this way at the second moment. Momentary arterial hypertension in patients can be justified by stressful and painful factors resulting from tracheal extubation[19].

The peripheral oxygen saturation observed at the first moment remained greater than or equal to 92% in 80% of the sample and in 73.34% of the sample at the second moment. These data corroborate the data collected on heart rate and the scores on both scales of respiratory distress. The combination of factors suggestive of normality demonstrates the low clinical severity of the assessed sample[15,19].

Another important factor in relation to the low severity of the sample was the fact that in the evaluation one hour after OTE, many patients were using ventilatory auxiliary devices, even without an indication according to the evaluation at the first moment. Some studies aimed to evaluate the use of NIMV prophylactically after OTE. The authors concluded that these devices do not prevent extubation failure and the need for reintubation and should not be used prophylactically[20].

The work of YAMAUCHI et al, in 2015, presents discordant results in relation to the use of NIMV prophylactically. The results showed the use of NIMV in three situations: 26% in cases of acute respiratory event, 10% in early ventilatory weaning, and 64% in prophylactic form, totaling 96%[14]. In this research 100% of the sample was submitted to the use of NIMV according to the multiprofessional practice, regardless of the classification of respiratory distress. The use of this device would be justified, according to the score of the evaluation scales, at the first moment in 46.67% of the sample and at the second moment in 6.66% of the sample.

CONCLUSION

Acute viral bronchiolitis is the most common respiratory disease in the pediatric population in an intensive hospital setting, especially in children under 6 months of age and female. We suggest that the Wood-Downes-Ferrés respiratory distress scales and that proposed by Downes & Raphaelly for high discomfort should be considered as auxiliary instruments for post-extubation evaluation and the practice of the multidisciplinary team.

We suggest further work be carried out with standardized methodology and a larger sample size, supporting the use, through scientific evidence, of evaluation instruments in clinical practice.

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