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# Noninvasive Ventilation Outside Critical Care Units for Children with Severe Low Respiratory Infection: Is it a Potential Strategy for Critically Ill Children in Uruguay?

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## Low Respiratory Infection

Acute lower respiratory tract infection remains as one of the first causes of infant death in several Latin American countries [1,2]. It also represents one of the first causes of admission in pediatric intensive care (ICU) units due to acute respiratory failure for developed and developing countries [3].

Children in this situation are provided mechanical ventilatory support and in some cases noninvasive ventilation (NIV) in a first stage during admission in the intensive care units [4].

Lack of pediatric intensive care resources to give response to the high demands in winter time appears as one of the main public health problems for the treatment of children with acute respiratory failure due to acute lower respiratory tract infection [3].

The study developed by Alonso et al. in 2012 has the objective to describe the results of applying noninvasive ventilation in a non-intensive care environment in children under two years with acute lower respiratory tract infection and analyze potential predictors of failure [5].

It was performed in the biggest pediatric public hospital in Montevideo, Uruguay during 2009 and 2010. It is a descriptive study with a prospective recruitment. Children under 2 years with lower respiratory tract infection and respiratory failure Tal score>8, or >6 and not responding to treatment were included. Children weighing <7 kg, unstable hemodynamics, neuro-psychic depression, pneumothorax, pneumo-mediastinum and/or mixed acidosis were excluded. NIV was applied in an area of moderate care outside intensive care units (combined with aspiration and administration of bronchodilator drugs according to requirements). A continuous monitoring of children was maintained and failure to INV was defined if no improvement or

Clinical deterioration despite using maximum parameters (PS 12 EPAP 10 FI02>0.6), severe hypercapnia (pCO2 ≥ 60) Glasgow ≤ 8; mechanical complications (pneumothorax, pneumomediastinum), hemodynamic instability or pH<7.20. In all these cases mechanical ventilatory support was applied.

NIV was successful in 151 of 185 children included (81.6%). No statistical differences in terms of age, weight and severity of disease at admission were identified between the group of children with treatment failure or success. After 2 hours respiratory frequency (RF) greater than 60 rpm, heart rate (HR) increased 140 cpm and support pressure (SP) greater to 9 were associated with failure ($p < 0.05$). Two children presented pneumothorax and one died.

Multivariate analysis showed that after 2 h the RF>60 rpm increase the risk of failure 6.4 times (CI 95 1.9 to 21.7), HR>140 cpm 4.3 (CI95 1.5 to 11.8) and SP>9 increased 8.7 times (CI95 2.3 to 32.2). Although increased heart rate appears as a potential predictive value it has to be taken with caution since it is unspecific.

We need to identify factors associated with success or failure of NIV having a predictive behavior to make decisions in a timely manner. The observed relationship between elevated heart rate at admission and 2 h with higher failure rate has limitations. The observed difference is not clinically significant and the majority of these patients receive multiple treatments which modify heart rate and variations could also be explained by hypoxemia and increased respiratory work. However, we emphasize that, as observed in other studies, the severity of respiratory work, particularly respiratory rate was an indicator of treatment failure with a more specific behavior [6,7].

This study has some methodological limitations that should be mention. The first one is absence of a control group that could provide unbiased comparisons of results. Another issue is limited sample size what could explain the broad confidence intervals that increase imprecision in the estimation of potential predictor factors of failure.

On the other hand, it is one of the very few studies performed in low-middle income countries regarding this type of health problem. Data collection was prospective avoiding limitation of retrospective studies based in records review.

The routine clinical application of NIV in critical lower respiratory tract infections management outside ICU requires further study but it appears as a promising strategy to optimize use of resource with good results. Future research should be directed to promote multicenter randomized clinical studies with appropriate sample sizes that could prove the benefit of promote NIV outside ICU for selected critically ill children.

NIV applied outside of ICU could reduce the demand for beds in these units at the most critical period of the year and also reduce complications associated with conventional mechanical ventilation. It should be the first option when possible since, according to current evidence, success or failure can be assessed shortly (two hours after implementation).

However, some concerns should be addressed, mainly to assure the accessibility to mechanic ventilation support for those children not responding to NIV and the availability of enough trained staff able to

do close follow up of very ill children in non-critical care units in countries where there may be shortage of qualified health care personnel.

These concerns are more political than scientific but we must not lose sight of them if we really want to improve these children´s health.

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