Postextubation Respiratory Support

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Postextubation Respiratory Support: Is High-Flow Oxygen Therapy the Answer?*

KEY WORDS: equipoise; pediatric intensive care unit registries; physiology; research

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Practice variability in the PICU is best exemplified by our heterogeneous and inconsistent (non-) invasive respiratory support practices (1). It is driven by lack of high-quality, robust scientific evidence and by personal beliefs, institutional preferences, and on what works in adults (2). This may be especially reflected in the use of noninvasive modalities such as high-flow nasal cannula (HFNC) oxygen therapy and noninvasive ventilation (NIV). Although there are no PICU studies reporting improved outcomes (such as duration of ventilation, mortality, or postdischarge functional status), HFNC and NIV have both been embraced by the pediatric critical care community since their introduction and considered by many as standard of care for first-line therapy (3). However, the lack of quality evidence supporting these practices should stimulate our community to conduct clinical trials designed to test the efficacy of HFNC or NIV in specific situations. Unfortunately, performing such studies is difficult as they are time and resource consuming and not infrequently hampered by the lack of equipoise among the clinical team or lack of personal equipoise. Equipoise is traditionally defined as a state of genuine uncertainty on the relative value of two approaches being compared in a trial, but nowadays, it is seen as a representation of uncertainty within the expert medical community (4). Another often used argument is that randomized controlled trials (RCTs) are designed to create near-ideal circumstances that often exclude patients or particular clinical scenarios that physicians treat (5). Hence, results of RCTs may not translate well into clinical practice. Alternatively, researchers move all too often

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to existing PICU registries in an attempt to identify a relationship between a specific intervention and outcomes (6). Obviously, databases provide an easily accessible opportunity to link current healthcare practices to the outcome of care. At the same time, these databases contain limited data and do not always specify the rationale for medical decisions. Furthermore, patient characteristics that drive real-life clinical decisions may also influence clinical outcomes, making it impossible to establish if a specific intervention causes the outcomes studied (7). Subsequent analyses are affected by a type of bias that is known as "confounding by indication." This type of bias means that there is a preference to start a specific intervention in the patient thought to benefit the most from that intervention (8). Confounding by indication can only be overcome by randomization. Researchers may attempt to adjust for this type of bias by calculating a propensity score. Propensity score matching is a statistical approach to estimate the effect of an intervention by accounting for covariates that predict receiving the intervention.

In this issue of *Pediatric Critical Care Medicine*, Badruddin et al (9) report the results of a secondary analysis using the Virtual Pediatric Systems (VPS) database to test the hypothesis that HFNC is associated with higher prevalence of reintubation within 24 hours compared with noninvasive positive pressure ventilation (NIPPV) among invasively mechanically ventilated patients with a primary diagnosis of bronchiolitis. A total of 783 patients (43.7%) were immediately supported with HFNC or NIPPV after a median duration of 5.5 days (interquartile range, 3.4–9.0 d) of mechanical ventilation. Interestingly, most patients received HFNC (86.5%), but patients with comorbidities—particularly those with cardiovascular comorbidities—were more often supported postextubation with NIPVV. Extubation to NIPPV was associated with more extubation failure necessitating reintubation than extubation to HFNC (11.7% vs 5.0%; p = 0.016) after adjusting or disease severity (Pediatric Index of Mortality [PIM]–2) score and presence of comorbidities (odds ratio, 2.43; 95% CI, 1.11–5.34). The authors concluded that "prospective trials are needed to determine if post-extubation support modality can mitigate the risk of extubation failure."

Their study is an elegant example of how real-world evidence can be obtained through comparative effectiveness research (10). This report does not mean that we do not need RCTs to truly understand if an intervention is superior or not. The authors rightfully call for prospective trials and appear to have a preference for pragmatic trials (11). Obviously, one advantage of a pragmatic trial is that it offers the bedside team clinical guidance. Badruddin et al (9) have nicely shown that there is a lack of equipoise among critical care practitioners as to which mode of support is superior out of HFNC or NIPPV post extubation (12). Yet, before designing future RCTs, one should ask this question: is it necessary to routinely support a patient with HFNC or NIPPV post extubation? There are no pediatric data showing better outcomes when patients are routinely supported with either HFNC or NIPPV compared with doing nothing. And, if the rationale is to prevent reintubation, what then is the prevalence of failed extubation in invasively ventilated patients with bronchiolitis and which potentially modifiable risk factors such as postextubation upper airway obstruction can be identified? Unfortunately, this number is unknown in the study by Badruddin et al (9), although it might have been gained by finding in the VPS database cohort, the failed extubation rate among patients who were not supported by HFNC or NIPPV.

Pragmatic trials may offer clinical guidance more easily, but the lack of scientific support for many things we do in the PICU should also make us curious about how things work. On top of that, one of the pitfalls of RCTs is that they may test the operator rather than the intervention. With this in mind, trial design necessitates thorough groundwork including a good understanding of the target population, selecting the right patient who is most likely to benefit from the intervention, and what drives the clinical decision-making by the operator. For example, it requires understanding of how patients are weaned from the ventilator, if and how extubation readiness (ERT) testing is performed, and how HFNC and NIPPV are used. Bronchiolitis has become synonymous with virus-induced lower respiratory tract disease, but the clinical phenotype ranges from obstructive with predominantly increased airway resistance to an acute respiratory distress syndrome with reduced lung compliance (13). It may be postulated that this difference in clinical phenotype may drive the choice for a particular mode of noninvasive respiratory support. Badruddin et al (9) attempted to address this by matching for age, gender, weight, any significant comorbidity, PIM-2 score, and

the duration of intubation, but the question remains to what extent each of these variables are actually involved in the clinical decision-making. Testing for ERT is a key component of the weaning process as it allows the critical care practitioner to assess the capability and endurance of the patient's respiratory muscles in the decision-making about a patient's readiness for extubation (14). ERTs are usually done by a spontaneous breathing trial (SBT) using pressure support (PS). However, postextubation work of breathing is overestimated if SBTs are performed with PS and may provide limited information if a patient is not at increased risk for extubation failure (15). Numerous factors affect the success rate of HFNC and NIPPV, including HFNC flow rate and for NIPVV the interface used, the degree of synchrony between the patient and the ventilator, and whether or not only continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP) is used. CPAP and BiPAP are two distinct modes of noninvasive respiratory support with the first one only providing a continuous airway pressure which may be an insufficient support in those with moderate to severely increased work of breathing.

So, where does this leave us for now? HFNC enthusiasts will welcome the results, NIV enthusiasts will receive the study with mixed emotions, and all others will remain undecided. Perhaps, some guidance can be found in a study done in adults at high risk for extubation failure reporting noninferiority of HFNC compared with NIPPV (16). Nevertheless, the only conclusion at this stage is that there are limited data supporting the routine and prophylactic use of HFNC or NIV post extubation in children with viral bronchiolitis. There is an urgent need for a well-designed RCT in a subgroup of children who are at increased risk for extubation failure. Although awaiting this much needed study, we are left in the dark but should at least try to refrain from routinely using interventions that at best are unproven.

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Improving "Neuro Checks" in Neonatal ICU and PICU Is a Serial Neurologic Assessment in Pediatrics*

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KEY WORDS: consciousness disorders; critical illness; Glasgow Coma Scale; intensive care units; neurologic examination

Adequate neurologic examinations in the PICU are an expectation that should be built into the practice of pediatric critical care. Similar to the role a piece of equipment plays in monitoring various physiologic variables to "warn" or provide feedback to clinical decision-makers about a patient's clinical status, serial neurologic examinations are an important part of the "monitoring system" (1, 2). Neurologic assessments on the PICU begin with keen observations and charting of serial neurologic examinations by bedside nurses. A standardized and consistent approach to the neurologic examination and documentation of findings in the medical record are invaluable for critical care practitioners and should improve communication between nurses and clinicians caring for children on the PICU.

Kirschen et al (3), in their article published in this issue of *Pediatric Critical Care Medicine*, developed a new standardized screening tool for bedside nurses to score the neurologic status of critically ill patients in the neonatal ICU (NICU) and PICU setting, known as "Serial Neurologic Assessment in Pediatrics" (SNAP). SNAP is a blend of components of the Glasgow Coma Scale (GCS) (4), Full Outline of UnResponsiveness (FOUR) score (5), and pediatric National Institutes of Health Stroke Scale (NIHSS) (6) and has several strengths. Compared with the GCS, SNAP emphasizes the importance of a more complete neurologic assessment with an ordinal arrangement of the degree of impairment in mental status, cranial nerves, communication, and motor function and linearity of all components (equal weighting to individual units of the score). Additionally, SNAP includes separate scales for infants (< 6 mo), toddlers (≥ 6 mo to < 2 yr), and children (≥ 2 yr old) (3). Last, SNAP is most akin to the FOUR score, which has shown good validity (7, 8) and correlation with outcome (9) in critically ill adults in medical ICUs.

Some pitfalls and theoretical disadvantages of SNAP, however, are similar to those seen with the scores from which SNAP is derived. The total GCS score, for example, is obtained by adding the values of three different behavioral responses to stimulation that are assumed to be independent variables—best motor response,

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