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The Evidence is In: Noninvasive Ventilation Saves Lives

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Three important evidence-based practices related to mechanical ventilation have emerged over the past 20 years: use of lower tidal volumes,¹ spontaneous breathing trials to determine readiness for liberation,² and noninvasive ventilation (NIV).^{3–5} In this issue of *Critical Care Medicine*, Cabrini and colleagues⁶ report a systematic review and meta-analysis of NIV in the acute care setting for the outcome survival. I have personally become weary of the deluge of meta-analyses published in recent years. But this is a good one and worthy of our consideration.

The evidence for NIV is robust. This meta-analysis included 78 trials that, in sum, randomized 7365 patients (3840 to NIV and 3525 to control). It is interesting that for every year from 1995 to 2013, there was at least one randomized controlled trial published on NIV reporting survival data. If one considers the additional observational data reported over the past 20 years, indeed it can be said that the evidence related to NIV and survival is mature.

The results of this meta-analysis confirm some of what is already known. It is established that the use of NIV for COPD exacerbation and acute cardiogenic pulmonary edema (CPE) improves survival.⁵ Using the metric of number needed to treat (NNT), the NNT for survival is 11 and 30 for COPD exacerbation and acute CPE, respectively. Although the NNT reported for acute respiratory failure is only 8, it is difficult to use this in practical terms because this category included mixed etiologies. For example, NIV is typically not recommended for severe ARDS.⁵

This meta-analysis provides previously underappreciated support for the use of NIV in both treatment (NNT 11) and prevention (NNT 19) of post-operative respiratory failure. Does this mean that all post-operative patients should receive NIV? That brings back memories of intermittent positive pressure ventilation (IPPB), which was long ago abandoned as

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ineffective. The meta-analysis provides some guidance, as the prevention benefit seems to be limited to those at high risk (NNT 10). More study is needed in this area; for example, 1) how risk is quantified, 2) whether NIV should be applied continuously or intermittently 3) when the therapy no longer necessary and can be discontinued, 4) whether NIV versus continuous positive airway pressure (CPAP) should be used, 4) the dose needed (NIV or CPAP settings). We need to careful not to repeat the experience of IPPB, where the therapy was administered in a nonselective and haphazard manner, leading to the therapy being discarded as ineffective.

There has been increasing interest in the use of NIV in the post-extubation period.^{7, 8} NIV might be used to facilitate earlier extubation, to prevent extubation failure in patients at risk, or to prevent re-intubation in the setting of extubation failure. The meta-analysis confirms a significant reduction in mortality when NIV was used in patients at high risk of extubation failure (NNT 10). However, NIV used to facilitate earlier extubation had no impact on survival (it potentially has other benefits such as fewer days of intubation). The meta-analysis confirms that mortality is not improved when NIV is used in the setting of a failed extubation.

Some ambiguity is introduced into this meta-analysis because the authors combined studies using NIV and CPAP. This is unfortunate because NIV, unlike CPAP, provides support of ventilation. In the setting of hypercapnic respiratory failure, it is likely the NIV, and not CPAP alone, is necessary. In other settings, such as CPE and prevention of post-operative respiratory failure, CPAP might be as effective as NIV. I have also seen high flow oxygen therapy called NIV. I think it important to recognize that NIV, CPAP, and high flow oxygen are distinctly different therapies in their indications and application.

NIV improves survival in appropriately selected patients. But what is the mechanism? Presumably the benefit is related to avoidance of intubation. Intubation carries the risk of ventilator-associated pneumonia, greater use of sedation, application of injurious pressures and tidal volumes, and delayed recognition of readiness for extubation. Although avoidance of intubation is desirable, it is also important to recognize when NIV is failing. The incidence of NIV failure is 20% or greater. If NIV is used in lieu of intubation, failure to improve within a few hours of NIV initiation should prompt consideration of alternative therapy such as intubation.

This meta-analysis not only informs the selection of patients where NIV is most likely to benefit, but also suggests that NIV is more beneficial when applied early rather than as rescue therapy. Although NIV is used increasingly, wider acceptance is possible. Strategies in initiate and expand the use of NIV should be implemented in acute care hospitals. Successful application of NIV is multidisciplinary and demands the buy-in of physicians, respiratory therapists, and nurses.⁹

There remain areas of controversy related to the practical use of NIV. One relates to choice of interface. A variety of interfaces are available. In my hands, an interface that fits over the nose and mouth is most effective in the setting of acute respiratory failure. The important consideration in selection of an interface is its fit to minimize leaks (including mouth leak),

enhance patient comfort, and avoid facial skin injury. Another area of controversy is selection of the ventilator for NIV. Most important is leak compensation. Although, as a group, ventilators designed specifically for NIV outperform ICU ventilators, some current generation ICU ventilators have leak compensation that rivals that of ventilators designed specifically for NIV.^{10, 11} Yet another area of controversy is the setting in which NIV can be safely administered.¹² Intermittent NIV or CPAP can probably be safely applied on the general wards. If NIV is used in lieu of intubation for acute respiratory failure, many hospitals appropriately demand that NIV is either initiated in a critical care setting, or that the patient is transferred to the ICU soon after NIV is initiated. It is important that acute care hospitals establish guidelines for the setting where NIV will be provided based on staffing levels, staff skills, and monitoring capability.

In conclusion, this meta-analysis contributes to support for use of NIV. Overall, the use of NIV is associated with a significant reduction in mortality (NNT=16). The evidence is in. NIV saves lives.

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