Non-invasive respiratory support of neonates: The non-traumatic way forward!

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Abstract

The quality of care in a Neonatal Intensive Care Unit (NICU) is judged by the standards of respiratory care the babies receive in the unit and the bedside care therein is given by the surrogate mothers of the tiny tot in the baby cot (incubator) read the NICU sisters. Appropriate and up to date technologies of respiratory support are the aces up the sleeves of the neonatologists that ensure intact survival of premature babies against the odds of barotraumas, volutrauma, bio-trauma etc. The level of escalation of respiratory support of neonates extends from oxygen therapy to continuous distending airway pressure devices, surfactant, nasal positive pressure ventilation, intubation and ventilation (including high frequency oscillation) and Extra- Corporeal Membrane Oxygenation (ECMO). Keeping the lungs expanded to prevent atelectrauma is a key strategy in neonates as this conserves surfactant and this support starts from the delivery room for premature babies. Disruptions of airway mucosal integrity and mucociliary function have deleterious consequences and hence gentle strategy of respiratory support avoiding intubation to the extent possible is advocated. High Flow Nasal Cannula oxygen (HFNC) therapy aims to minimize even the nasal mucosal injury that can happen with the current nasal respiratory support devices. Although the threshold for surfactant therapy varies between NICUs, the earlier is better and the aim is to keep the FiO2 below 0.3 or 0.4. The INSURE (INtubate, Surfactant and Extubate) was evolved earlier to minimize the duration of intubation needed to administer surfactant. Earlier in this decade even this has been replaced by the Minimally Invasive Surfactant Therapy (MIST) wherein surfactant is administered using a no intubation technique. Dubai has a published report on MIST in our NICU recently. The evidence base and meta-analysis have attested to the superiority of non-invasive respiratory support strategies and the initial follow up data available in the literature is encouraging.

Non-invasive respiratory support is used in infants and children with acute and chronic conditions associated with impaired respiratory drive, inadequate lung inflation, and altered gas exchange resulting in respiratory insufficiency or failure. Previously, a predominance of the evidence was devoted to the neonatal and adult population, but recent evidence advocating for less invasive ventilation has been a catalyst to increase the study and use of CPAP or noninvasive ventilation (NIV) in infants and pediatric patients. CPAP refers to the administration of continuous positive airway pressure during all phases of the respiratory cycle of a spontaneously breathing patient, whereas NIV refers to the application of 2 pressure levels (inspiratory and expiratory) designed to enhance ventilation by creating pressure gradients that facilitate the movement of air in and out of the lungs. Both CPAP and NIV have a goal that is consistent with improving or adequately restoring the functional residual capacity in the lung while minimizing the inspiratory work of breathing. The primary goal for the use of CPAP is to improve oxygenation by improving functional residual capacity and lung inflation in patients with an adequate respiratory drive. NIV improves the effective minute ventilation enhancing CO2 elimination by augmenting inspiration in patients with respiratory failure or impending respiratory failure without the use of an artificial airway. Effective ventilation will also result in improved oxygenation as the ventilation/perfusion ratio improves. NIV is commonly provided in the form of positive pressure; however, negative pressure delivery devices are available but are not widely used in the United States.

CPAP was first utilized in the neonatal population to treat respiratory distress syndrome associated with prematurity in the early 1970s. CPAP is administered by nasal prongs or mask to provide an adequate distending pressure that subsequently results in expansion and stabilization of collapsed alveoli secondary to surfactant deficiency.1–4 The successes seen in neonatal and adult CPAP and NIV use over the years have generated an expanded interest for its use in pediatric patient populations. The recent popularity and widespread use of high-flow nasal cannula (HFNC) have led to its inclusion in this discussion, although HFNC therapy should not be considered as a form of positive pressure delivery. Restoring or improving the functional residual capacity by applying continuous positive pressure to the ventilating lung units reduces the work of breathing by eliminating the need to overcome the opening pressure of the lung, and it prevents collapse and reopening of alveoli. CPAP does not provide tidal breathing support, and patients receiving CPAP alone must be able to maintain airway patency and have adequate respiratory muscle strength and neurological drive to breathe. With CPAP and NIV, care must be taken to avoid regional over distention of the lungs. Reducing the need for an artificial airway is the primary advantage for the use of noninvasive modalities, whereas secondary advantages include the reduced risk of nosocomial infections, decreased need for sedation, increased tolerance for enteral feeds, potential for care outside of the ICU, and an improved ability to ambulate.