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Introductory: Non Invasive Ventilation in Medicine

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1. Introduction

With the worldwide increasing use of noninvasive ventilation (NIV) and many updated evidences coming under the application of NIV in neuromuscular disease, neonates, and open circuit mouthpiece ventilation apart from the documented success of NIV in OSA, COPD, type 2 respiratory failure and pulmonary edema, it is the time to get more knowledge about its application for various chronic respiratory diseases such as interstitial lung disease and non-respiratory disease characterized by type 1 or type 2 respiratory failure in due course of time, and it is also important to know the potential application of NIV in children and neonates and as a mode for weaning from the mechanical ventilation, NIV is a rapidly changing field; hence, it is very important in clinical practice to have expertise in applying the technique and acquiring problem-solving skills of NIV.

If we go back to history, initially, negative pressure ventilators were invented primarily to tide over the ventilatory crisis of polio epidemic (epidemics of poliomyelitis), which had begun in the First World War and swept across Europe and the USA in the 1930s–1950s. They were of different types including cuirass ventilator, chest bellow, iron lung, tank ventilators, and many more but the main drawback with all these was that they were large, heavy, and cumbersome to operate and handle and were primarily used for the neuromuscular disease. Practical limitations were compounded by the huge outbreak of polio in Denmark in 1952, which was associated with a very high prevalence of cases with bulbar weakness. Not only an insufficient number of iron lungs were available, but these were also inadequate in caring for patients with bulbar problems—mortality rose to 90% and the only solution was invasive positive-pressure ventilation via a tracheostomy. This switch to positive pressure continued heralding the development of modern ICU. Later on, positive-pressure ventilators were developed with endotracheal intubation, which is a must for the application of these ventilators. From 1980 onward, positive pressure was applied through the face mask and found to be really effective for patients with COPD and

obstructive sleep apnea, and it heralded the era of NIV globally. There was a brief resurgence of NIV in 1980s, but mainly to care for those with chronic ventilatory failure.

Long-term chronic use of NIV began to spur to ventilatory progress during 1980s. This was related to better understanding of the sleep physiology and the discovery of OSA and beneficial effects of CPAP. The original CPAP machines were very large, but newer machines are smaller, compact, and portable. Importantly, mask design and comfort has also improved, leading to success of NIV application. NIV is now one of the most evidence-based areas of respiratory medicine. NIV reduces mortality and morbidity in acute exacerbations of COPD, and this improved outcome in Duchenne muscle dystrophy and other neuromuscular diseases, OSA, in acute hypoxemic respiratory failure secondary to pulmonary edema and weaning from mechanical ventilation including high-risk patients for weaning. An additional major change in the past 30–40 years has been the increasing indications for long-term, chronic NIV and, of course, long-term application of CPAP in OSA.

For patients with a range of causes of ventilatory failure, the natural history progresses from normal breathing to a gradual loss in lung volumes and then, initially, changes in blood gases are seen at night due to hypoventilation, and if that is not addressed, ultimately, progress to daytime respiratory failure, cardiac decompensation, and premature death. In Duchenne muscular dystrophy and other neuromuscular diseases, once a patient starts developing high carbon dioxide level during the daytime and or night time, suggestive of ventilatory muscles fatigue and carries a dismal prognosis if the Home NIV support is not provided earliest possible. In COPD, recent trials have shown NIV may be beneficial in stable hypercapnic patients. NIV has been extended to the pediatric age range, with the feasibility of using NIV to control nocturnal hypoventilation in children initially being demonstrated predominantly in neuromuscular conditions. Many of these children now survive to adolescence or adulthood, as shown in the section entitled “Chronic NIV in hereditary neuromuscular disorders.”

There is also growing interest in NIV in cardiology. There is no doubt that patients with heart disease and OSA benefit from treatment of the OSA. By contrast, Cheyne-Stokes respiration is a form of central sleep apnea in patients with chronic heart failure. Recent work shows that around half of patients with mild heart failure have sleep disordered breathing too. CPAP can be used to treat OSA, but it does not work in central sleep apnea or Cheyne-Stokes respiration. NIV is now being used in some situations to palliate symptoms without the aim of prolonging survival. Here, goals such as reduction in dyspnea and control of symptoms of nocturnal hypoventilation should be set preemptively so that if these are not met, NIV can be discontinued and palliative efforts are directed elsewhere. NIV combined with cough assist devices can also be used to manage severely ill type 1 spinal muscular atrophy infants with the aim of discharging the patient to their home and managing breathlessness.

2. Implementation of NIV in clinical practice

There is evidence that patients who would benefit from NIV are not receiving it even for gold standard indications, such as acute hypercapnic COPD, mainly because the medical team does

not feel comfortable to start NIV; in such case, they must take MICU or pulmonary medicine doctor's opinion for the NIV in COPD and they must try to emphasize the use of NIV to the patients to improve quality of life and to reduce morbidity and mortality in not only COPD but also in all well-established indications for NIV use in various respiratory diseases. Pulmonary and MICU doctors are at forefront to recommend the use of NIV in established and potential indications to improve quality of life and survival.

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