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NONINVASIVE VENTILATION

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Noninvasive Ventilation refers to the delivery of mechanical ventilation to the lungs using techniques that do not require an endotracheal airway. During the first half of the 20th century, negative pressure types of noninvasive ventilation were the main means of providing mechanical ventilatory assistance outside of the anaesthesia suite. By the 1960s however, invasive (i.e. via an endotracheal tube) positive pressure ventilation supreceded negative pressure ventilation, primarily because of better airway protection. The past decade has seen a resurgence in the use of noninvasive ventilation, largely because of the development of nasal ventilation, which has the potential of providing ventilatory assistance with greater convenience, comfort, safety and less cost than invasive ventilation.

WHY THE INTEREST IN NONINVASIVE VENTILATION ?

A major driving force behind the increasing use of noninvasive ventilation has been the desire to avoid the complications of invasive ventilation. Although invasive mechanical ventilation is highly effective and reliable in supporting alveolar ventilation, endotracheal intubation carries well-known risks of complications.[1]

These fall into three main categories; complications directly related to the process of intubation and mechanical ventilation, those caused by the loss of airway defense mechanisms, and those that occur after removal of the endotracheal tube[2]. The first category includes aspiration of gastric contents, trauma to the teeth, hypopharynx, esophagus, larynx, and trachea, arrhythmia's, hypotension, and barotrauma that may occur during placement of a trańslarygeal tube. With tracheostomy placement, risks include hemorrhage, stomal infection, intubation of a false lumen, mediastinits, and acute injury to the trachea and surrounding structures, including the esophagus and blood vessels[3]. In the second category, endotracheal tubes provide a direct conduit to the lower airways for microorganisms and other foreign materials, permitting chronic bacterial colonization, inflammation, and impairment of airway ciliary function. These factors facilitate the occurrence of nosocmial pneumonia, seen is an much as 21% of mechanically ventilated intensive care unit (ICU) patients[4], and sinusitis, that occurs in 5 to 25% of nasally intubated patients, related to blockade of the sinus ostia and accumulation of infected secretions in the paranasal sinues[4]. The chronic aspiration and irrigation associated with endotracheal intubation also necessitate endotracheal suctioning that further irritates lower airway mucosa, causing discomfort, further inflammation, edema, and increased mucus production. In the third category, hoarseness, sore throat, caugh, sputum production, hemoptysis, upper airway obstruction caused by vocal cord dysfunction or laryngeal swelling, and tracheal stenosis may follow extubation[5].

From the point of view of the patient, perhaps the most troubling aspects of translaryngeal intubation are tube-associated discomfort and the compromised ability to eat and communicate that create feelings of powerlessness, isolation, and anxiety[6]. This may increase the need for sedation, delaying weaning thus adding to the costs of care, and potentiating the risks of further complications. Placement of a tracheostomy does little to simplify care. Sophisticated equipment, including suctioning paraphernalia and a high level of technical expertise among caregivers, is required, adding substantially to cost[7]. In addition, tracheostomies lead to upper airway colonization with gram negative bacteria, increasing the risk of pneumonias[5]. Further, long term tracheostomies are complicated by tracheomalacia, endotracheal granulation tissue formation, and tracheal stenoses that sometimes contribute to airway obstruction, chronic pain, and tracheoesophageal or even tracheoarterial fistulas[5]. These considerations and potential complications may limit the options for chronic care placement and may even preclude home discharge in patients with limited personnel and financial resources who would otherwise be candidates for home placement.

By averting airway intubation, noninvasive ventilation has the potential of avoiding these problems if candidates are carefully selected using established guidelines. In contrast to invasive ventilation, noninvasive ventilation leaves the upper airway intact, preserves airway defense mechanisms, and allows patients to eat, drink, verbalize, and expectorate secretions. Several recent studies indicate that NPPV reduces infectious complications of mechanical ventilation, including nosocomial pneumonia and sinusitis[8]. Noninvasive ventilation may enhance comfort, convenience, and portability[9] at less cost than endotracheal intubation[7]. Furthermore, noninvasive ventilation may be administered outside of the intensive care setting, as long as adequate nursing and respiratory therapy support can be provided, allowing caregivers to more rationally utilize acute-care beds, and it greatly simplifies care for patients with chronic respiratory failure in the home.

NONINVASIVE POSITIVE PRESSURE VENTILAION.

Positive pressure ventilators, whether invasive or noninvasive, assist ventilation by delivering pressurized gas to the airways, increasing transpulmonary pressure, and inflating the lungs. Exhalation occurs by means of elastic recoil of the lungs and any active force exerted by the expiratory muscles. The major difference between invasive and NPPV is that with the later, gas is delivered to the airway via a mask or 'interface" rather than via an invasive conduit. The open breathing circuit of NPPV permits air leaks around the mask or through the mouth, rendering the success of NPPV critically dependent on ventilator systems designed to deal effectively with air leaks and to optimize patient comfort and acceptance.

Interfaces for the delivery of NPPV or CPAP. Interfaces are devices that connect ventilator tubing to the face, facilitating the entry of pressurized gas into the upper airway during NPPV. Currently available interfaces include nasal and oronasal masks and mouthpieces.

Nasal masks. The nasal mask is widely used for administration of CPAP or NPPV particularly for chronic applications. The standard nasal mask is a triangular coneshaped clear plastic device that fits over the nose and utlizes a soft cuff to form an air seal over the skin. Nasal masks are available from many manufacturers in multiple sizes (pediatric and adult small, medium, large, wide, and narrow, and so on) and shapes, largely because of the demand for such devices in the treatment of obstructive sleep apnea. The standard nasal mask exerts pressure over the bridge of the nose in order to achieve an adequate air seal, often causing skin irritation and redness, and occasionally ulceration. Various modifications are available to minimize this complication such as use of forehead spacers or the addition of a thin plastic flap that permits air sealing with less mask pressure on the nose. Recently, several manufacturers have introduced nasal masks with gel seals that may enhance comfort. In addition, newer "mini-masks" have been developed that minimize the bulk of the mask, reducing feelings of claustrophobia and permitting patients to wear glasses while the ventilator is in use. For occasional patients who have difficulty tolerating commercially available masks, custom-molded, individualized masks that can be made to conform to unique facial contours are also available.

SUMMARY AND CONCLUSIONS.

Use of NPPV has rapidly proliferated during the past decade. Previously, body ventilators such as negative pressure devices were the main noninvasive means of assisting ventilation. After the introduction of the nasal mask to treat obstructive sleep apnea during the mid-1980s and the subsequent development of nasal ventilation, NPPV became the ventilator mode of first choice to treat patients with chronic respiratory failure. More recently, NPPV has been attaining acceptance for certain indications in the acute setting, as well.

On the basis of controlled trials demonstrating marked reduction in intubation rates as well as improvements in morbidity, mortality and complication rates, NPPV is now considered the ventilatory mode of first choice in selected patients with CPAP exacerbation. The indications for NPPV are not as clear in patients with non-COPD causes of acute respiratory failure. For acute pulmonary edema, CPAR alone drastically reduces the need for intubation, although studies have not demonstrated reductions in morbidity or mortality rates. NPPV avoids intubation and reduces complication rates in patients with hypoxemic respiratory failure, but more controlled trials are needed to establish precise indications. In the meantime, NPPV administration to patients with non-COPD causes of acute respiratory failure appears to be safe as long as patients are selected carefully with particular attention to the exclusion of inappropriate candidates. A possible role is also emerging for NPPV in the facilitation of weaning patients from invasive mechancial ventilation. In this context, noninvasive ventilation can be used to permit earlier removal of invasive airways than would otherwise be the case, to prevent reintubation in patients developing post-extubation respiratory failure, and to serve a prophylactic role in postoperative patients who are at high risk for pulmonary complications.

For chronic respiratory failure, a wide consensus now favors the use of NPPV as the ventilatory mode of first choice for patients with neuromuscular diseases and chest wall deformities, despite a lack of randomized controlled trials. Central hypoventilation and failure of obstructive sleep apnea to respond to CPAP are also considered acceptable indications, although evidence to support these later applications is sparse. For patients with severe stable COPD, some evidence support the use of NPPV in severely hypercapnic patients, particularly if there is associated nacturnal hypoventilation. However, the data are conflicting and do not permit the formulation of firm selection guidelines.

NPPV has emerged as the noninvasive ventilation mode of first choice over alternatives such as negative pressure ventilation or abdominal displacement ventilators. However these later techniques are still used in some areas of the world and may be effective for patients who fail NPPV because of mask intolerance. Noninvasive ventilation has undergone a remarkable evolution over the past decade and is assuming an important role in the management of both acute and chronic respiratory failure. Appropriate use of noninvasive ventilation can be expected to enhance patient comfort, improve patient outcomes, and increase the efficiency of health care resource utilization. Over the next decade, continued advances in technology should make noninvasive ventilation even more acceptable to patients. Future studies should better define indications and patient selection criteria, further evaluate efficacy and effects on resource utilization, and establish optimal techniques of administration.

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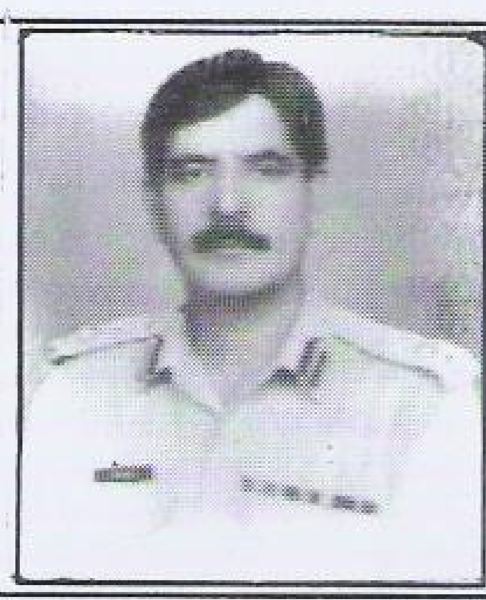

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