NON–INVASIVE VENTILATION

11.1 Non–invasive ventilation (NIV): general considerations

There cannot be many situations in respiratory medicine which have undergone such a dramatic change in the last 20 years as the treatment of respiratory failure with NIV. As an example, children with Duchenne muscular dystrophy are living to be 30 or 40 years old, getting an extra 10–20 years of life, thanks to non–invasive ventilation. "*Non–invasive ventilatory support, a practical handbook*", edited by AK Simonds (2007), is essential reading for Health Care Professionals who want to become involved.

11.1.1 Different types of ventilatory support

Non–invasive ventilation (NIV) is delivered via a facemask, nasal mask or plugs, tracheostomy or a helmet (Figure 11.2). NIV is no different, mechanically, from *invasive* mechanical ventilation (IMV) via an endotracheal tube in the Intensive Care Unit (ICU). The difference is that the NIV patient is usually cooperative and independent, but the patient on IMV is sedated and

totally dependent on others. An awake patient receiving ventilatory assistance via a tracheostomy is between the two in dependence terms.

11.1.3 Technical aspects

see Simonds, 2007, pp.1–38 for more information

Pressure pre-set ventilators are in more widespread use than volume-pre-set ventilators. They are more compact, the selected peak input pressure compensates for leaks, and ensures that the alveoli are not exposed to bursts of very high pressure with possible barotrauma or pneumothorax. But, the pressure ventilator will deliver less tidal volume if airflow resistance increases or the lung becomes stiffer.

VENTILATOR CIRCUIT FOR BI–LEVEL PRESSURE SUPPORT

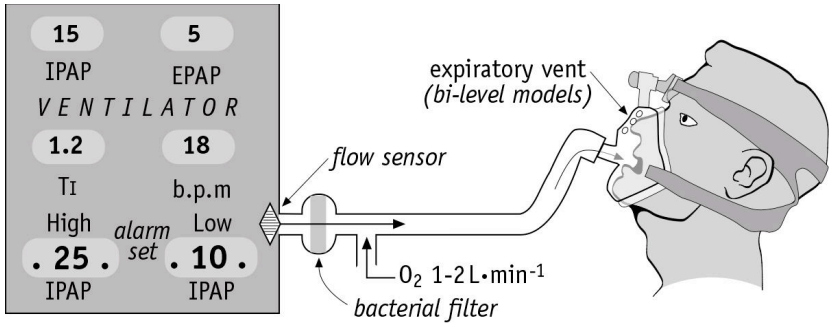

Figure 11.1 Diagram of ventilator circuit with bacterial filter, O_2 inflow, and 22 mm tubing attached to full face mask with in-built expiratory leak. Entraining oxygen nearer to the face mask gives a higher FIO_2. Typical ventilator settings (cm H_2O or s [TI]) shown for patient with neuromuscular weakness.

Ventilators operate in *control* (or timed, T), *assist–control* (or spontaneous/timed, S/T) or *assist* (spontaneous, S) mode. In c*ontrol* mode, the ventilator takes over completely the timing and depth of inspiration and expiration. In theory, the respiratory muscles can switch off, and rest absolutely. For someone with normal lungs, the sensation is of a rapid completion of expiration, without the normal "braking", followed by a pause. In *assist–control* mode, the patient triggers the ventilator with an inspiratory effort (sensed by negative mask pressure or flow reversal); if the patient fails to breathe within a set time frame, the ventilator will deliver a breath to the preset inspiratory pressure. In *assist* mode (suitable for subjects with good respiratory drive, such as COPD), inspiration and expiration is patient–triggered; an expiratory trigger switches off the inspiratory pressure (IPAP) once inspiratory flow has declined to a pre-set level (e.g. 30% of maximum $\dot{V}I$). *Assist–control* is the method of choice, and most comfortable for the patient whose triggered breaths are assisted.

11.4 Learning Points

- NIV treats ventilatory failure, defined as a raised $PaCO_2$
- The commonest indications for NIV are respiratory muscle weakness, chest wall deformity, obesity hypoventilation syndrome and COPD
- In–hospital use is for acute and acute-on-chronic respiratory failure
- Domiciliary (home) use treats chronic (stable) hypercapnia, usually in neuromuscular or chest wall diseases, and often only at night
- Pre-set pressure ventilators with EPAP are used most frequently
- CPAP splints the upper airway and raises FRC; it does not ventilate patients. CPAP is used for OSA and acute pulmonary oedema

Further Reading

General

British Thoracic Society Standards of Care Committee. Non–invasive ventilation in acute respiratory failure. Thorax 2002; 57: 192-211.

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Specific points

1. **Chatwin M, Nickol AH, Morrell MJ, Polkey MI, Simonds AK.** Randomised trial of inpatient versus outpatient initiation of home mechanical ventilation in patients with nocturnal hypoventilation. Respir Med 2008; 102: 1528-35.
2. **Nickol AH, Hart N, Hopkinson NH, Moxham J, Simonds A, Polkey MI.** Mechanisms of improvement of respiratory failure in patients with restrictive thoracic disease treated with non–invasive ventilation. Thorax 2005; 60: 754-60.
3. **Ragette R, Mellies U, Voit T, Teschler H.** Patterns and predictors of sleep disordered breathing in primary myopathies. Thorax 2002; 57: 724-8.
4. **Simonds AK.** Risk management of the home ventilator dependent patient (editorial). Thorax 2009; 61: 369-71.