NON-INVASIVE VENTILATION IN COPD 2: STARTING AND MONITORING NIV

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Part 2 of this two-part unit examines the role of non-invasive ventilation (NIV) in treating hypercapnic respiratory failure and discusses the care of patients on NIV.

**NON-INVASIVE VENTILATION**

NIV techniques have increasingly been used to manage respiratory failure without intubation and conventional mechanical ventilation (Preston, 2001). NIV refers to ventilatory support provided by a delivery of pressurised gas flow via the upper airway, using a tight-fitting mask (Preston, 2001).

Non-invasive positive pressure ventilation (NIPPV) and nasal ventilation (NV) are two terms that are also used for NIV systems. This article uses the term NIV to describe the types of non-invasive ventilatory support as used by the British Thoracic Society (2002) guidelines and BiPAP for bi-level positive airway pressure NIV, which is discussed later.

**NIV IN RESPIRATORY FAILURE**

Different types of ventilator have been used to provide NIV in COPD-related respiratory failure. The BTS (2002) advised that a single model of ventilator be used in a clinical area for ease of training. BiPAP is a bi-level ventilator that is simple to use and recommended for acute NIV services (BTS, 2002) and is the ventilator discussed here.

BiPAP is a pressure-controlled generator that aims to reduce acidosis and carbon dioxide levels and provide optimal oxygenation (Sawkins, 2001). It does this by delivering a pressurised gas flow through a tight-fitting mask always at a level higher than atmospheric pressure, that is, it delivers a ‘positive’ pressure (Preston, 2001). This positive pressure is delivered throughout inhalation and exhalation but at different levels, hence the term ‘bi-level’ NIV. The inspiratory positive airway pressure (IPAP) is generated as the patient breathes in. As the patient exhales expiratory positive airway pressure (EPAP) takes over. The BiPAP then alternates between the higher pressure of IPAP and the lower pressure of EPAP at frequencies that synchronise with the patient’s breathing pattern (Preston, 2001).

BiPAP enhances ventilation specifically at the alveolar level (Preston, 2001). Alveoli (particularly in COPD) are prone to collapse (atelectasis) and difficult to reinflate. The maintenance of a positive pressure in the airways helps to keep them inflated while the positive pressure outside the alveoli helps to reinflate those that have already collapsed (Woodrow, 2003a). Fully inflating the alveoli increases surface area for gaseous exchange (Preston, 2001), and allows them to continue to exchange gases between breaths (Woodrow, 2003a).

**IPAP and EPAP**

IPAP and EPAP work together to facilitate efficient overall ventilation but have slightly different effects. IPAP increases tidal volume – the air that passes in and out of the lungs in each breath cycle (Woodrow, 2003b). This enhances alveolar ventilation and decreases carbon dioxide levels (Preston, 2001). The difference between IPAP and EPAP creates a pressure support that also increases breath size and allows more carbon dioxide to be flushed out (Woodrow, 2003b).

EPAP specifically increases the functional residual capacity of the lungs and prevents airway closure during expiration, thereby boosting oxygen levels (Preston, 2001). The increased alveolar pressure also forces interstitial fluid back into the pulmonary circulation, therefore decreasing oedema and improving gaseous exchange (Woodrow, 2003b). By assisting ventilation in this manner the patient’s dyspnoea is alleviated and respiratory muscle effort is decreased, reducing the use of accessory muscles and associated oxygen expenditure (Preston, 2001). NIV is provided alongside traditional treatment such as IV or oral antibiotics, systemic corticosteroids and increased doses of bronchodilator via nebuliser (Schumaker and Epstein, 2004).

**LEARNING OBJECTIVES**

1. Know how to manage the care of patients who are receiving non-invasive ventilation (NIV).
2. Understand the importance of psychological support for patients on NIV, and be aware of the potential complications of this therapy.

**HOURLY MONITORING ONCE THE PATIENT IS STABILISED**

- Temperature, pulse, blood pressure
- Respiratory rate and depth, use of accessory muscles and coordination with the ventilator
- Consciousness level
- Check ventilator is on the correct settings
- Look at tubing for kinks and ensure exhaust points are not blocked or open towards the patient
- Check that the patient is comfortable
- Check the facial skin around the mask for pressure ulcers and use a hydrocolloid dressing for protection if necessary
- Examine abdomen for distension as air swallowing and nausea are possible with NIV
- Regular oral fluids can help make sputum less tenacious and easier to expectorate and can be given via a straw under the mask or by removing the mask altogether
- Ensure frequent breaks for food and fluids, chest physiotherapy and prescribed nebulisers

**Sources:** Hill (2004); BTS (2002); Preston (2001); Sawkins (2001)
BENEFITS AND CONTRAINDICATIONS
NIV avoids problems of invasive ventilation: decreased cardiac output; aspiration; tension pneumothorax; bronchospasm (Preston, 2001); the use of sedation; and the need for an ICU bed (Woodrow, 2003a). It also preserves speech, swallowing and coughing mechanisms (Preston, 2001).

Contraindications include: upper airway obstruction; post facial/upper airway/ gastrointestinal surgery; haemodynamic instability; facial abnormalities; burns; trauma; impaired consciousness; inability to protect the airway; bowel obstruction; copious respiratory secretions; vomiting; severe co-morbidity; confusion/agitation; lung contusion; coagulopathy; hypotension; shock; unstable haemodynamics; severe arterial oxygen desaturation; cerebral oedema; refractory hypoxaemia (BTS, 2002).

Hess (2004) found that severe illness, greater secretions, poor initial response and pneumonia were predictors of NIV failure. The BTS (2002) stated that NIV can be initiated provided there are contingency plans for tracheal intubation, or if it has been decided not to proceed to invasive ventilation.

STARTING BIPAP
Psychological support
Nurses should give clear instructions and involve patients in the start-up process (Sawkins, 2001). Encouraging them to hold the mask to their face while the ventilator is on and asking them to breathe with the machine is a good way to begin (Tully, 2002). Patients can also be shown how to release the mask quickly so they feel they have some control over the system. Support needs to be ongoing so they can relax and breathe with the machine (Preston, 2001).

Setting the mode
The BiPAP ventilator has three modes. The ‘spontaneous/timed’ mode allows nurses to set a breaths per minute back-up rate (Sawkins, 2001), which is synchronised with the patient’s breathing pattern. If the patient fails to inspire, the machine will initiate a breath for them. The ‘spontaneous’ mode is used if the patient can initiate all breaths (Preston, 2001; Sawkins, 2001), while the ‘timed’ mode is useful for patients who are able to maintain their own airway but unable to initiate breaths (Woodrow, 2003b).

‘Rise time’ adjusts the breath pattern (the length of time taken for inspiratory flow to rise to full pressure). With normal breathing, inspiratory pressure rises until full force is reached about halfway through inspiration. Tachypnoeic patients may need faster rise times to ensure full IPAP is reached before expiration. With obstructed airways, slower rise times may be needed to prevent distress (Woodrow, 2003b).

Fitting mask and initial observations
The full face mask is recommended for the initial 24 hours and is better for COPD patients who tend to mouthbreathe (Hess, 2004). Correct placement, position and size are key factors in the success of NIV to ensure a good seal (Preston, 2001) and prevent leakage around the eyes, which can lead to conjunctivitis (Woodrow, 2003b). Initial systemic observations should be carried out and repeated hourly when the patient’s condition is stable (see box).

Initial settings
BiPAP generators use room air unless supplementary oxygen is added through the port of the face mask (Woodrow, 2003b). Oxygen can be delivered at an initial flow rate of one litre per minute and titrated depending on ABG results and ongoing oxygen saturations, which generally aim to be maintained above 90% (Preston, 2001).

Initial generator settings are commonly IPAP 8cmH2O and EPAP 4cmH2O (Preston, 2001). At first optimal pressures may not be achievable and lower ones may have to be set then titrated upwards with the patient’s tolerance (Sawkins, 2001). IPAP can be gradually increased over 30–60 minutes and maximum levels are between 12 and 20cmH2O (BTS, 2002). Any further adjustments to the IPAP setting will impact on carbon dioxide levels while changes to the EPAP or supplementary oxygen will lead to changes in oxygenation (Woodrow, 2003b).

ONGOING MONITORING
In the acute period the patient should have continuous pulse oximetry and ECG monitoring with blood pressure recordings every 15 minutes (BTS, 2002). Pulse oximetry recording should be interpreted in light of ABG results as it gives no indication of carbon dioxide levels (Preston, 2001).

The patient will need a medical review with ABG analysis at around one, four and eight hours after commencing BiPAP, or more often if indicated (Preston, 2001). If carbon dioxide and pH levels do not improve after 6–8 hours despite optimal ventilator settings, NIV should be discontinued and invasive ventilation considered (BTS, 2002).

Decisions about what to do in the event of NIV failure must be agreed and documented prior to treatment (Booker, 2005). If NIV has been undertaken as the ceiling of treatment in a patient who is not suitable for intubation, it should be stopped and an alternative treatment implemented (BTS, 2002).