

# More about...Emergency medicine

## Non-invasive positive pressure ventilation (NPPV) in the emergency unit

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Non-invasive ventilation has become a frequently used modality in intensive care units in South Africa. Although it is not yet standard practice in our country, new research proves that there is a definite place for non-invasive positive pressure ventilation (NPPV) in the emergency unit when managing a patient in acute respiratory failure.<sup>1</sup> Managers of emergency units should consider the proven benefits for patients, adding this treatment modality to their units. All staff using NPPV should be adequately trained. The availability of a pulmonary physiotherapist helps a great deal with the implementation and management of NPPV.

### Definitions

**Acute respiratory failure.** The presence of 2 of the following 4 criteria indicates acute respiratory failure: (i) acute dyspnoea; (ii) arterial oxygen partial pressure ( $P_aO_2$ ) of less than 50 mmHg at room air; (iii) arterial carbon dioxide partial pressure ( $P_aCO_2$ ) of more than 50 mmHg; and (iv) significant respiratory acidaemia.<sup>2</sup>

**CPAP.** Continuous positive airway pressure.

**BiPAP.** Bi-level positive airway pressure. It allows positive air pressure at two different levels – an inspiratory positive airway pressure (pressure support) and an expiratory airway pressure (positive end-expiratory pressure). These pressures are controlled and adjusted separately.

### NPPV in the emergency unit

#### Indications

- Acute severe asthma not responding to conventional treatment.<sup>3-5</sup>
- Acute exacerbation of chronic obstructive pulmonary disease (COPD).<sup>6</sup>
- Near drowning.<sup>7</sup>
- Acute pulmonary oedema.<sup>8</sup>
- Severe thoracic trauma.<sup>9,10</sup>
- Severe pneumonia.<sup>3</sup>
- Restrictive airway disease with respiratory failure (e.g. neuromuscular disease).<sup>1</sup>
- When intubation is not indicated (terminal illness).<sup>3</sup>

NPPV requires an awake, co-operative patient who is haemodynamically stable. It should not be used with the gasping near-death patient.

#### Contraindications<sup>1,3,11,12</sup>

- Hypovolaemia.
- Hypotension (systolic BP < 90 mmHg).
- Confused, unco-operative or comatose patient.
- Respiratory arrest, or gasping patient.
- $P_aO_2$  < 60 mmHg or saturation < 90% on a rebreather mask.
- Uncontrolled cardiac ischaemia or arrhythmias.

**Table I. Setting up a patient for NPPV<sup>5,11</sup>**

#### Requirements

- A ventilator that has non-invasive ventilation modes, or a dedicated CPAP or BiPAP ventilator
- Cardiac monitor
- Non-invasive blood pressure monitoring
- Oximeter
- One nurse per patient for serial vital signs measurement and continued observation
- Patient lies at a > 45° angle.

#### Procedure

##### Pressure settings

- Set expiratory positive pressure, CPAP or positive end-expiratory pressure (PEEP) at 3 - 5 cm
- Set inspiratory pressure (or pressure support) at 8 - 10 cm
- Inspiratory pressure should be set higher than expiratory pressure
- If the patient has difficulty during inspiration, triggering breaths, increase the expiratory positive airway pressure
- If tidal volumes are shallow (< 7 ml/kg), increase inspiratory pressures
- In hypoxic patients, increase the expiratory pressure at increments of 2 cm  $H_2O$ , keeping the inspiratory pressure constant
- In patients with hypercapnia, increase the inspiratory pressure at increments of 2 cm  $H_2O$ , increasing the expiratory pressure at 1 cm  $H_2O$  for every 2.5 cm increase in the inspiratory pressure
- Total pressures > 15 - 20 cm will rarely be tolerated
- $F_iO_2$  is titrated to achieve  $S_aO_2$  of more than 90%

Connect oxygen

Apply headgear

Check for air leaks

If required, continue nebulisations

Continue monitoring of vital signs and clinical response

Episodic removal of mask or reduction of pressures can be attempted when improvement is significant and has persisted for  $\pm$  4 hours



Fig. 1. A typical non-invasive face-mask.



Fig. 2. A non-invasive mask strapped to a 'patient's' face.



Fig. 3. A dedicated non-invasive ventilator.

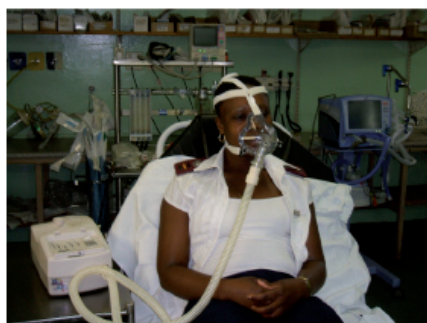


Fig. 4. A demonstration of the non-invasive ventilation system.

- Inability of the patient to protect his/her airway.
- Persistent vomiting.
- Facial trauma or anatomical abnormalities of the face, which would prevent the mask from fitting correctly.
- Recent orofacial, oesophageal or gastric surgery.

#### Advantages

- Patient's dyspnoea is relieved.
- Patient can talk and eat once stable, and requires less sedation.
- Intubation and its complications such as trauma and nosocomial infections can be avoided.

#### How it works

NPPV eases the work of breathing. Respiratory muscles are unloaded and therefore muscle fatigue is avoided. Oxygenation is improved by improving ventilation-perfusion mismatching, recruitment of collapsed alveoli and dilating bronchioles, and by forcing fluid out of the alveoli.<sup>3</sup>

Non-invasive ventilation should not be seen as a modality that reduces the nursing and monitoring requirements of the seriously ill patient. Patients on NPPV require strict monitoring of their vital signs, cardiac rhythm, dyspnoea, accessory muscle use and blood gas values. If there is no improvement of these signs after 30 minutes - 2 hours, the patient should be considered for endotracheal intubation and mechanical ventilation.

In the emergency unit, CPAP or BiPAP are most commonly delivered via a full-face mask (see Figs 1-4). Because most patients feel claustrophobic when the mask is applied, they require assistance and calming during the early stages of therapy. Initially the mask is held to the patient's face and is not strapped onto him/her, as this worsens the sensation of claustrophobia. After a few minutes, as the patient becomes accustomed to the mask and starts to relax, the mask is then strapped to him/her. See Table I for the requirements and procedure of setting up a patient for NPPV.

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## Management of the choking victim

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Foreign-body airway obstruction (choking) is probably the most frightening, yet potentially the most reversible acute emergency imaginable. If the airway is completely obstructed, progressive hypoxia develops within seconds, with unconsciousness and death following shortly thereafter, unless immediate relief is provided. The fact that this can happen to anyone at any time, regardless of state of health, physique or age, is testimony to the need to know exactly what actions are required at a moment's notice.

#### Conscious victim

Ask the victim 'Are you choking?'

- If the victim is able to cough, talk or breathe, encourage the victim to