

Non-invasive ventilation in chronic obstructive pulmonary disease: management of acute type 2 respiratory failure

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ABSTRACT – Non-invasive ventilation (NIV) in the management of acute type 2 respiratory failure in patients with chronic obstructive pulmonary disease (COPD) represents one of the major technical advances in respiratory care over the last decade. This document updates the 2002 British Thoracic Society guidance and provides a specific focus on the use of NIV in COPD patients with acute type 2 respiratory failure. While there are a variety of ventilator units available most centres now use bi-level positive airways pressure units and this guideline refers specifically to this form of ventilatory support although many of the principles encompassed are applicable to other forms of NIV. The guideline has been produced for the clinician caring for COPD patients in the emergency and ward areas of acute hospitals.

KEY WORDS: bi-level positive airways pressure units, chronic obstructive pulmonary disease, non-invasive ventilation

Introduction

Non-invasive ventilation (NIV) in the management of acute type II respiratory failure in patients with chronic obstructive pulmonary disease (COPD) represents one of the major technical advances in respiratory care over the last decade. The National Institute for Health and Clinical Excellence (NICE) recommend that NIV be available in all hospitals admitting patients with COPD.¹ This has led to a rapid expansion in the provision of NIV services with over 90% of UK admitting hospitals offering this intervention. The UK national audit of acute hospital COPD care in 2003, however, suggested that treatment was often applied to patients outside the existing British Thoracic Society (BTS) inclusion criteria.^{2,3} This document updates the 2002 BTS guidance and provides a specific focus on the use of NIV in COPD patients with acute type 2 respiratory failure. While there are a variety of ventilator units available most centres now use bi-level positive airways pressure (BiPAP) units and this guideline refers specifically to this form of ventilatory support

although many of the principles encompassed are applicable to other forms of NIV. The guideline has been produced for the clinician caring for COPD patients in the emergency and ward areas of acute hospitals. Guideline development was in accordance with the AGREE principles and is summarised in the online version of this guideline (www.rcplondon.ac.uk/pubs/brochure.aspx?e=258). An extended version of this guideline encompassing service provision is available on the BTS website.

Clinical context

Non-invasive ventilation, within the intensive care unit and the ward environment, has been shown in randomised controlled trials and systematic reviews to reduce intubation rate and mortality in COPD patients with decompensated respiratory acidosis (pH <7.35 and PaCO₂ >6 kPa) following immediate medical therapy.^{5–14} It should therefore be considered within the first 60 minutes of hospital arrival in all patients with an acute exacerbation of COPD in whom a respiratory acidosis persists despite maximum standard medical treatment, which includes:

- controlled oxygen to maintain SaO₂ 88–92%
- nebulised salbutamol 2.5–5 mg
- nebulised ipratropium 500 µg
- prednisolone 30 mg
- antibiotic agent (when indicated).

A clearly documented treatment plan for NIV, including how potential failure will be dealt with and whether escalation to intubation and mechanical ventilation is indicated, should be documented in the case notes at the outset of treatment. Whenever possible the patient and carers should be involved in these discussions. Once started, patient comfort, breathing synchrony and enhanced compliance are key factors in determining outcome. Low starting pressures increase patient compliance but should be quickly adjusted upwards to achieve therapeutic effect. If effective, treatment will usually be required until the acute cause has resolved, commonly about two to three days.

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The guidelines

Recommendation	Grade
A Documentation	
<p>1 An acute non-invasive ventilation (NIV) service should have a local protocol stating:</p> <ul style="list-style-type: none"> ● criteria for selection and treatment of patients^{9,16,17,18} ● the local setting in which they should be treated. <p>More complex or sicker patients, eg with a pH <7.26, should be managed with a low threshold for intubation, unless NIV is deemed to be the ceiling of treatment, and be admitted to a high dependency unit or intensive care unit (ICU) depending upon local circumstances.^{2,9}</p>	A
<p>2 Documentation for each patient should include:</p> <ul style="list-style-type: none"> ● a written prescription for the use of acute NIV ● a record of compliance including breathing synchrony with NIV treatment documented including hours of use, times on NIV ● a documented plan which addresses: <ul style="list-style-type: none"> – how potential failure of NIV will be dealt with – whether escalation of care is indicated – whether NIV is the ceiling of treatment – whether the patient is for resuscitation or specific palliative care measures. <p>Patient-orientated literature on the use of NIV should be available for all patients with chronic obstructive pulmonary disease (COPD) treated in hospital.</p>	C
B Patient selection	
<p>1 NIV should be considered in all patients with an acute exacerbation of COPD in whom a respiratory acidosis (pH <7.35, PaCO₂ >6 kPa) persists despite immediate maximum standard medical treatment on controlled oxygen therapy for no more than one hour.^{12,13}</p>	A
<p>2 Patients should be stratified into five groups based on:</p> <ul style="list-style-type: none"> ● their pre-morbid state ● the severity of the physiological disturbance ● the reversibility of the acute illness ● the presence of relative contraindications ● the patient's wishes, where possible. 	C
<p>3 The stratification should be recorded in the medical notes.</p> <ol style="list-style-type: none"> (1) Requiring immediate intubation and ventilation (2) Suitable for NIV and suitable for escalation to intensive care treatment/ intubation and ventilation if required (3) Suitable for NIV but not suitable for escalation to intensive care treatment/ intubation and ventilation (4) Not suitable for NIV but for full active medical management (5) Palliative care agreed as most appropriate management. 	C
C Set-up	
<p>1 The decision to commence NIV should be made by a doctor of specialty training (ST) level 2 or above who is competent to do so.</p> <p>A trained and competent healthcare professional should initiate NIV.¹⁶</p> <p>The patient should be in a sitting or semi-recumbent position in bed and the following are recommended:</p> <ul style="list-style-type: none"> ● a full-face mask for the first 24 hours followed by switch to a nasal mask if preferred by the patient ● an initial inspiratory positive airway pressure (IPAP) of 10 cm H₂O and expiratory positive airway pressure (EPAP) of 4–5 cm H₂O. These settings are well tolerated by most patients⁹ 	C

continued

The guidelines – continued

Recommendation	Grade
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- IPAP should be increased by 2–5 cm increments at a rate of approximately 5 cm H₂O each 10 minutes with a usual pressure target of 20 cms H₂O or until a therapeutic response is achieved or patient tolerability has been reached⁹
- oxygen when required should be entrained into the circuit and then the flow adjusted to achieve the target saturation, usually 88–92%¹⁹
- bronchodilators should preferably be administered off NIV but may be administered on NIV and when so should be entrained between the expiration port and face mask. Delivery of both oxygen and nebulised solutions is affected by NIV pressure settings^{20–22}
- if a nasogastric tube is in place, a fine bore tube is preferred to minimise mask leakage.

D Monitoring

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| <p>1 Monitoring should include a mixture of physiological measures and clinical parameters.^{23–27}</p> <p>These should be used to formulate a management plan and within the first 4 hours of NIV assist in the decision as to the need to escalate to intubation.^{4,9}</p> | <p>B</p> <p>A</p> |
| <p>2 Staff involved in the care and monitoring of NIV patients should be appropriately trained and experienced.^{16,28,29}</p> | <p>B</p> |
| <p>3 The following should be recorded and be used to formulate an iterative management plan:</p> <ul style="list-style-type: none"> ● baseline observations: <ul style="list-style-type: none"> – arterial blood gas (ABG) – respiratory rate – heart rate ● continuous pulse oximetry and electrocardiogram recording during the first 12 hours²³ ● repeat ABGs: <ul style="list-style-type: none"> – after one hour of NIV therapy and one hour after every subsequent change in settings – further ABG at four hours or earlier in patients who are not improving clinically ● frequent clinical monitoring of acutely ill patients: <ul style="list-style-type: none"> – every 15 minutes in the first hour – every 30 minutes in the 1–4 hour period – hourly in the 4–12 hour period ● observations should include: <ul style="list-style-type: none"> – respiratory rate – heart rate – level of consciousness – patient comfort – chest wall movement – ventilator synchrony – accessory muscle use. | <p>C</p> |
| <p>4 Patient comfort and enhanced compliance are key factors in determining outcome.</p> <ul style="list-style-type: none"> ● Synchrony of ventilation should be checked frequently. ● A clinical assessment of mask fit to include skin condition and degree of leak (particularly onto the corneas) should be performed at the same time.^{9,27} | <p>A</p> |

E Escalation

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| <p>1 A management plan in the event of NIV failure should be made at the outset:</p> <ul style="list-style-type: none"> ● the appropriateness for escalation to invasive mechanical ventilation should be assessed and recorded at the initiation of NIV ● when uncertainty exists or the patient is to be denied invasive mechanical ventilation then this should be discussed with the responsible clinical consultant | <p>C</p> |
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continued

The guidelines – continued

Recommendation	Grade
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- if escalation is deemed appropriate this should be discussed with the ICU team
- treatment options should also where possible be discussed with the patient unless they do not have capacity to do so.³⁰

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| 2 | A decision to intubate and proceed to invasive mechanical ventilation should normally be made within four hours or sooner of starting NIV. Improvements in respiratory rate, heart rate and ABG parameters are usually apparent within this time. ^{9,16} | A |
| 3 | Intubation rather than further NIV should be considered in patients suffering 'late failure' (defined as failure after 48 hours of NIV). ³¹ | B |
| 4 | Decisions not to proceed to invasive mechanical ventilation should be taken by a consultant. | C |

F Duration of treatment

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| 1 | Patients who benefit from NIV during the first four hours of treatment should receive NIV for as long as possible (minimum of six hours) during the first 24 hours. ^{4,5,6,32,33} | A |
| 2 | Treatment should last until the acute cause has resolved, commonly about two to three days. | C |
| 3 | In patients in whom NIV is successful (pH ≥ 7.35 achieved, resolution of underlying cause and symptoms, respiratory rate normalised) following the first 24 hours or longer, it is appropriate to start a weaning plan: <ul style="list-style-type: none"> • gradual reduction of the duration of NIV should be determined by clinical improvement • the use of a pro forma to chart physiological indices has been shown to improve successful weaning from NIV.³³ | C |

G Weaning

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| 1 | Initially weaning should be during the day with extended periods off the ventilator for meals, physiotherapy, nebulised therapy etc.
After successfully weaning during the day, many patients will require an additional night on NIV. | C |
| 2 | The weaning strategy should be documented in the medical and nursing records. The following is recommended: ^{7,17} <ul style="list-style-type: none"> • continue NIV for 16 hours on day 2 • 12 hours on day 3 including 6–8 hours overnight use • NIV may be discontinued on day 4 unless continuation is clinically indicated • some patients may determine at an earlier stage that they no longer require NIV and self-wean • some patients improve rapidly and a clinical decision to wean early can be made • long-term nocturnal support may be indicated in selected patients following assessment by the respiratory team. | C
A |

H Palliation

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| 1 | Palliation of symptoms is appropriate in some patients where standard medical treatment and NIV fails and a decision has been made and documented not to escalate to intubation and mechanical ventilation or where a patient chooses not to have NIV or other interventionist treatment. ³⁴ <ul style="list-style-type: none"> • If the patient gains symptom relief continued NIV may be appropriate for palliation of breathlessness, but normally would be withdrawn. • Opiates and benzodiazepines can be used to treat breathlessness in this situation. • The palliative care team should be involved and a suitable care pathway followed after discussion with the patient and family. | C |
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