Holistic assessment of patients with COPD before the use of non-invasive ventilation

This article uses a case study to illustrate why patients with COPD require holistic assessment and arterial blood gas analysis before non-invasive ventilation is used.

Lung function tests and respiratory symptoms are used to diagnose COPD. Periodic worsening of these symptoms indicates an exacerbation of COPD (Box 1).

Pharmaceutical management of an acute exacerbation of COPD may include:
- Increased frequency of bronchodilators;
- Antibiotics to treat signs of infection;
- Corticosteroids;
- Theophyllines and respiratory stimulants.

Many patients improve rapidly if optimal oxygen therapy is used alongside pharmaceutical management (British Thoracic Society Standards of Care Committee, 2002). However, optimising oxygen therapy requires careful monitoring of both oxygen and carbon dioxide levels in the blood using arterial blood gas analysis. Interpreting an arterial blood gas is complicated but analysis is used with increasing regularity on general wards in acute hospitals (Lynes, 2003), and nurses need to understand when and why blood gases are monitored.


Types of respiratory failure

Type 1 respiratory failure describes an abnormally low concentration of oxygen in the blood where the partial pressure of oxygen dissolved in arterial blood (PaO₂) is low (<8kPa), while the carbon dioxide level (PaCO₂) is normal or low (4.5–5.8kPa).

Type 2 respiratory failure occurs when a patient has low oxygen levels but carbon dioxide levels are raised. Definitions are summarised in Box 2.

In type 2 respiratory failure, blood gas analysis helps to clarify the speed at which the failure has occurred.

- If the deterioration is rapid (acute), the rising level of carbon dioxide in the blood will affect the body’s ability to compensate for the increased acidity. The result is that the pH of the blood becomes acidic. (It will move below the normal pH of 7.4.)
- If the deterioration is chronic, the body has time to compensate for the retention of carbon dioxide by retaining bicarbonate ions (which are alkaline). The blood gas will display an elevated PaCO₂ and an elevated HCO₃⁻ (bicarbonate ion concentration) but the pH will remain normal.

Acute-on-chronic type 2 respiratory failure will display a mixture of the above. An acute exacerbation of COPD may result in an acidic pH (<7.4), depicting the acute phase of the condition, but the patient will have raised carbon dioxide and bicarbonate levels associated with the chronic disease.

Box 3 outlines the systematic approach that should be used to analyse arterial blood gas. It is possible to adopt an inappropriate management plan if the final step of interpreting the blood gas within the context of the patient’s presenting symptoms is missed.

Using non-invasive ventilation

Non-invasive ventilation in the form of Bilevel Positive Airways Pressure (BiPAP) may be appropriate if the patient has acute or acute-on-chronic type 2 respiratory failure that fails to respond to standard medical therapy. It can be used:

- As a holding measure while the use of additional therapies is discussed;
- As a trial, with a view to mechanical ventilation if the patient fails to improve;
- As a ceiling of treatment (NICE, 2004). Contraindications to its use are in Box 4.
Updated BTS guidelines (Royal College of Physicians et al, 2008) recommend that a stratification system is used, whereby patients are classified according to the most appropriate treatment depending on their co-morbidities.

These classifications are:
- Immediate intubation and ventilation;
- Suitable for non-invasive BiPAP and intubation if the non-invasive BiPAP fails;
- For non-invasive BiPAP but not for intubation or intensive care if the non-invasive BiPAP fails;
- Not suitable for non-invasive or invasive ventilation but for active medical treatment;
- For palliative care only.

The indications and contraindications do not highlight the real consequences of using BiPAP inappropriately. The following case study identifies how to use BiPAP in an acute situation to resolve an immediate clinical problem but how it can also lead to mismanagement of a patient’s condition.

**CASE STUDY**
The following blood gas reading was taken when Mr Smith was breathing 28% oxygen from a venturi mask, after admission from a GP to the respiratory ward of a general hospital (the patient’s name has been

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**BOX 4. CONTRAINDICATIONS TO THE APPLICATION OF BIPAP**
- Recent facial or upper airway surgery
- Facial abnormalities, burns or trauma
- Fixed upper airway obstruction
- Vomiting
- Recent upper gastrointestinal surgery
- Copious respiratory secretions
- Life-threatening hypoxaemia
- Severe co-morbidity
- Untreated pneumothorax

Source: RCP (2008)
changed). Mr Smith has been diagnosed with an exacerbation of COPD:

- pH 7.19kPa
- PCO₂ 11.6kPa
- PO₂ 6.2kPa
- HCO₃⁻ 26mEq/L. See Box 5 for normal levels.

These arterial blood gas results depict an acute respiratory acidosis (an acidic pH of <7.4, a low PaO₂ and a raised PaCO₂ or carbon dioxide retention), and conform to the classic definition of type 2 respiratory failure (Box 2).

However, the appropriate management plan for this patient will vary considerably, depending on his presenting signs and symptoms, as well as the acute or chronic nature of his disease.

### MANAGEMENT OPTIONS

#### Option 1

BiPAP, a form of non-invasive ventilation, could be administered with the key aims of increasing the patient’s depth of breathing (tidal volume) and so reducing his respiratory rate and work of breathing (Tully, 2002).

By optimising the patient’s BiPAP settings in accordance with RCP et al (2008) guidelines, you would expect an improvement/reduction in the acidosis on the next blood gas (pH moving towards 7.4 as a result of the reduction in retained levels of CO₂).

Non-invasive BiPAP can be performed on a general ward (Elliott et al, 2002) and, despite its slightly claustrophobic nature, it is generally well tolerated and can offer a lifeline to some patients.

Once the decision to use BiPAP has been made, it is necessary to address the question of whether this intervention represents the ceiling of COPD with the result that his quality of life is severely limited, and it may be appropriate to start a discussion about the need for palliative care rather than active treatment of his chronic disease.

While the application of non-invasive BiPAP can give Mr Smith and the healthcare team time to review this decision, it may be seen as a means of extending life and causing distress to a patient at the terminal stage of a disease process (Prigmore, 2006).

Once the decision to provide palliative care has been made, taking subsequent arterial blood gas samples would be inappropriate as the procedure can cause the patient pain and distress.

Observation of Mr Smith’s respiratory rate, level of consciousness and work of breathing can be used by nurses to inform them of changes in his condition.

#### Option 2

If the patient’s consciousness level is deteriorating rapidly, this key symptom will influence the decision to adopt option 2.

With no other information available, the appropriate management would be immediate intubation and mechanical ventilation.

Non-invasive ventilation relies on an awake and compliant patient (NICE, 2004) and will assist respiratory effort when spontaneous breathing is present and the patient can maintain an open airway.

Delaying intubation with a trial of BiPAP on a patient whose consciousness level is deteriorating will increase the risk of a respiratory arrest.

#### Option 3

This is used if auscultation of the patient’s lungs identifies that there are copious upper airway secretions but the patient is exhausted and unable to clear them.

An increase in both volume and viscosity of secretions is a common symptom of exacerbations of COPD. The application of BiPAP at this stage may inhibit the removal of these secretions, especially if it is administered without humidification.

Removal of secretions by oral or deep suctioning (potentially involving the insertion of a nasopharyngeal airway) will keep an airway patent and may also relieve the acute respiratory symptoms and negate the need for non-invasive ventilation.

#### Option 4

This describes the care of Mr Smith during a subsequent hospital admission. Some patients with COPD will go on to develop chronically raised carbon dioxide and bicarbonate levels. This blood gas result is included to highlight the evolving chronic ill health of the patient.

In option 4, the blood gas result is:

<table>
<thead>
<tr>
<th>pH</th>
<th>7.19</th>
</tr>
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<tbody>
<tr>
<td>PCO₂</td>
<td>11.6kPa</td>
</tr>
<tr>
<td>PO₂</td>
<td>6.2kPa</td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>38mEq/L</td>
</tr>
</tbody>
</table>

The raised bicarbonate level suggests that Mr Smith’s respiratory acidosis has a chronic and an acute element.

The patient has had numerous exacerbations of COPD with the result that his quality of life is severely limited, and it may be appropriate to start a discussion about the need for palliative care rather than active treatment of his chronic disease.

While the application of non-invasive BiPAP can give Mr Smith and the healthcare team time to review this decision, it may be seen as a means of extending life and causing distress to a patient at the terminal stage of a disease process (Prigmore, 2006).

Once the decision to provide palliative care has been made, taking subsequent arterial blood gas samples would be inappropriate as the procedure can cause the patient pain and distress.

Observation of Mr Smith’s respiratory rate, level of consciousness and work of breathing can be used by nurses to inform them of changes in his condition.

### CONCLUSION

Non-invasive BiPAP can be life-saving for some patients admitted with exacerbations of COPD in type 2 respiratory failure. However, without thorough nursing assessment, alongside accurate arterial blood gas interpretation, suboptimal care may be administered.

Nurses need to be vigilant with their observations and be prepared to broach key questions with their medical colleagues about ongoing management of these patients.

### REFERENCES


