ACUTE RESPIRATORY FAILURE
1: ASSESSING PATIENTS

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This is the first in a two-part unit on acute respiratory failure. Part 1 explores respiratory failure and its causes and identifies ways of recognising patients in acute respiratory failure.

Respiratory failure is an inability to maintain adequate gaseous exchange. Normal respiration occurs through negative pressure ventilation – air is drawn into the lungs as the diaphragm contracts and the intercostal muscles move the ribcage out. The impetus for this comes from the lowering of blood pH, caused mainly by raised carbon dioxide levels in the blood as a result of normal cellular respiration. The functional lung units (alveoli) are filled with air, which has a higher concentration of oxygen than the blood in the capillary network surrounding the alveoli. Oxygen moves into the blood by diffusion where it binds with haemoglobin to form oxyhaemoglobin, which is transported around the body. At the same time carbon dioxide moves from the blood to the alveoli and is then excreted via exhalation.

Broadly speaking, respiratory failure falls into two groups: type 1 and type 2.

TYPE 1 RESPIRATORY FAILURE
Type 1 refers to hypoxaemia, in which there is a decrease in the oxygen supply to a tissue. Hypoxaemia is mainly caused by a disturbance between the ventilation (gas) and perfusion (blood) relationship within the lungs. Levels of carbon dioxide in the blood can remain normal or reduce as the amount of gas breathed in and out each minute increases to compensate for lack of oxygen.

Common causes of type 1 respiratory failure include:
- Atelectasis: a collapse of lung units;
- Pneumonia: an inflammation of the lung tissue, usually of infective origin;
- Pulmonary oedema: an accumulation of fluid in the lungs.

Cell metabolism in the presence of reduced oxygen leads to accumulation of acid. This has negative effects on organ performance and metabolism and, ultimately, leads to cellular death.

TYPE 2 RESPIRATORY FAILURE
Type 2 refers to hypercapnoea, the presence of an abnormally high level of carbon dioxide in the circulating blood, which can occur with or without hypoxia. This type of respiratory failure is primarily caused by a reduction in the amount of gas inhaled and exhaled over time (minute ventilation), usually expressed as hypoventilation.

The inability to excrete carbon dioxide results in a systemic acidosis, which has negative effects on organ performance and metabolism, ultimately leading to cellular death. In chronic situations the body responds to the acidosis by producing more buffers, thus ‘compensating’ for the failure. This process is typically seen in patients with COPD and can be exacerbated by acute illness, such as chest infection.

Common causes of type 2 respiratory failure include:
- Depression of the respiratory centre such as opiate overdose;
- Acute chest disease: infection, asthma, pneumonia;
- Spinal injury;
- Acute neuromuscular disease: myasthenic crisis, Guillain-Barre syndrome;
- Pneumothorax or haemothorax;
- Airway obstruction: foreign bodies or swelling/oedema.

PATIENT ASSESSMENT
Acute respiratory failure is a life-threatening condition. It is important to undertake an accurate assessment so the most appropriate nursing care and treatment can be administered and then evaluated effectively (Jevon and Ewens, 2001).

General presentation
Patients with respiratory failure may appear anxious or exhausted or they may be unresponsive. Hypoxia and hypercapnoea can alter mental state, and confusion or delirium may be present. Skin colour may be pale and central cyanosis may be evident; this is usually demonstrated as a blue tinge to the skin and mucous membranes, particularly the lips. Patients with hypercapnoea may appear flushed as a result of vasodilation associated with high carbon dioxide levels.

Patients may adopt a certain posture, intended to maximise lung expansion, such as sitting forward with shoulders hunched. They may experience further respiratory distress when lying down (orthopnoea). Pursed-lipped breathing may also be present as a compensatory mechanism to improve gas exchange.

Ability to talk and communicate can indicate the degree of the respiratory failure. Patients who are severely breathless will seldom talk in sentences and tend to give short answers to questions or use non-verbal communication.

The airway
Airway patency, artificial or otherwise, should be asessed in the first instance. Airway sounds should be listenened for – snoring or stertorous breathing may indicate partial airway obstruction. Stridor – a harsh, vibrating sound, may be present...
during inspiration or expiration and may indicate partial obstruction. Secretions in the upper airway may also be heard as low gurgling sounds. Airway obstruction should be treated immediately (see part 2).

Respiratory rate and characteristics

Changes in respiratory rate can be the most important early clinical manifestation of critical illness (Goldhill et al, 1999). Respiratory rate should be measured and recorded in all patients, particularly those at risk, as recommended in local policies and guidelines to provide trends for further analysis. Electronic devices are available to perform this task but may be unreliable so ‘manual’ measurement – counting the number of breaths per minute – is recommended.

The normal resting respiratory rate for adults is 10–15 breaths per minute but some people with long-term conditions may have higher ‘normal’ rates. A change or increase in respiratory rate should alert nurses that a patient may be deteriorating and further monitoring should be put in place with prompt review by senior staff. Normal breathing is regular and rhythmic and any abnormalities in breathing pattern should be noted and reported as they may indicate neurological dysfunction or acid base disturbance.

Assessment of respiratory sounds may include inspiratory or expiratory ‘wheeze’, which may indicate bronchospasm. Upper airway secretions may also be heard as gurgling sounds.

Chest movement should be assessed for its symmetry and pattern. The chest wall should be observed for overall integrity – recession of any part may indicate rib fracture or flail segments. Decreased movement in one side may indicate a pneumothorax or collapsed lung/area of lung. Accessory muscles, such as the sternocleidomastoid and the scalene muscles, may be used in respiratory failure as an attempt to improve gas exchange. Abdominal muscles may also be used in order to improve diaphragmatic contraction. Patients with airway obstruction may demonstrate a paradoxical movement of the abdomen and chest wall.

Respiratory volumes, including vital capacity and tidal volume, may be measured using a spirometer. These volumes may be particularly useful when viewed as a trend or in the management of longer-term respiratory problems. Subjective assessment of breath size may be particularly useful in the acute situation. Breathing should be noted as shallow, deep or normal and, again, this should be compared against patients’ normal rate. Peak expiratory flow rate is a convenient, inexpensive measurement of airway calibre and most useful when expressed as a percentage of patients’ previous best value (British Thoracic Society Standards of Care Committee, 2002) or charted as a trend. Peak expiratory flow rates of 50–70% of patients’ personal best indicate severe airway obstruction (Smyth, 2005).

Acute respiratory failure is often linked with increased pulmonary secretions. The volume and type of these should both be noted and specimens sent for microbiological analysis as necessary. Green or yellowish purulent secretions may indicate an infective process, whereas white or pink frothy secretions may indicate pulmonary oedema and a cardiogenic cause of failure. The type, frequency and causes of stimulation of any cough should also be noted.

PULSE OXIMETRY

Pulse oximetry has a useful role in assessing patients with respiratory failure. It measures the percentage of haemoglobin that is saturated with oxygen. However, it does not provide information on haemoglobin concentration, oxygen delivery to the tissues or ventilatory function, so patients may have normal oxygen saturations yet still be hypoxic (Higgins, 2005). The reliability of pulse oximeters is also questionable in patients who are cold, vasoconstricted or shivering. Any information that is gained using pulse oximetry must be viewed in conjunction with information from physical assessments (Casey, 2001).

ARTERIAL BLOOD GAS ANALYSIS

Arterial blood gas and acid base balance analysis can contribute significantly to managing patients who are in respiratory failure and the effectiveness of any treatment. It allows accurate measurement of blood acidity/alkalinity as well as measurement of levels of arterial oxygen and carbon dioxide. Interpretation of results is often complex.

Key references

- The full reference list for this unit is available in Portfolio Pages at nursingtimes.net

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