NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Interventional procedures consultation document

Extracorporeal carbon dioxide removal for acute respiratory failure

Acute respiratory failure (when the lungs do not work effectively) is a life-threatening condition. It can cause a person's blood to have abnormally low levels of oxygen (hypoxia) or abnormally high levels of carbon dioxide (hypercapnia), or both.

In this procedure, blood is taken from the circulation out of the body (extracorporeal). It is then passed across a synthetic membrane that allows some of the carbon dioxide to be removed. The aim of the procedure is to lower carbon dioxide levels in the blood independently of the lungs.

NICE is looking at extracorporeal carbon dioxide removal for acute respiratory failure. This is a review of NICE's interventional procedures guidance on extracorporeal carbon dioxide removal for acute respiratory failure.

NICE's interventional procedures advisory committee met to consider the evidence and the opinions of professional experts with knowledge of the procedure.

This document contains the draft guidance for consultation. Your views are welcome, particularly:

- comments on the draft recommendations
- information about factual inaccuracies
- additional relevant evidence, with references if possible.

NICE is committed to promoting equality of opportunity, eliminating unlawful discrimination and fostering good relations between people with particular protected characteristics and others.

This is not NICE's final guidance on this procedure. The draft guidance may change after this consultation.

After consultation ends, the committee will:

- meet again to consider the consultation comments, review the evidence and make appropriate changes to the draft guidance

- prepare a second draft, which will go through a resolution process before the final guidance is agreed.

Please note that we reserve the right to summarise and edit comments received during consultation or not to publish them at all if, in the reasonable opinion of NICE, there are a lot of comments or if publishing the comments would be unlawful or otherwise inappropriate.

Closing date for comments: 26 July 2023

Target date for publication of guidance: November 2023

1 Draft recommendations

1.1 For people with acute hypoxic respiratory failure, extracorporeal carbon dioxide removal should not be used. Find out why NICE recommends not to use some procedures on the NICE interventional procedures guidance page.

1.2 For people with acute hypercapnic respiratory failure, extracorporeal carbon dioxide removal should be used only in research. Find out what only in research means on the NICE interventional procedures guidance page.

1.3 Patient selection should be done by a multidisciplinary team including clinicians with specialist expertise in managing acute hypercapnic respiratory failure.

1.4 The procedure should only be done by clinicians with specialist expertise in the procedure in specialist intensive care centres with appropriate levels of support.

1.5 Research should report:

- short- and long-term:
  - patient-reported outcomes
  - improvements in respiratory function
- adverse events including:
  - bleeding
  - symptomatic and asymptomatic intracranial bleeding
  - infection
  - cannulation complications
  - pain.

Why the committee made these recommendations

Some people with acute respiratory failure have low levels of oxygen in their blood (acute hypoxic respiratory failure). When compared with standard care,

available evidence shows that extracorporeal carbon dioxide removal has no effect on how long these people live, how long they spend in hospital, or how long they spend in intensive care. There is also evidence of an increased risk of bleeding in the brain when this procedure is used. So, this procedure should not be done for acute hypoxic respiratory failure.

Some people with acute respiratory failure have increased levels of carbon dioxide in their blood (acute hypercapnic respiratory failure). There is limited evidence for the efficacy of extracorporeal carbon dioxide removal in this group, and there are safety concerns around its use. When compared with standard care, the evidence suggests that people who have this procedure spend less time on ventilation, and there is no change in the number of serious adverse events. But it is uncertain if this procedure leads to improved long-term benefits. So, this procedure should only be used in research for acute hypercapnic respiratory failure.

2 The condition, current treatments and procedure

The condition

2.1 Acute respiratory failure is a life-threatening condition. It can cause hypoxia (abnormally low levels of oxygen in the blood), hypercapnia (abnormally high levels of carbon dioxide in the blood), or both. Acute respiratory distress syndrome is a severe type of acute respiratory failure. It can be caused by conditions including sepsis, pneumonia, respiratory viruses, chest trauma, inhalational injury, aspiration, and pancreatitis. The most common cause of hypercapnic respiratory failure is an acute exacerbation of chronic obstructive pulmonary disease.

Current treatments

2.2 The management of acute respiratory failure involves treating the underlying cause and providing increased oxygen by non-invasive or invasive ventilation.

The procedure

2.3 The 2 main types of extracorporeal carbon dioxide removal ($ECCO_2R$) are venovenous ($vvECCO_2R$) and arteriovenous ($avECCO_2R$). In both types, cannulae are connected to a low-resistance synthetic membrane device where exchange of carbon dioxide takes place. In $vvECCO_2R$, either a single-access double-lumen catheter or a dual-access system using 2 venous catheters is inserted into a large vein or veins (usually the femoral or internal jugular veins) and connected to a venovenous circuit. Flow across the membrane is maintained using a pump. In $avECCO_2R$, cannulae are inserted into an artery and a vein (usually the femoral artery and femoral vein). Arterial blood pressure drives blood continuously through the device and it is returned through the vein.

2.4 $ECCO_2R$ can be done using either a true $ECCO_2R$ system or a modified extracorporeal membrane oxygenation system. People having $ECCO_2R$ are given blood thinning drugs such as heparin to prevent blood clots forming in the circuit.

2.5 $ECCO_2R$ can be used in people with acute hypoxic respiratory failure. The aim of $ECCO_2R$ is to lower carbon dioxide levels in the blood in people with acute respiratory failure, independently of the lungs. Lung-protective ventilation settings such as lower airway pressures and lower tidal volumes can be used to reduce the risk of ventilator-induced lung injury. However, using lung-protective settings can cause carbon dioxide levels to rise, leading to negative effects. $ECCO_2R$ is used to reduce blood carbon dioxide levels so that lung-protective ventilation settings can be maintained. This may improve the likelihood and speed of lung recovery.

2.6 $ECCO_2R$ can be used in people with acute hypercapnic respiratory failure with the aim of reducing the need for intubation and mechanical ventilation. It may also reduce the length of time that a person receives non-invasive ventilation.

3 Committee considerations

The evidence

3.1 NICE did a rapid review of the published literature on the efficacy and safety of this procedure. This comprised a comprehensive literature search incorporating literature published since the last interventional procedures guidance on this procedure and a detailed review of the evidence from 9 sources, which was discussed by the committee. The evidence included 2 systematic reviews and meta-analyses, 3 randomised controlled trials (RCTs), a long-term follow-up analysis of 1 of the RCTs, 2 case series, and a secondary analysis of 1 of the case series. It is presented in the summary of key evidence section in the interventional procedures overview. Other relevant literature is in the appendix of the overview.

3.2 The professional experts and the committee considered the key efficacy outcomes to be: mortality, reduction in hospital length of stay, reduction in intensive care unit length of stay, and reduction in duration of ventilation.

3.3 The professional experts and the committee considered the key safety outcomes to be: bleeding, intracranial bleeding, infection, and cannulation complications.

3.4 Patient commentary was sought but none was received.

Committee comments

3.5 The committee was informed that the use of arteriovenous extracorporeal carbon dioxide removal ($ECCO_2R$) is largely being replaced by venovenous $ECCO_2R$ in the UK.

3.6 The committee noted that there are ongoing clinical trials into the use of $ECCO_2R$ for acute hypercapnic respiratory failure.

3.7 The committee was informed that implementation of standard care such as non-invasive ventilation is variable across centres.

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Chair, interventional procedures advisory committee
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