Supportive therapy with extracorporeal membrane oxygenation for acute respiratory distress syndrome

Acute respiratory distress syndrome is a severe form of respiratory failure characterized by acute onset of significant hypoxaemia (PaO_2:FiO_2 <200 mmHg) with diffuse bilateral pulmonary air-space shadowing on chest X-ray, without clinical signs of heart failure (Bernard et al, 1994). It has a heterogeneous aetiology with wide-ranging pulmonary and extra-pulmonary causes. It commonly requires intensive care unit admission with high mortality and morbidity.

Different management strategies have been investigated for patients with acute respiratory distress syndrome. Ventilation using low tidal volumes of 6 ml/kg *vs* 12 ml/kg has been shown by the ARDSnet Group (Acute Respiratory Distress Syndrome Network, 2000) to have a significant mortality benefit. However, other potential therapeutic interventions, e.g. inhaled nitric oxide, high frequency oscillatory ventilation and prone ventilation, have not significantly reduced mortality.

There has been a great deal of interest in the role of extracorporeal membrane oxygenation as an adjunct in the management of patients with severe acute respiratory distress syndrome. Extracorporeal membrane oxygenation was developed from the cardiopulmonary bypass methods used in cardiac surgery and was first described as a treatment for severe respiratory failure by Hill et al (1972). There have been multiple anecdotal reports of extracorporeal membrane oxygenation as a rescue technique in adult acute respiratory distress syndrome.

Extracorporeal membrane oxygenation should be used

Extracorporeal membrane oxygenation is an alternative means of delivering oxygen to the circulation. It potentially avoids damaging ventilatory strategies and allows time for the precipitant cause of the patient's acute respiratory distress syndrome to be treated. The use of extracorporeal membrane oxygenation in cardiac surgery and in paediatrics is well established. Mugford et al's (2008) meta-analysis supports its use in cases of severe respiratory failure in non-premature newborns.

A randomized controlled trial involved 180 adult patients with acute respiratory distress syndrome who received either standard ventilatory management in their referring hospital or transfer to Glenfield Hospital, Leicester for consideration of extracorporeal membrane oxygenation (Peek et al, 2009). There was decreased 6-month mortality or severe disability (37% *vs* 53%, P=0.03) in patients transferred.

Extracorporeal membrane oxygenation has historically been seen as a 'rescue' technique which could result in failure to demonstrate clear efficacy in its use as a result of selection bias. As it is rarely attempted outside specialist centres, its widespread adoption may improve skills and decrease the overall morbidity and mortality compared to current levels.

Extracorporeal membrane oxygenation should not be used

There are a number of inherent problems of extracorporeal membrane oxygenation use. The process involves insertion of very large cannulae and systemic anticoagulation. There is the potential for severe local trauma and bleeding, the risk of embolic events and, in the longer term, line-related sepsis. Extracorporeal membrane oxygenation requires specialist equipment, highly trained staff and constant vigilance which mean it is costly. It is only performed in a few centres in the UK and so the disadvantages and potential risk associated with the transfer of critical acute respiratory distress syndrome patients need to be considered.

In the trial by Peek et al (2009) only 70% of the conventionally managed patients received standard ARDSnet lung-protective ventilation; patients transferred to Glenfield for consideration of extracorporeal membrane oxygenation had significantly longer periods of time of low-volume, low-pressure ventilation than patients not managed at the specialist centre (P≤0·0001). Only 76% of the 90 patients randomized for consideration of extracorporeal membrane oxygenation actually received it. There was no difference in mortality for extracorporeal membrane oxygenation *vs* conventional ventilation in the overall trial population. The improved outcomes may be attributable to this centre's generalized expertise in dealing with severe acute respiratory distress syndrome.

Conclusions

The role of extracorporeal membrane oxygenation for the management of adult patients with severe acute respiratory distress syndrome is still uncertain. With more experience in its use and improvements in technology, particularly with more portable machines, it could be valuable in future. Further trials are needed before it can be routinely recommended. BJHM

Dr P Gillen *is Advanced Trainee in Intensive Care Medicine and* **Dr MR Duffy** *is Consultant in Intensive Care Medicine, Derriford Hospital, Plymouth PL6 8HD*

Correspondence to: Dr P Gillen (phil.gillen@nhs.net)

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Anaesthetic and critical care dilemmas are coordinated by Dr Pervez Sultan and Dr Kate Adams, Specialist Registrars in Anaesthetics, University College Hospital London

Ideas for future dilemmas can be sent to Rebecca Linssen rebecca.linssen@markallengroup.com