Extracorporeal membrane oxygenation (ECMO) uses a pump oxygenator to provide prolonged respiratory or cardiac support in the intensive care unit. Since the first successful use of ECMO was reported in 1972, there have been conflicting opinions on the use of ECMO to salvage moribund patients. The American National Institute of Health (NIH) study showed no survival advantage compared with conventional treatment and a virtual cessation of ECMO in adults followed the publication of this study. However, a mortality rate of more than 60% for ARDS patients forced intensivists to continue to search for successful therapies; partial liquid ventilation, inhaled nitric oxide, prone ventilation and pressure control inverse ratio ventilation have all been advocated. All of these modalities may result in improved blood-gas tensions, and some in improved survival. Unfortunately, while such improvements may be statistically significant we are still faced with the clinical problem of a mortality rate of 82% to 55% from severe ARDS. It is likely that the small response in terms of survival lies in the fundamental problem that any treatment which relies on the injured lung to maintain gas exchange will become increasingly ineffective as lung disease becomes more severe, mortality increasing from 33% with moderate lung injury to more than 82% with severe injury,18 because of continued barotrauma, volutrauma and oxygen toxicity, all combining to produce ventilator lung injury. Eventually a point is reached when the airway pressure, minute volume and \( F_\text{O}_2 \) necessary to maintain life exceed the lungs capacity to resist the continual and repeated insults of ventilation, and thus the patient perishes. We return therefore inexorably to the concept that some form of extrapulmonary gas exchange coupled with gentle ventilation, “lung rest”, which causes no further damage to the “baby lung” is the most rational treatment for refractory severe respiratory failure, provided any significant morbidity associated with the treatment itself can be minimized or eliminated. The intra-vena caval oxygenator (IVOX) needs further development in terms of gas transfer capability and clinical ease of operation before it becomes a viable option, as in its current form only modest reductions in ventilator settings, which is the goal of extrapulmonary gas exchange, are possible. Thus ECMO remains the only current technique which can support gas exchange outside the lung, and allow the lung to be rested and recover. Numerous case series, summarized by Lewandowski and colleagues, have shown that ECMO, including extracorporeal carbon dioxide removal (ECCO2R) can result in similar or reduced mortality (51%) compared with conventional treatment (56%) but is usually applied only to patients with more severe disease. Unfortunately the intensive care community in general remains unconvinced as to the purported benefits of ECMO, as there are difficulties in comparing different historical series of patients treated in different hospitals, at different times, with different severities of illness and different treatment techniques. A recent attempt to solve this conundrum was the randomized study of ECCO2R vs PCIRV conducted by Morris and colleagues. No significant difference was apparent between the 58% mortality in the PCIRV group and the 69% mortality in the ECCO2R group. This study was interpreted by the authors and the sceptics to confirm the findings of the earlier NIH study, that ECMO is ineffective, but the methodological and technical considerations discussed by Rossaint and colleagues in this issue of British Journal of Anaesthesia make this conclusion unguarded. However, it is safe to conclude from the data of Morris and colleagues that low-flow ECCO2R, even when provided by an inexperienced team, and when complicated by haemorrhage and technical problems, is as good as the very best PCIRV.

Full flow (i.e. enough to provide oxygenation and carbon dioxide removal) veno-venous ECMO has been shown to be effective in supporting gas exchange, allowing a reduction in ventilation and \( P_\text{O}_2 \). While there are reasonable concerns on the use of historical controls when comparing different treatments, common sense indicates that if these results have been duplicated by numerous different ECMO providers around the world, and if consultants continue to refer their moribund patients for ECMO, the most likely explanation is that ECMO is effective.

This conclusion is supported by comparing our own series of adult respiratory patients with the patients described by Morris and colleagues. For the first 50 patients referred to us for treatment, mean \( P_\text{A}_\text{O}_2/F_\text{O}_2 \) ratio was 8.7 (SD 4.9) kPa, not significantly different from the control group of Morris and colleagues (t test, \( P=0.741 \)), the Murray score was 3.4 (0.5) and hospital mortality 34%, a significant improvement over the best published series of patients undergoing conventional ventilation (58% mortality) (chi-square 11.71, \( P=0.0006 \)).
Assuming that one accepts the benefits of ECMO with lung rest, the problem of transporting the critically ill, hypoxic patient to a hospital providing ECMO still remains. Our own experience is that while this may often be possible, patients who are extremely hypoxic, especially those who are dependent on inhaled nitric oxide, can be very unstable during transfer, and usually need to be “crashed on” to ECMO on arrival at our hospital. The answer to this problem is initiation of extracorporeal support at the referring hospital and transfer of the patient back to the ECMO centre on ECMO in a calm, unhurried manner. Rossaint and colleagues
 have reported their experience with eight extremely hypoxic patients transported on veno-venous ECMO; there were six long-term survivors. A 25% mortality for patients with an $P_{A_0}/F_{O_2}$ < 6.7 kPa and a mean Murray score of 3.59 is impressive even if transport were not involved.

This experience confirms the observation of other ECMO transport teams, that if the patient’s gas exchange can be supported extracorporeally, patients can be stabilized and transported many thousands of miles in safety. Other authors have elected to use mainly veno–arterial perfusion during transport to provide more haemodynamic control, and then convert to veno-venous support when the patient has been stabilized back at the ECMO centre. Another curious fact to emerge from series of patients transported on ECMO is that the outcome in this group of patients too ill to be moved by conventional means is often better than patients transported to the ECMO centre using positive pressure ventilation. The University of Michigan group reported a mortality rate of 14% for adult ECMO transport patients compared with 43% for other adult ECMO patients. This may indicate that patients should be referred for ECMO earlier, before severe hypoxia is established, or alternatively that mobile ECMO should be used more widely.

Mobile ECMO is now available in the UK, as the Heartlink ECMO centre at Glenfield Hospital, Leicester, now has transport facilities. The mobile ECMO system has been used once thus far to transport a 2-yr-old boy with Kawasaki syndrome to a transplant centre; the patient remained stable during transport despite absent underlying myocardial function but, unfortunately, heart transplantation 1 week later was not successful.

Intensivists who are sceptical about the potential benefits of ECMO should audit (and publish) the mortality of their patients with hypoxic acute respiratory failure. If they can show consistently better mortality than 34% for a mean $P_{A_0}/F_{O_2}$ of 8.7 kPa and Murray score of 3.4 then they are justified in continuing to treat their patients conventionally; if however they cannot, it is in their patients’ best interests to consider the benefits of ECMO when conventional treatment is failing, and before terminal ventilator lung injury has occurred (7 days).

Unfortunately, many intensivists remain sceptical. Indeed the editorial accompanying the publication of the UK Collaborative Neonatal ECMO study stated that ECMO was an “unfavourable outcome”. If one believes this then considering the evidence one must therefore consider death and disability to be preferable to ECMO. We do not believe this to be the case.

**References**


18. Registry of the Extracorporeal Life Support Organisation, Ann Arbor, Michigan, USA.


