Appraising extracorporeal life support — current and future roles in adult intensive care

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Despite advances in conventional intensive care, patients continue to die of cardiorespiratory failure. Many of them could be bridged to recovery, longer term destination devices or thoracic organ transplantation, with the timely use of extracorporeal life support (ECLS).\(^1\)\(^,\)\(^2\) Selected patients with chronic cardiac or respiratory failure can also be helped with ECLS. The advent of 3rd and 4th ventricular assist devices has revolutionised management of chronic heart failure and we are likely to witness increasing use of these devices in the coming years.\(^1\) Intensive care will have to adapt to these technological advancements as intensivists will play a key role in the provision of these services.

Venovenous (VV) ECLS and venoarterial (VA) ECLS remain the most commonly applied techniques for respiratory and cardiac support, respectively. However, the ECLS circuit also allows flexibility to apply more bespoke mechanical circulatory support in the form of temporary uni-ventricular or bi-ventricular assist devices.\(^1\) Whether such resource-intensive approaches should be taken in any given patient is a complex question that requires more scrutiny. At the heart of this lies a fundamental question: what is an acceptable survival rate for rescue ECLS therapies when compared with conventional therapies such as mechanical ventilation or pharmacological circulatory support, and how should we judge the value of providing such therapies? The rationale for supportive treatments in intensive care medicine is to buy time while we attend to the underlying problem, and attempt to return the patient to an acceptable level of function relative to their pre-morbid state. In the vast majority of cases, ECLS should not be applied in an intensive care unit for mere prolongation of life — what has been termed a “bridge to nowhere” — because it would be almost impossible to justify the resources expended and the toll it takes on all involved.\(^3\)

The critical question from now will be how best to integrate ECLS into a modern ICU and across health systems. With current technology and focused training, is it possible that the majority of intensivists could initiate “damage control” ECLS in a typical ICU and then refer patients to a tertiary centre for further management? Alternatively, retrieval systems can also be set up to transfer patients from referring centres. However, timely retrieval may not always be possible and often ECLS initiation has to be expedited. Therefore, intensivists may have to gain sufficient skills to initiate ECLS therapies and closely liaise with an advanced ECLS centre so that timely ECLS can be provided for selected patients. This may sound like a difficult proposition currently, but it should be noted that ECLS centres are rapidly increasing in number and ECLS is no longer restricted to tertiary centres. It is important to appreciate that ECLS can be conducted in both tertiary and referring centres. The referring centres may perform ECLS as a “bridge to transfer” and the tertiary centre, with their experience and resources, may be able to bridge the patients to recovery, a more advanced device, transplantation, or palliation if no meaningful outcome is possible.

The Conventional ventilatory support versus Extracorporeal membrane oxygenation for Severe Adult Respiratory failure (CESAR) trial\(^4\) showed that transferring mechanically ventilated patients to a high-volume, ECLS-capable centre improved outcomes. It is conceivable that such a benefit may also be seen when patients on ECLS are referred to an advanced ECLS centre. There is some evidence of a volume–outcome relationship, with higher-volume centres achieving better outcomes than low-volume centres.\(^5\) Patients were not retrieved on ECLS in the CESAR trial and 25% of the patients allocated to the ECLS arm did not actually receive ECLS and were managed conventionally. Transferring a ventilated patient who has severe acute respiratory distress syndrome and refractory hypoxaemia, or a patient in worsening cardiogenic shock, carries significant risks which have to be balanced against initiation of ECLS by the less experienced referring team or waiting for a retrieval team to arrive. Nonetheless, in time, referring centres may gain significant expertise in patient selection and timely initiation of ECLS. The next step will be to develop expertise and resources that will enable them to perform longer runs of ECLS, especially in patients receiving extracorporeal respiratory support.

ECLS technology lends itself to the establishment of such “hub and spoke” models. Modern circuitry is easy to prime, pumps are portable, and cannula-insertion kits are improving with time. Intensivists routinely perform ultrasound-guided percutaneous vascular procedures using the Seldinger technique. Most referring hospitals have general or vascular surgical services whose staff can also assist with surgical cut-down if necessary. Many hospitals even have cardiac catheterisation laboratories that may also
be used for cannulation. While venovenous ECLS usually necessitates large drainage and return cannulae to be inserted, venoarterial ECLS can be established with smaller arterial return cannulae (e.g., 14Fr), potentially alleviating the need for a backflow cannula, at least during transfer. Echocardiography plays an important role in patient selection, cannulation and post-cannulation care. In a damage-control situation, a more focused echocardiographic evaluation can be performed and then a more detailed evaluation may be performed at the receiving hospital. Such a model of care is particularly relevant to a country such as Australia, where vast distances mean tertiary and referring ECLS services will have to collaborate effectively.

The key to success for such an ambitious service is early communication between the tertiary and referring centre. There has been a significant proliferation of ECLS centres in the past few years. This is likely to continue. Increasing adoption of ECLS technology may result in reduced equipment costs. While tertiary hospitals should continue to play an important role in education, training and quality assurance, smaller hospitals may become progressively more confident and be able to initiate ECLS and care for their patients without necessarily transferring them to larger tertiary institutions. More advanced ECLS centres will undoubtedly have to increase capacity to cater to the altered referral patterns and influx of patients supported on ECLS.6

Not everyone who receives mechanical ventilation, renal replacement therapy or ECLS can survive the ICU to a meaningful end point. Notwithstanding the challenges of finding evidence for ECLS therapies, our efforts should be to integrate ECLS therapies into ICUs in a cost-efficient way and apply them in carefully selected patients. ECLS clinicians often remark, “the efficacy of ECLS when correctly applied to an appropriate patient is self-evident”.7 There is a steep learning curve indeed, and one of our challenges will be to balance excessive enthusiasm for ECLS with excessive pessimism.

Ongoing research, education and training are fundamental to furthering the field of ECLS. Building reliable databases, prompt reporting of use, education, simulation, quality assurance, prospective cost:benefit analyses, and accrediting of ECLS practitioners are areas that all need attention. Health systems will have to establish the most efficient ways of delivering ECLS to the right patients, whether through ECLS retrieval or expanding services to hospitals across a geographical area of need. Experienced centres have a major role to play in guiding the design and conduct of clinical trials. Global networks such as the International ECMO Network (ECMONet, www.internationalecmonetwork.org) and the Extracorporeal Life Support Organization (ELSO, www.elso.org), have a key role to play in organising multinational research and best-practice guidelines.

We need to establish the best outcome measures and trial designs for ECLS therapies. ECLS is an invasive intervention that lasts days to months, and is not a therapy that lends itself to a randomised, controlled, double-blinded trial design. Many ECLS centres will now find it ethically challenging to maintain equipoise when confronted with a patient with severe cardiorespiratory failure and subject them to a trial of ECLS versus conventional therapy without a cross-over option.7,8 In that case, how do we meaningfully compare an advanced rescue therapy with conventional treatment? Is it a fair comparison to start with? Should we simply accept that ECLS is just another way of supporting patient physiology? As we allowed positive pressure ventilation to evolve in the absence of alternatives, we may ultimately acknowledge that ECLS has a fundamental role in advanced ICUs. Clinical studies should be complemented by high-quality mechanistic studies that provide answers to questions that cannot be asked in the clinical environment. ECLS therapies have been around for several decades now, but the level of enthusiasm is increasing among the adult ICU community. The growing number of ECLS centres, cases and publications stand as a testament to this.9-11

Long-term quality of life and function in adult ICU survivors has received insufficient attention. This is particularly true of ECLS patients. However, it is slowly being addressed by researchers in neonatal and paediatric ECLS, who have conducted detailed neuropsychological and quality-of-life studies for many years following ECLS.12-14 This is leading to a sea change in how long-term follow-up is conducted in some parts of the world. In Holland, for example, where much of this research is being done, all neonatal and paediatric ECLS survivors are offered an 18-year follow-up program, fully funded by the government, in which the patient spends one day attending a multidisciplinary clinic at the age of 6 months, then at 1, 2, 5, 8, 12 and 16–18 years of age. The national attendance rate is over 85%. A central tenet of this program is that the application of therapies such as ECLS should be monitored to assess their long-term sequelae. Consequently, long-term follow-up is seen as an obligation for the teams offering ECLS and considered an integral part of care.15 This astonishing system is considerably more advanced than anything currently offered to adult ECLS survivors.

There is certainly a need for a robust debate across the larger intensive care community and among other ECLS stakeholders so our patients can continue to receive the best of what intensive care has to offer and, we hope, enjoy the best possible quality of life after they leave the ICU.
Competing interests
None declared.

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