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VIEW POINT

Veno-venous extracorporeal membrane oxygenation for the acute respiratory distress syndrome: a bridge too far?

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ABSTRACT

Veno-Venous Extracorporeal Membrane Oxygenation (VV-ECMO) provides a bridge to recovery in patients with acute respiratory failure due to the acute respiratory distress syndrome (ARDS). Survival in ARDS has improved over 15 years, and VV-ECMO may rescue even the most severe of these patients. Predictors of survival on ICU are based upon the principles of reversibility of the inciting aetiology, and premorbid 'reserve' – an imprecise term encompassing comorbidities and frailty. ECMO can support failing organs for prolonged periods, thus sometimes masking trajectories of decline, or unmasking irretrievable intrinsic conditions at a later time point in the critical illness. Clinicians are confronted with new on-treatment dilemmas: how long should we continue this high level of care? Will the patient's limited respiratory reserve manage off ECMO? Or are we hastening their demise? How long is it justifiable to keep someone on ECMO, if the predicted survival off is ultimately poor, but they are in a stable state whilst supported? The palliative withdrawal from ECMO is unchartered territory that requires further study. We describe two representative cases and discuss the wide ethical issues surrounding the initiation and withdrawal of ECMO.

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Veno-venous extracorporeal membrane oxygenation; acute respiratory distress syndrome; ethics; palliative; end of life

The European life support registry shows that 59% of adult patients on veno-venous extracorporeal membrane oxygenation (VV-ECMO) for severe acute respiratory failure survive to discharge [1]. Within that figure lies a range of outcomes, and predictive factors. The principles of reversibility and reserve, pertaining to the inciting condition and the underlying physiological status of patient, influence decisions of acceptance for VV-ECMO, and outcomes [2]. Based upon the currently vaildated scoring systems in use, higher age, immunocompromised status, associated extrapulmonary organ dysfunction, low respiratory compliance and non-influenza diagnosis seem to be the main determinants of poorer outcome [3]. However, currently these predictive scoring systems are inaccurate and further research is required to determine those who will best benefit from ECMO [4].

Here, we reflect on two cases that give an overview of some of the ethical dilemmas faced by healthcare providers and family in those patients whose progress is deemed ultimately unrecoverable.

Case 1

A 58-year-old gentleman was initiated on bi-femoral VV-ECMO on day 2 of treatment of acute respiratory failure secondary to H1N1-influenza. He had a past medical history of hypercholesterolaemia but was otherwise fit and well. Admission CT-scan of the thorax revealed bilateral pulmonary emboli, extensive bilateral consolidation and small pleural effusions.

The patient had a prolonged admission on ECMO with protective mechanical lung ventilation. He was given high dose methylprednisolone as a strategy to resolve persisting non-infective consolidation. He had slow improvement in parenchymal ground glass changes and the development of progressive bilateral cavitations complicated by pneumothoraxes requiring pleural drainage (Figure 1). Video-assisted

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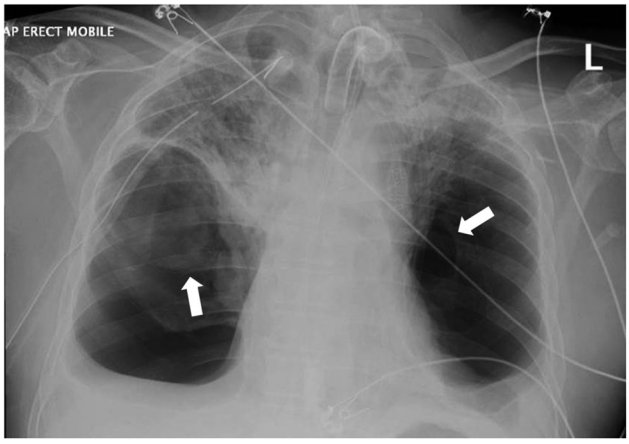

Figure 1. Chest radiograph revealing giant bilateral pulmonary cavitations (indicated by arrows).

thoracoscopic bullectomy was considered but ruled out due to uncertainties of benefit to physiological reserve and the perioperative risk in the acute setting.

Despite concerns regarding poor persisting intrinsic pulmonary physiological reserve, the patient was successfully decannulated following a 69-day ECMO run. He was awake, alert and able to communicate non-verbally with his wife and family through tracheostomy ventilation on and immediately off ECMO.

Unfortunately, over the coming two weeks he developed progressive hypercapnic respiratory failure despite optimising ventilatory support, and it became clear that his own lung capacity for oxygenation and carbon dioxide removal was insufficient for sustainable independent life. Referral for lung transplantation and a further ECMO run were discussed in the multidisciplinary setting, but due to severe physical deconditioning and loss of perceived reserve he was not considered to be a suitable candidate.

In a final effort to improve his lung mechanics and gas exchange, bilateral radiologically guided chest tube drainage of the giant cavities was attempted. Despite technical success there was continued clinical and physiological deterioration. Following family discussion and with input from the multidisciplinary team (MDT) including palliative care specialists, there was recognition of slow deterioration despite optimal respiratory support. Management was therefore switched to best supportive care, with initiation of a palliative regime of analgesia, sedatives and anxiolytics. Organ donation was pursued at the family's request. Shortly thereafter planned withdrawal occurred, and the patient passed away with his family at his bedside. Thus, a period of hope and interaction with family after surviving the original insult due in great part to ECMO, gave way to a non-livable state of

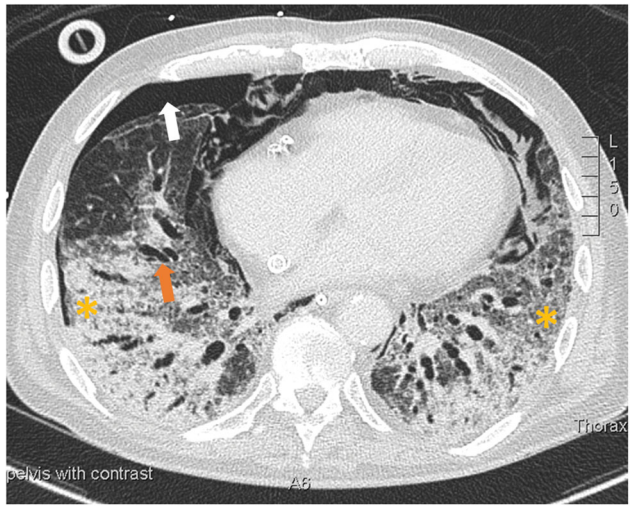

Figure 2. CT scan of the thorax revealing bilateral ground glass changes (*), traction bronchiectasis (grey arrow) and right-sided pneumothorax (white arrow).

respiratory failure some days after ECMO was withdrawn.

Case 2

A 63-year-old gentleman was referred for VV-ECMO to aid treatment of acute respiratory failure secondary to H3N1 Influenza, subsequent hospital acquired pneumonia and ventilator acquired barotrauma. He had a past medical history of hypertension, ischaemic heart disease, coronary artery bypass grafting and peripheral vascular disease. Prior to this illness he was fit and active. A CT-scan and the clinical story suggested a reversible inflammatory component to pre-existing asymptomatic interstitial lung disease, hence ECMO respiratory support was initiated on day 10 after initial presentation (Figure 2).

The patient had a prolonged ECMO run with predominantly pulmonary infective complications and delirium, and tracheostomy assisted attempts at weaning and rehabilitation. Despite aggressive treatment of interstitial lung disease using pulsed methylprednisolone and rituximab there was limited parenchymal recovery some 6 weeks on, and the patient remained fully dependent on extra-corporeal lung support. Numerous attempts at weaning ECMO were unsuccessful. Recognition of the likely inability to liberate him from ECMO became reality for the caregivers, his family and himself.

The patient was neurologically and cognitively intact and able to take part in discussions regarding end of life care. He and his partner requested time prior to weaning of support, to allow time to put his affairs in order. He expressed an interest in non-heart

beating organ donation, and a meeting with the local transplant coordinator was arranged.

Following a 73-day ECMO run, and with active family participation the approach to withdrawal was gradual. This required great sensitivity, patience, a supportive environment (e.g. side room with open access to family and friends), and advice from numerous colleagues, not least psychologists and palliative support teams, as well as discussions with organ donation advocates. There developed a recognition and understanding of exploring all possibilities even if not feasible (i.e. transfer back to his local hospital or even home on ECMO for palliation). An openess, frankness and insight from his medically trained wife, his family and the team looking after him, led to a proposal for the final process. Following a celebratory drink, at his request, and private farewells, a palliative process of narcotics and anxiolytics was initiated. Withdrawal was done carefully in the following manner: ECMO carbon-dioxide-removal was gradually decreased with development of carbon dioxide narcosis, prior to reducing the fraction of inspired oxygen. This approach allowed a gradual reduction in Glasgow coma score and prevention of air hunger. Consequently, he passed away with his family at his bedside. Two people benefitted from his organ donation, receiving kidney transplantation after each had nearly four years on the transplant waiting list.

Discussion

VV-ECMO is indicated in patients with potentially reversible acute respiratory failure who have no limitation to on-going life-sustaining treatment. Identifying suitable patients is based on the CESAR-trial and mainly validated in flu-patients [5]. Recently, the EOLIA-study did not demonstrate a primary outcome benefit of ECMO in severe ARDS [6]. However, secondary benefits, controversy in methodology and its role as accepted practice in a commissioned acute respiratory failure network continue to favour its selected use as lifesaving therapy. Difficulties may arise, as at time of referral in certain cases of non-infective respiratory failure, underlying exclusion criteria may not yet be identified, whilst the optimism when initiating ECMO and immediate relief of the life threat often with important time pressure, sometimes masks the reality of the ensuing chronic critical illness. Whilst in this paper we have focussed on VV-ECMO for respiratory failure, parallels can be draw in the use of left ventricular assist devices and veno-arterial support for cardiac failure [7].

Initiating best supportive palliative care in ECMO patients can be ethically challenging due to lack of information regarding the patient's prior wishes, and the psychological distress of their relatives. What seems like a stable state of organ support to the family often belies the true severity of their condition and the likely outcome. Clinicians are bound by the mental capacity act to act in patient's best interests [8], and in ECMO scenarios next of kin often play a central role as surrogate decision makers. ECMO is a complex process and clear communication is required to enable surrogates to make profound and lasting decisions. Many factors will influence the surrogate opinion, including preheld instincts and beliefs, cognitive dissonance and sometimes focussing on minutiae rather than the big picture [9]. These may lead to denial of the prognosis. Discussions regarding withdrawal of life-sustaining mechanical support can lead to feelings of anger and abandonment. This highlights the importance of recognising that ECMO is a bridge to recovery rather than a cure, when recovery with conventional ICU-therapy no longer becomes a likely outcome.

Prolonged ECMO-use for acute respiratory failure is associated with a lower survival rate, compared with reported survival in short duration ECMO [10]. Many patients can maintain a borderline organ function but lose their reserve during the disease process; therefore, even after successful decannulation from ECMO, morbidity and mortality remain high. Concerns regarding the negative impact of prolonged therapy in the context of minimal chance of full recovery are central to MDT discussions. As ECMO can support failing organs for prolonged periods of time it can blur the trajectory of chronic critical illness, masking profiles of clinical decline, or unmasking irretrievable intrinsic conditions at a later point in the critical illness. Whilst some patients recover quickly, there are those who do not recover but also do not deteriorate, leading to a state of 'suspended animation', the 'bridge to nowhere' [11]. Yet we pose the hypothetical question; is there reason other than rationing ECMO use, why such a patient should not stay on ECMO indefinitely? Here social justice (i.e. a rationed system) competes with surrogate autonomy (the family wish for everything to be done). The ethical dilemmas associated with putting patients onto ECMO support have been considered more recently [11]. However, there is no

specific guidance available in the literature for the palliative withdrawal of ECMO in patients who are alert and neurologically intact. Hence, the need to draw from the principles of palliative care in oncology and more recently from care of the dying in the intensive care unit. Indeed, involvement of the palliative care team in the ICU has been shown to improve symptom control and patient and family satisfaction [12]. The value of informed and shared decision making, with a patient centred approach, in accordance with patients and families wishes, is as relevant to patients on ECMO, for whom recovery has been determined not to be possible, as for those with severe cardiac disease or others in the intensive care environment [13]. The use of now established frameworks for end of life pathways allow time for preparation and acceptance [14], and the concept of 'dying with dignity' is crucial in these circumstances [15].

Summary

Often, at time of referral, underlying exclusion criteria to VV-ECMO may not have been fully identified. Since ECMO-startup is mostly in an emergency life threatening situation, the fuller picture that defines the true reversibility often comes to light at a later point. Recognition and explanation that a significant minority of those on a prolonged ECMO run may succumb despite support, necessitates careful ongoing family discussion to prevent false hope. Currently predictive scoring systems are inaccurate and further research is required to determine those who will best benefit from ECMO. However, to ensure that those with reversible processes are not prevented from lifesaving treatment, there will inevitably be some patients who will not recover, but also not decline rapidly. This state of 'suspended animation' on prolonged extracorporeal support blurs the conventional trajectories of chronic critical illness.

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Disclosure statement

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