Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Consensus on the referral and admission of patients with severe respiratory failure to the NHS ECMO service

Respiratory extracorporeal membrane oxygenation (ECMO) in England and Scotland is provided by a multicentre service, which has been commissioned and regulated by the National Health Services (NHS) of England and Scotland since 2011. The respiratory ECMO service has consistently reported excellent patient survival rates (mean of 74% over the 6 years before the COVID-19 pandemic[1]) that remained unchanged during the first wave of COVID-19 in March to August, 2020, despite the unprecedented high number of concurrent patients treated with ECMO. During the first wave of the pandemic, the NHS England ECMO service treated 236 patients, with an overall survival rate of 74% at decannulation. This survival rate compares favourably with internationally reported data series.[2,3]

As of September, 2020, the number of cases of COVID-19 had started to rise again in the UK. On Oct 22, 2020, representatives from all ECMO centres in England and Scotland convened a meeting to discuss the National ECMO strategy and response to a new wave of severe respiratory failure caused by COVID-19. From this meeting, there are four main points we wish to report.

The first point is one of reassurance. All centres in the ECMO service have robust systems in place to manage a substantial increase in caseload. In addition, NHS England has established a national surge and escalation plan to meet these increased demands that will allow for an even greater surge of patients with severe respiratory failure than encountered during the first wave. Secondly, and on a similar note, the survival rate of patients with COVID-19 who received ECMO during the first wave is identical to that reported for other causes.[1,4]

The third point requires more attention. The ECMO service has reviewed approximately 2400 referrals to the service since March, 2020. During the second wave of COVID-19, the ECMO service noted an increase in the number of referred patients who had received long periods (ie, ranging from a few days to 2 weeks) of non-invasive ventilatory support (continuous positive airway pressure or non-invasive ventilation) at high inspired fractions of oxygen compared with the first wave.

Our concern is for those patients with both severe hypoxaemic respiratory failure[5,6] and high respiratory efforts,[7] in whom, in our view, mask ventilation has been unsuccessful. In our experience, the prevalence of barotrauma is higher (eg, pneumomediastinum) and delays to initiate lung-protective invasive ventilation are longer in these patients compared with those in the first wave and those with all-cause acute respiratory distress syndrome (ARDS), leading to longer ECMO runs and consequently less reversible severe lung disease. We therefore suggest implementing strategies to identify these patients as early as possible, so that delays in intubation can be avoided, using evidence-based lung-protective ventilation strategies, and instituting prone positioning in a timely manner. This recommendation is intended to maximise early referrals to the national ECMO service, and potentially avoid a proportion of patients developing progressive and irreversible lung injury. Given the possible implications, each ECMO centre will audit the use of non-invasive respiratory support in patients referred to the service and report the results to NHS England, so that robust data can be collected and analysed.

The fourth point is about the use of corticosteroids for ARDS in patients with COVID-19. Some studies of COVID-19 and other causes of ARDS have reported a survival benefit with the early use of steroids. However, the optimal timing of administration and the dosing regimen of steroids for severe ARDS in patients with COVID-19 are still unclear. It is our experience that, after reviewing the clinical status of patients (including the biochemical markers of inflammation), we often initiate higher doses of steroid, more consistent with those in previous ARDS trials,[8,9] than recommended in the recent RECOVERY trial[10] published in 2020. It is important to distinguish

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***Panel*: Indications for the use of extracorporeal membrane oxygenation (ECMO) in severe respiratory failure**

Criteria for referral for ECMO:

- Potentially reversible severe respiratory failure (eg, PaO_2/FiO_2 of <6·7 kPa for ≥3 h or PaO_2/FiO_2 of <10·0 kPa for ≥6 h)[4]
- A lung injury score of 3 or higher
- Uncompensated hypercapnia with a pH of 7·20 or higher, despite a respiratory rate of more than 35 breaths per min, or due to life-threatening airway disease (eg, asthma, airway trauma, or air leak)[4]

Criteria for considering ECMO:

- Unsuccessful trial of ventilation in the prone position for 6 h or more (unless contraindicated)
- Unsuccessful optimal respiratory management with lung-protective ventilation after discussion with a national ECMO centre

Additional criteria for consideration by ECMO centres:*

- Indices of low potential to recover (eg, a Respiratory ECMO Survival Prediction [RESP] score† of ≤3)
- Receiving invasive mechanical ventilation for 7 days or more[4]

Exclusion criteria for ECMO:

- Refractory or established multiorgan failure
- Evidence of severe neurological injury
- Cardiac arrest for more than 15 min

*At least two ECMO centres should agree that it is appropriate to proceed to ECMO for patients meeting one of these criteria. †When calculating the RESP score, the number of days on a high-flow nasal cannula should not count towards the total number of days on ventilation. If the patient receives continuous positive airway pressure (CPAP) or non-invasive ventilation (NIV) for more than 1 day before intubation, the number of days on CPAP or NIV would count towards the total number of days on mechanical ventilation if CPAP or NIV was used for more than 12 h/day on average and the PaO_2/FiO_2 was less than 20·0 kPa (with a FiO_2 of more than 60%, a $PaCO_2$ of less than 4·0 kPa, or a respiratory rate of more than 25 breaths per min); the $PaCO_2$ was greater than 6·5 kPa or the $PaCO_2$ had been increasing since CPAP or NIV use, or both; or the inspiratory tidal volume (if measured) was greater than 9·5 mL/kg predicted bodyweight.

between the administration of steroids for their anti-inflammatory and immunomodulatory actions in early COVID-19[10] and their effects on a steroid-responsive lung process (eg, organising pneumonia), or their possible effects on lung remodelling in late persistent ARDS.[8] Appropriately powered randomised trials comparing steroid dosing regimens in these different patients are crucial and much needed.

In the meeting, the national ECMO service agreed that it is appropriate to continue offering support with ECMO to selected patients with acute, severe, but potentially reversible, respiratory failure, including those with COVID-19.[1]

Referrals to the service should be made by adult intensive care units for patients who continue to deteriorate despite appropriate conventional ventilatory support, or for patients in whom ventilation could be harmful because of the severity of hypoxaemia or hypercapnia (panel).

We declare no competing interests.

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