ECMO/CRRRT combined support in the treatment of critically ill patients with novel coronavirus pneumonia

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We present the cases of two patients critically ill diagnosed with novel coronavirus pneumonia (NCP). Both patients were male and met the COVID-19 diagnostic criteria in the Guidelines For the Diagnosis and Treatment of COVID-19 issued by China’s National Health Commission. The diagnosis of COVID-19 was confirmed by a positive real-time fluorescent reverse transcription–polymerase

Figure 1 CT of CASE 1 before ECMO-CVVH (Panels A and B) and after (Panels C and D).
chain reaction (RT–PCR) test for 2019-nCoV nucleic acid. Patients were enrolled in the study if they were in a clinically critical condition on admission and had any of the following conditions: respiratory failure requiring mechanical ventilation, shock, or failure of other organs requiring intensive care unit (ICU) care and treatment. The indication for extracorporeal membrane oxygenation (ECMO) in critically ill patients with NCP at our treatment centre was severe acute respiratory distress syndrome (ARDS) with ineffective protective pulmonary ventilation. In our procedure, ECMO and continuous renal replacement therapy (CRRT) are combined; the right femoral vein and left femoral artery are selected for V-A ECMO, and the right internal jugular vein and femoral vein are selected for V-V ECMO. ECMO assistance A MAQUET extracorporeal heart–lung machine and a heparin-coated ECMO circuit were used for both patients. The cannula was placed in the femoral vein and artery under direct vision. Sheaths of appropriate specifications (14F–24F for the artery and 16F–26F for the vein) were selected according to intraoperative investigation. Heparin was used to maintain an activated coagulation time (ACT) of between 180 and 220 s, and ventilator parameters and oxygen concentrations were appropriately adjusted according to the results of artery and vein blood gas analysis. Intubation and the establishment, operation, daily management, and withdrawal of ECMO/CRRT were performed by the ECMO/CRRT multidisciplinary team (MDT).

During ECMO/CRRT administration, attending physicians from the ECMO/CRRT MDT and nurses specializing in ECMO/CRRT were on 24-h duty. Vital signs (mean arterial pressure, urine volume, infusion volume), analgesia and sedation management, nutrition management, and ECMO/CRRT function (considering possible thrombus and cannula damage) were recorded. The patients’ mixed venous blood oxygen saturation (ScVO₂) was maintained at 0.65–0.75, haemoglobin at > 110 g/L, and haematocrit at >0.30. In those patients

**Figure 2** CT of CASE 1 before ECMO-CVVH (Panels A and B) and after (Panels C and D).
who received ECMO combined with bedside CRRT, the median average duration was 9.7 days (7–13 days). After treatment, ECMO and mechanical ventilation were withdrawn successfully. A total of three complications occurred during ECMO, mainly thrombocytopenia. No serious adverse reactions occurred during the treatment. Laboratory testing showed increased leucocytes and lymphocytes and decreased inflammatory factors after ECMO/CRRT treatment. Both the patients were eventually removed from the breathing machine and ECMO. Computed tomography (CT) scans of the two patients showed a significant decrease in ground-glass opacity (Figures 1 and 2, panel A vs. panel B, panel C vs. panel D). CT scans were performed in the two patients with residual fibrosis after treatment. Cardiac structure and valvular dysfunction were not found in any of the two patients during follow-up echocardiography. The left and right ventricles were normal in size and function. The survival rate of ECMO/CRRT treatment for the patients with cardiopulmonary failure who failed conventional treatment in this group was 100%, which indicates that the option of ECMO and CRRT could be promising to support patients.

**Consent:** The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

**Conflict of interest:** none declared.