

Severe Acute Respiratory Distress Syndrome Secondary to Acute Pancreatitis Successfully Treated With Extracorporeal Membrane Oxygenation in Three Patients

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Objective

To review three patients who underwent extracorporeal membrane oxygenation (ECMO) for acute respiratory failure secondary to pancreatitis.

Summary Background Data

Severe acute pancreatitis often causes the acute respiratory distress syndrome (ARDS), and if ventilation is required, the mortality rate is more than 50%. If the ratio of $\text{PaO}_2/\text{FiO}_2$ falls below 100 mm Hg or the Murray lung injury score exceeds 3.5, the mortality rate rises to more than 80%. Three patients who have severe ARDS secondary to pancreatitis, who were hypoxic despite ventilation with 100% oxygen and high airway pressures, and who were all successfully treated with ECMO are reported here. The consensus here is that all three patients would have died without ECMO.

Methods

Retrospective chart review and discussion of the literature.

Acute pancreatitis may be complicated by the acute respiratory distress syndrome (ARDS).^{1,2} We report three patients with acute pancreatitis secondary to alcohol intoxication, which resulted in severe ARDS refractory to maximal conventional ventilation. In one patient who was unresponsive to inhaled nitric oxide, the estimated mortality rate was 63% to 93%.³ All three patients are long-term survivors after successful support by veno-venous extracor-

Results

Pre-ECMO data: mean $\text{PaO}_2/\text{FiO}_2$ 59.3 mm Hg, mean Murray lung injury score 3.7, one patient administered 20 ppm inhaled nitric oxide. ECMO data: mean extracorporeal flow at initiation of ECMO 56.3 mL/kg per minute, all patients administered veno-venous ECMO, mean duration of ECMO 104.7 hours. All patients were successfully weaned from ECMO and extubated. One patient had a protracted hospital stay because of a colo-cutaneous fistula. All patients are long-term survivors.

Conclusions

Extracorporeal membrane oxygenation proved an effective therapy for severe ARDS complicating acute pancreatitis. Extracorporeal membrane oxygenation was conducted without bleeding complications in these three patients.

poreal membrane oxygenation (ECMO). Despite acute hemorrhagic pancreatitis, major hemorrhage did not occur during ECMO.

CASE SUMMARIES

Patient 1

The first patient was a 24-year old woman who had severe epigastric pain. The serum amylase was 1650 Somogyi U/L. Hypoxia developed and she required ventilation by day 5. By day 6, her ratio of $\text{PaO}_2:\text{FiO}_2$ was 72.8 mm Hg, her Murray score was 4.0 (4), and she was transferred for ECMO. She was cannulated percutaneously for veno-ve-

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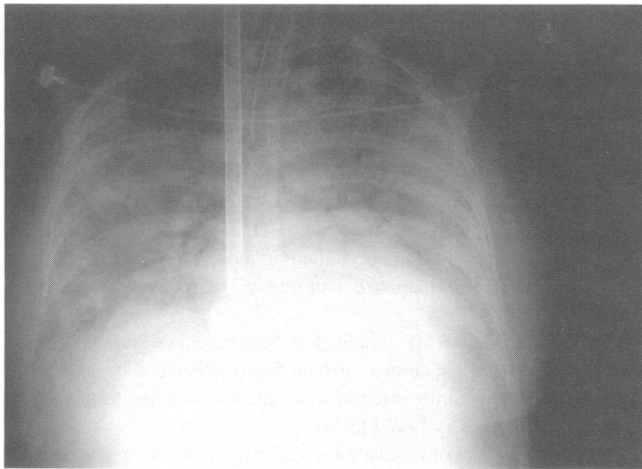


Figure 1. Chest x-ray showing severe adult respiratory disease syndrome and extracorporeal membrane oxygenation cannula position in patient 1.

nous ECMO, draining from the right internal jugular vein, and returning via the right femoral vein (Fig. 1.). Extracorporeal flow was initially 59 mL/kg per minute, which allowed ventilation to be reduced to rest settings (peak pressure 20 cm H₂O, end expiratory pressure 10 cm H₂O, rate 10, and FiO₂ 30%). Her lung function gradually improved, and she was decannulated after 78 hours and extubated 24 hours later. At 3 months she resumed a normal lifestyle.

Patient 2

The second patient was a 28-year old woman with a 2-day history of severe epigastric pain. The serum amylase was 1419 IU/L. Progressive hypoxia resulted in ventilation on day 7, with rapid deterioration to a PaO₂:FiO₂ ratio of 50 mm Hg despite a peak inspiratory pressure of 50 cm H₂O. Her Murray score was 4.0,⁴ and she was transferred for ECMO. During transfer she became hypotensive (mean arterial pressure, 45 mm Hg) and had increasing hypoxia (SpO₂ 24%). She was cannulated for veno-venous ECMO and stabilized with a flow of 60 mL/kg per minute. Ventilation was reduced to rest settings (see patient 1). She improved and was decannulated after 121 hours. Seven days later, she had melena, anemia, and abdominal distension. Gastroscopy results were normal. Abdominal computed tomography (CT) showed a multiloculated peripancreatic collection, which was drained at laparotomy. A colo-cutaneous fistula developed from the splenic flexure, which required excision and colostomy. She became emaciated but responded to gastrostomy feeding and was discharged home after 4 months.

Patient 3

The third patient was a 30-year old woman with a 1-day history of nausea, vomiting, abdominal distension, and pain.

Her alcohol intake was 42 U/week. On examination she had lower abdominal pain, guarding, and ascites. Her serum amylase level was 820 IU/L. She underwent exploratory laparotomy that revealed a swollen, hemorrhagic, inflamed pancreas but no other abnormality. After surgery, she was ventilated but remained hypoxic, hypotensive, and acidotic. Her gas exchange continued to deteriorate despite 20 ppm inhaled nitric oxide. By postoperative day 1, her PaO₂/FiO₂ ratio had fallen to 55 mm Hg in spite of a peak airway pressure of 44 cmH₂O. Her Murray score was 3.0.⁴ She was transferred for ECMO and veno-venous ECMO was initiated (flow 50 mL/kg per minute). Ventilator settings were reduced to rest setting. After 115 hours she was decannulated. She was extubated 48 hours later, transferred back to her referring hospital the next day, and breathed 30% oxygen. She was discharged home 2 weeks later.

DISCUSSION

The mortality rate for acute pancreatitis has changed little in 20 years (10 to 15%).^{5–8} Gallstones and alcohol are factors in 80% of the cases.^{7,9} Respiratory impairment is common, and fulminant ARDS develops in 30% of patients.⁷ The mortality rate in patients requiring ventilation is in excess of 50%.^{3,7} If the PaO₂:FiO₂ ratio falls below 100 mm Hg or the Murray score exceeds 3.5, the mortality rate rises to more than 80%.¹⁰ The advantage of ECMO is the elimination of the continuing lung damage caused by high airway pressures (barotrauma) and tidal volumes (volutrauma).^{11,12} In addition, FiO₂, and thereby oxygen toxicity, often can be greatly reduced to 21%.

Bleeding, which previously was thought to be inherent in ECMO,^{13–15} has been eliminated almost completely. Unfortunately, hemorrhage can still occur in the presence of a preexisting condition (e.g., intracranial bleeding.)

We think this is the first time ECMO has been used successfully in the United Kingdom for the treatment of ARDS secondary to pancreatitis. One case of pancreatitis that was successfully treated with ECMO has been reported in the United States,¹⁶ and pancreatitis is mentioned in another series, but the number of patients and the outcomes are not reported.¹⁷

Although previous randomized trials of adult ECMO have not been encouraging,^{13,15} there are significant differences in case selection and clinical management of ECMO between our practice and that described in these reports that may contribute to the improved outcome. Specifically significant are the use of veno-arterial ECMO without lung rest by Zapol et al.¹³ and the low-flow extracorporeal carbon dioxide removal by Morris et al.¹⁵ Our practice includes the use of percutaneous veno-venous cannulation, ECMO circuits designed to provide sufficient flow to support oxygenation and carbon dioxide removal, diuresis to dry weight, lung rest, transfusion to optimize oxygen delivery (hematocrit, 40%–45%), and low-range heparinization (activated clotting time, 180–200 seconds). Another important factor

in determining a good outcome with ECMO is patient selection. If the duration of high-pressure ventilation is longer than 7 days, this is a contraindication to ECMO in our institution. The recent publication of the randomized United Kingdom collaborative ECMO study¹⁸ shows that in the neonatal population, the reduction in mortality and morbidity rates with ECMO when compared to conventional treatment is real and not the result of case selection or difficulty in the interpretation of historical control data.

CONCLUSIONS

The survival of these patients with severe respiratory failure secondary to pancreatitis, who were thought by their referring physicians to be dying, is more likely the result of therapeutic effects of improved gas exchange rather than of any confounding factor. Extracorporeal membrane oxygenation should be considered in the treatment of severe respiratory failure that complicates acute pancreatitis.

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