Prikaz primera prve uporabe veno-venske zunajtelesne membranske oksigenacije (ECMO) v Mariboru

First treatment with venovenous extracorporeal membrane oxygenation in Maribor

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Ključne besede:
zunajtelesni krvni obtok, VV ECMO, refraktarna hipoksemija, akutna dihalna odpoved, intenzivna medicina, enota za intenzivno terapijo.

Key words:
extracorporeal life support, VV ECMO, refractory hypoxemia, acute respiratory failure, intensive care unit, critical care.

Članek prispel / Received
12. 1. 2018
Članek sprejet / Accepted
13. 4. 2018

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Izvleček

Namen: *V prispevku želimo prikazati primer prve uporabe veno-venske zunajtelesne membranske oksigenacije (VV ECMO) na Oddelku za intenzivno interno medicino (OIIM) Univerzitetnega kliničnega centra Maribor (UKC Mb) pri bolniku z refraktarno hipoksemijo.*

Prikaz primera: *52-letni bolnik je bil po uspešnem 38-minutnem oživljanju na terenu po srčnem zastoju pripeljan v UKC Maribor, intubiran in umetno predihan. Zaradi miokardnega infarkta s ST elevacijo (STEMI) je bila opravljena primarna perkutana revaskularizacija (angl. left anterior descending coronary artery – LAD) in vstavljena 1 koronarna žilna opornica. Po posegu v OIIM smo zaradi refraktarne hipoksemije ob aspiracijski pljučnici nastavili VV ECMO. Vstavitev, zdravljenje in odstranitev VV ECMO šest dni kasneje so potekali brez zapletov. Prehodno se je bolnikovo stanje izboljšalo, vendar se*

Abstract

Purpose*: We report on the first patient with refractory hypoxemia treated with venovenous extracorporeal membrane oxygenation (VV ECMO) at the Medical Intensive Care Unit of the University Medical Centre Maribor.*

Case report: *A 52-year-old male was admitted after successful cardiopulmonary resuscitation from out-of-hospital cardiac arrest (first rhythm was ventricular fibrillation, with 40 min to return of spontaneous circulation). The patient underwent primary percutaneous revascularization of the left anterior descending coronary artery with insertion of one coronary stent. Hypoxemia was present during patient transportation and the procedure and continued to worsen after admission. Due to refractory hypoxemia caused by aspiration pneumonia, treatment with the VV ECMO was initiated. The ECMO procedure was performed without complications and led to improvement in gas exchange and*

je v nadaljevanju zdravljenja zaradi bolnišnične pljučnice in katetrske sepse stanje ponovno tako poslabšalo, da je bolnik po nekaj tednih zaradi hude napredovale večorganske odpovedi umrl.

Zaključek: *Odziv na zdravljenje refraktarne hipoksemije ob aspiracijski pljučnici z VV ECMO je bil učinkovit in nezapleten, čeprav je bolnik zaradi večorganske odpovedi po ponovni bolnišnični okužbi kasneje umrl.*

lung mechanics. The patient was then successfully weaned from ECMO, decannulated, and extubated. After extubation, the patient's course of treatment was complicated by hospital pneumonia and catheter-related blood stream infection. As his state deteriorated, reintubation was necessary. Despite intensive treatment, the patient died on day 30.

Conclusions*: Response to the VV ECMO treatment of refractory hypoxemia due to aspiration pneumonia was positive and without complications. In spite of initial improvement, the patient died after several weeks due to recurring infection and septic shock.*

INTRODUCTION

Hypoxemic respiratory failure with refractory hypoxemia is a serious complication in patients with acute respiratory failure. Most commonly it is defined by either a partial pressure of arterial oxygen (PaO2) ≤ 60 mmHg or (PaO2/FiO2) ≤ 100 mmHg, or inspired oxygen (FiO2) of 0.8–1.0 mmHg (1,2). A last resort rescue manoeuvre for this condition is the use of extracorporeal membrane oxygenation (ECMO) (1,3–5). ECMO circuits require insertion of vascular cannulae with a large diameter and the ability to maintain extracorporeal flow comparable to cardiac output. We present the first case of venovenous (VV) ECMO in a patient with refractory hypoxemia at the Medical Intensive Care Unit (MICU).

CASE PRESENTATION

A 52-year-old male with previous history of arterial hypertension was admitted after experiencing an out-of-hospital cardiac arrest. Bystanders initiated basic life support immediately after collapse. First recorded rhythm after arrival of the emergency medical team was ventricular fibrillation and return of spontaneous circulation (ROSC) was achieved after 38 min of resuscitation, which included 8 min of basic and 30 min of advanced life support measures. During resuscitation, the patient was intubated, mechanically ventilated, and remained comatose after ROSC. Anterior wall ST-elevation myocardial infarction was present on the electrocardiogram after ROSC, as the patient was transported to the regional 24/7 cardiac catheterization center.

While being mechanically ventilated, the patient required high positive end-expiratory pressure (PEEP, 10 cmH2O) and FiO2 of 1.0 mmHg to maintain adequate oxygenation during transportation and coronary intervention. One drug-eluting stent was inserted into the left anterior descendant coronary artery before admission to the MICU.

On admission, the patient was mechanically ventilated (CMV, PEEP 10 cmH2O, FiO2 1.0 mmHg). The peripheral oxygen saturation (SatO2) was between 85 and 90%. The patient required 0.6 mcg/kg/min of noradrenaline to maintain the mean arterial pressure around 60–65 mmHg. Despite increasing PEEP to 15 cmH2O, SatO2 did not reach 90%. Refractory hypoxemia served as the reason to initiate rescue procedure by inhalation of nitrous oxide. In spite of treatment, severe respiratory failure persisted (PaO2/FiO2 remained around 60 mmHg, with SatO2 at 80–85%). A decision was made to start VV ECMO, where a 23 Fr drainage cannula was inserted into the right femoral vein (depth 40 cm) and a 21 Fr return cannula was inserted into the right internal jugular (depth 15 cm). ECMO flow was set at 3 L/min, ECMO FiO2 at 100%, and sweep gas flow at 6 L/min. Over the next

few minutes SatO2 increased to over 90% and mean arterial pressure increased to around 80 mmHg. The settings on the ventilator were changed to tidal volume of 300 mL, with frequency of 14/min, and FiO2 at 40% to reach ultraprotective ventilation.

After admission, dual antiplatelet therapy (aspirin, Brilique) was continued and treatment with statin and empirical antimicrobial therapy with meropenem after blood cultures was initiated. Tracheal aspirates and urine sample were also obtained. The patient required inotropic support with dobutamine as the ejection fraction of the left ventricle was around 20% on admission. The need for noradrenaline decreased to approximately 0.2 mcg/kg/min 60 min after ECMO circulation was started and levosimendan added.
From tracheal aspirates collected on admission, Haemophilus influenzae and Staphylococcus aureus sensitive to meropenem treatment were isolated.
Weaning from ECMO was started on day 5. The patient tolerated 1 h of mechanical ventilation with ECMO sweep gas flow set to 0 L/min on day 6. Vascular cannulae were removed on the same day.
Over the course of the next few days after initial improvement, ventilator-associated pneumonia (S. aureus) and catheter-related blood stream infection (S. epidermidis) developed. Antimicrobial therapy was changed according to bacterial resistance to piperacillin-tazobactam. The patient was extubated on day 9. However, reintubation was required on day 16, followed by tracheostomy due to prolonged respiratory failure with difficult weaning from mechanical ventilation, which included multiple spontaneous breathing trials. The Glasgow Coma Scale was 14 on day 5. Furthermore, delirium developed after extubation, necessitating additional antipsychotic therapy. During the last days of treatment, inflammatory markers increased again, new infiltrates were observed on the chest radiograph, and escalating doses of noradrenalin were required. Antimicrobial therapy was changed empirically to vancomycin, cefepime, and anidulafungin, after microbiological samples were obtained. Pneumonia with sepsis then developed. In spite of treatment, the patient died on day 30 due to refractory septic shock.

DISCUSSION

The main principle behind the VV ECMO is oxygenation and decarboxylation. The main parts of a VV ECMO circuit are the pump, membrane, circuit, cannulae, and monitors (3, 6).

The reported survival rate of patients with acute respiratory failure on VV ECMO is between 50–71%. The randomised controlled trial of conventional ventilatory support vs extracorporeal membrane oxygenation for severe adult respiratory failure (CESAR), where conventional ventilatory support was compared to VV ECMO in severe acute respiratory failure, reported survival at six months or absence of severe disability in 63% of the patients in the ECMO arm, in comparison to 47% in the standard therapy arm (7).

In our patient, the VV ECMO was run uneventfully and without any complications that could be attributed to extracorporeal circulation. Despite this, the patient did not survive and died after a number of further septic complications, resulting in the multiple organ failure syndrome.

Mortality approaching 90% in a group of patients with circulatory shock and acute renal failure during VV ECMO support was present in a study by Wu et al. (8). Circulatory shock, need for renal replacement therapy, and cardiac arrest were predictors of hospital mortality in a study by Schmidt et al. (9).

CONCLUSION

The first treatment with VV ECMO in our hospital was performed in a patient with severe acute respiratory failure with multiple organ failure syndrome. In spite of initial improvement, the patient died after several weeks due to recurring infection and resulting septic shock. Our case highlights the importance of data collection and benchmarking after introduction of new treatment modalities.

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