

Extracorporeal carbon dioxide removal (ECCO₂R) in the treatment of a puerpera with acute respiratory distress syndrome (ARDS) caused by bacterial pneumonia

Ekstrakorporalno uklanjanje ugljičnog dioksida (ECCO₂R) u liječenju puerpere sa sindromom akutnog respiracijskog distresa (ARDS) uzrokovanog bakterijskom upalom pluća

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Case report

Extracorporeal carbon dioxide removal (ECCO₂R) is a method of reducing surplus CO₂ levels from patients who are adequately oxygenated via mechanical ventilation. Although the method is currently in an experimental stage, we present a case of acute respiratory distress syndrome (ARDS) caused by severe bacterial pneumonia in which before mentioned method was chosen and successfully utilized.

Prikaz bolesnika

Ekstrakorporalno uklanjanje ugljičnog dioksida (ECCO₂R) je metoda smanjenja viška ugljičnog dioksida (CO₂) u bolesnika koji su adekvatno oksigenirani putem mehaničke ventilacije. Iako je metoda trenutno u eksperimentalnoj fazi, prikazujemo bolesnicu sa sindromom akutnog respiracijskog distresa (ARDS) uzrokovanog teškom bakterijskom upalom pluća u liječenju koje je spomenuta metoda odabrana i uspješno primijenjena.

Introduction

Extracorporeal carbon dioxide removal (ECCO₂R) is still in its experimental phase [1]. The premise of this method is extracorporeal removal of the surplus CO₂ from the patient's organism (so called "respiratory dialysis") [2]. At this moment it is still not officially accepted as a conventional treatment procedure. The indications for the procedure are pulmonary CO₂ retention, post ECMO (extracorporeal membrane oxygenation) CO₂ retention and acute respiratory distress syndrome (ARDS) [1]. The goal of this report is to present a case of a patient successfully treated using the ECCO₂R method.

Case report

A 31-year-old female patient, in her 35th week of pregnancy, was transferred to the University Hospital for Infectious Diseases "Dr. Fran Mihaljević" in Zagreb for the treatment of bacterial pneumonia complicated with ARDS. Except for a heart murmur she has known about since childhood (that was never properly evaluated by a cardiologist), her patient history was unremarkable. She lived with her husband and their five children (one child had a positive recent history for an unspecified respiratory infection). The patient's bodily functions and living habits were unremarkable. She had no allergies to medications.



Figure 1. Chest X-ray – diffuse bilateral infiltrates of the parenchyma from the apex to the bases with the left pulmonary apex relatively spared. Enlarged heart shadow. Possible bilateral pleural effusion.

Slika 1. Radiogram prsnog koša – difuzni bilateralni infiltrati parenhima od apeksa do baza s relativno pošteđenim plućnim apeksom lijevo. Povećana sjena srca. Mogući bilateralni pleuralni izljev.

The patient did not receive influenza vaccine prior to the flu season. Current illness began with a fever up to 39.7 °C accompanied by cough and dyspnoea. The initial diagnostic evaluation revealed heightened inflammatory parameters (CRP 282.1, PCT 1.44, lactate 4.50, WBC 12.1) and a complete infiltration of the right lung and the lower two thirds of the left lung on the chest X-ray (Figure 1).

Upon admission to the University Hospital for Infectious Diseases Zagreb the patient developed acute respiratory insufficiency and was intubated and mechanically ventilated. Because of her severe health status, she was sent via medical transportation to the Clinic for Gynecology and Obstetrics Hospital Petrova, Zagreb for consiliary OB-GYN evaluation. Upon evaluation, cesarean section was indicated. In consultation with a gynocologist an emergent cesarean section was indicated. The procedure was successful – the child's Apgar score was 7/8 out of 10. Upon finishing the procedure, the patient was returned to the University Hospital for Infectious Diseases Zagreb for further treatment of the respiratory illness. Upon arrival the patient received a broad spectrum antibiotic coverage with ceftriaxone, azithromycin and flucloxacillin parenterally and oseltamivir orally with all other required symptomatic and supportive measures. Even though the

PCR of the nasopharyngeal swab was negative for the influenza virus, the initial low platelet count of 176 and the creatinine kinase level of 1172 indicate that the patient's disease initially probably started as a respiratory viral infection – taking into account the epidemiological factors, most probably influenza that got complicated by bacterial superinfection later on. The microbiological evaluation of the tracheal aspirate revealed *Streptococcus pneumoniae* while all the other microbiological samples were negative. The patient's ECG revealed a right bundle branch block, and transthoracic echocardiography revealed pulmonary hypertension, atrial septal defect and tricuspid regurgitation of the 2nd degree. On the 22nd of January the patient developed severe acidosis (pH 7.172, pCO₂ 66.9 mmHg, pO₂ 91 mmHg, BE -4 mmol/L, HCO₃ 24.5 mmol/L, sO₂ 94 %) and treatment with extracorporeal carbon dioxide removal was initiated. After the initiation of ECCO₂R, the patient's acid-base parameters started returning to normal, she was hemodynamically stable and did not develop any further complications. The patient was evaluated by an OB-GYN consultant twice during her hospital stay, the wound from the C-section healed with no signs of inflammation or infection, and was advised to attend a checkup upon hospital discharge. On the 28th of January, after six

days ECCO₂R was terminated. Upon removal of inhalation sedation the patient developed high blood pressure (with a poor response to medications) and generalized seizures. The seizures were successfully treated with anti-convulsive medications. The EEG showed an abnormal, irregular and epileptiform focus in the right frontotemporal region, while the MRI scan of the brain did not locate the reason for the convulsive episodes. The patient was tested positive for proteinuria (0.65 g/L, ref. <0.3 g/L) and therefore was suspected of developing postpartal eclampsia. During the remainder of hospital stay, the patient's health status improved; hypercapnia was successfully treated, oxygenation improved and the patient was weaned from mechanical ventilation and extubated. Also, no more convulsive episodes were noted. A generalised improvement was registered in both lab work and chest X-rays. The second EEG detected slight diffuse irregularities with a slower conduction on the left lateral side. Before being discharged from the hospital, transesophageal echocardiography verified the atrial septal defect (type secundum – 21 mm) with a left to right shunt and pulmonary hypertension. The patient was discharged from the hospital and referred to a cardiology specialist for further evaluation.

Discussion

Acute respiratory distress syndrome is an acute, diffuse, inflammatory process that manifests itself by extensive lung tissue damage, increased permeability of pulmonary blood vessels and inadequate gas exchange in the parenchyma of the lung. The clinical manifestations are hypoxemia and bilateral pulmonary infiltrates while the pathological manifestation is diffuse alveolar damage (alveolar edema with or without bleeding, acute inflammation of the alveolar septa and hyaline membrane formation) [3, 4]. It is important to point out that ARDS is a syndrome of multiple possible etiologies and, in many cases, the etiology is never really identified [4]. The key treatment method for ARDS is mechanical ventilation, but it is important to stress out that mechanical ventilation has its downsides – ventilator associated lung injury (VALI) being the most important one. Also, in severe cases of ARDS, hypoxemia and/or hypercapnia cannot be corrected by mechanical ventilation alone, and in those cases adjunctive methods are required [5]. In situations where mechanical ventilation alone is not enough and the patient is persistently hypoxemic (with or without notable hypercap-

nia) extracorporeal membrane oxygenation (ECMO) is indicated. But, in cases where the patient is adequately oxygenated and hypercapnia alone is the major problem (not only in ARDS but also in patients with exacerbation of chronic obstructive pulmonary disease, patients with severe asthmatic attacks and those with post ECMO CO₂ retention) ECCO₂R has (for now) proven to be a treatment method worth considering [1].

Conclusion

Although currently in its experimental phase, this case report draws the conclusion that ECCO₂R was a useful auxiliary method for treating persistent hypercapnia in our patient who managed to achieve adequate oxygenation with mechanical ventilation. It is also worthwhile mentioning that, thanks to ECCO₂R we did not need to utilize the VV-ECMO method and, consequently, the possible side effects and complications associated with ECMO treatment were avoided. Considering the positive treatment outcome of our patient, we consider ECCO₂R a promising method for treating hypercapnia in adequately oxygenated patients with ARDS. However, further investigations are mandatory to assess the actual usefulness of ECCO₂R in treating hypoxemic patients with adequate oxygenation.

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