

Case Report

Extracorporeal Membrane Oxygenation for Multi-drug Intoxication

Jesima Y*, Lakshmi pathi T**, Theodore S***, SivaKumar R****

*Perfusion Trainee, **Perfusionist, ***Consultant Cardiac Surgeon, ****Consultant Cardiac Anesthetist, Department of Cardiothoracic & Vascular Surgery, Chettinad Super Speciality Hospital, Chettinad Academy of Research & Education, Chennai, India.



Ms. Jesima Yasmin is pursuing her internship in Chettinad Hospital and Research Institute, Chennai

Corresponding author - Dr. Sanjay Theodore (sanjayawake@gmail.com)

Chettinad Health City Medical Journal 2017; 6(3): 00 - 00

Abstract

A young woman presented to our hospital following Multi drug suicidal poisoning. The patient's condition deteriorated and she developed severe Metabolic Acidosis and Refractory cardiogenic shock on conventional therapy. In order to prevent the Multi organ failure, Veno-Arterial Extracorporeal Membrane Oxygenation (VA-ECMO) was initiated. The patient's hemodynamics improved significantly after the application of ECMO. She was weaned successfully after 69 hours.

Key Words: β -blocker and Calcium Channel Blocker Poisoning, Extracorporeal Membrane Oxygenation.

Abbreviations:

VA-ECMO - Veno Arterial Extracorporeal Membrane Oxygenation.

ACT - Activated Clotting Time.

ABG - Arterial Blood Gas.

VBG - Venous Blood Gas.

Introduction

Drug overdose and poisoning with cardiotoxic drugs like β -blockers (BB) and Calcium Channel Blockers (CCB) are rare. Successful management of these patients with severe Cardiogenic Shock and Multi-organ dysfunction can be achieved with early institution of VA-ECMO^{1,2}.

Extracorporeal Life Support using ECMO provides Respiratory and Circulatory support for many fatal conditions.² In this case, we report the use of VA-ECMO for a patient with Refractory cardiogenic shock due to β -blocker (BB) and Calcium Channel Blocker (CCB) toxicity. BB and CCB toxicity pose a great threat to the cardiovascular system by producing significant cardiovascular depression which can be fatal¹.

The goal of preventing Multi-organ deterioration and providing adequate hemodynamic support until the complete drug clearance from the patient's system has been successfully achieved through the incorporation of ECMO¹.

Case Report

A 23 year old woman was admitted with vomiting and drowsiness in our Emergency Department. There was history of ingestion of 60 tablets of T.Amlodipine (300mg) and T.Metoprolol (3000mg). On admission the patient was drowsy but oriented. Her Heart Rate was 54 beats/min and Blood pressure was 70/20mm

Hg. She was Tachypneic and Spo₂ was 87%. She was given oxygen. Dopamine infusion of 10mcg/kg/min was started. She continued to have bradycardia, hypotension and oliguria that gradually deteriorated. Oral activated charcoal therapy had been given in the Emergency Department to enhance the elimination of toxic drugs.

Her chest X-Ray showed bilateral non-homogenous opacities, consistent with Pulmonary edema. Metabolic Acidosis steadily increased and hemodynamics worsened over time. Considering the Refractory Cardiogenic Shock, worsening Metabolic Acidosis, severe Acute Respiratory Distress Syndrome, Acute Kidney Injury and to prevent the Multi-organ deterioration, ECMO was initiated after 22 hours of Resuscitation.

Veno-Arterial cannulation was done through Femoral vein and artery. A 17Fr Femoral Artery cannula (Biomedicus, Medtronic; Minneapolis, USA) was inserted percutaneously into the Left Femoral Artery. A 19Fr venous drainage cannula (Biomedicus, Medtronic; Minneapolis, USA) was inserted percutaneously into the Right Femoral vein. The circuit consisted of Poly Vinyl Chloride tubing, a centrifugal pump (Jostra Rotaflow Centrifugal pump; Macquet, Jostra Medizintechnik AG, Hirrlingen, Germany) and a Membrane Oxygenator (Quadrox i). Heater – cooler system (Cincinnati Sub Zero products Inc; Cincinnati, Ohio, USA) was used (Fig 1).

Time	pH	pO ₂ (mmHg)	SO ₂ (%)	pCO ₂ (mmHg)	HCO ₃ ⁻ (mmol/L)	Lac (mmol/L)
9:02 AM	7.19	58	84	30	11	3.9
10:06 AM	7.15	124	97	35	11	3.9
12:42 AM	7.26	306	99	21	9	4.9

Table 1 - Worsening Metabolic Acidosis.

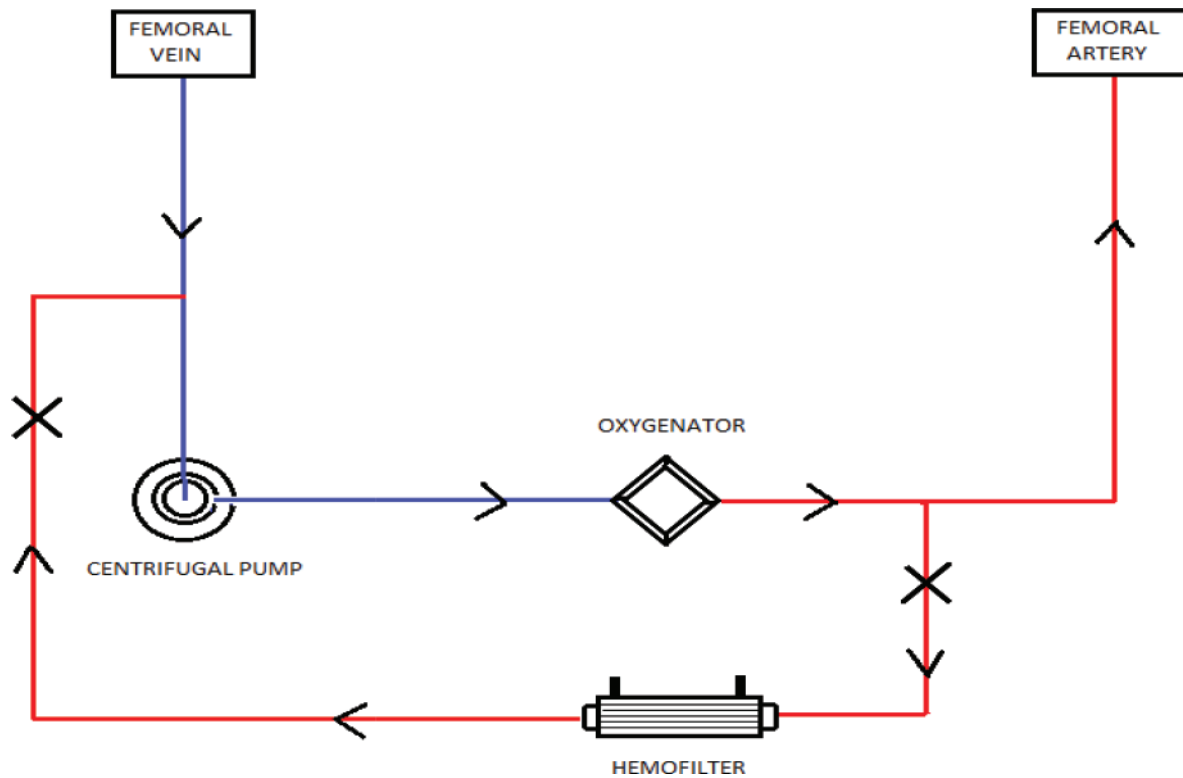


Fig 1 : Circuit

ECMO Management

Blood flow was initiated with a flow rate of 2L/min/m² and gas flow through the membrane was set at 2L/min. The lungs were kept ventilated with SIMV mode, PEEP-8, Pressure support – 12 and FiO₂ – 80 %. The Activated Clotting Time was maintained between 200 – 250 secs with the continuous infusion of Unfractionated Heparin.

The ACT and ABG were checked every one hour. Mixed Venous Oxygen Saturation and Lactate levels were used to monitor the tissue perfusion. The VBG revealed a MVO₂ in the range of between 60- 75 % throughout the procedure which reflects the adequate tissue perfusion.

The pressure drop of the oxygenator (ΔP) helps in predicting any clots within the oxygenator membrane.

$$\Delta P = MAP_{pre-oxy} - MAP_{post-oxy}$$

The ΔP was monitored continuously and maintained within 10mmHg throughout the procedure.

The urine output increased immediately after initiation of ECMO and the inotropic supports were slowly tapered as the hemodynamics improved. After 10 hours of ECMO the Lactate levels decreased to a more physiological level of 1.6 mmol/L.

	pH	pO ₂ (mmHg)	SO ₂ (%)	pCO ₂ (mmHg)	HCO ₃ ⁻ (mmol/L)	Lac (mmol/L)
Before ECMO initiation	7.26	341	99	21	9	4.6
At initiation of ECMO	7.30	117	98	28	14	3.9
After 10 hours of ECMO	7.38	267	99	35	20	1.6
After 24 hours of ECMO	7.35	79	96	37	21	1.4
After 48 hours of ECMO	7.43	106	98	35	21	1.3
After 65 hours of ECMO	7.43	95	98	35	23	1.4

Table 2 - Indicates the improvement of Metabolic parameters.

Continuous Arterio-Venous Hemofiltration (CAVH) was instituted to regulate the intravascular volume and to treat the Acute Kidney Injury.

The inotropic support was progressively tapered and discontinued completely with improvement in cardiac function. On day 4, with adequate Respiratory, Metabolic and Hemodynamic parameters, the patient was weaned off ECMO and decannulated.

Discussion

Cardiovascular failure is the leading cause of the death in patients with drug overdose². VA-ECMO can be used as a bridge to recovery for these patients who are not responding to conventional therapy³. Only a few reports have been published about the use VA-ECMO in drug overdose patients presenting with refractory cardiogenic shock^{1,2}. β -blocker and Calcium Channel Blocker toxicity results in poor myocardial contractility, hemodynamic deterioration due to cardiogenic shock and Arrhythmias¹. We did not observe any major rhythm disturbance except Bradycardia. The effect of β -blocker and Calcium Channel Blocker induced bradycardia was counterbalanced by the chronotropic effect of high dose vasoactive drugs and helped in maintaining a near normal Heart Rate of 60-80 beats/min¹.

Metoprolol is mainly metabolised in Liver and its metabolites are excreted in urine. Its half life is 3-7 hrs⁴. Elimination of Amlodipine is mainly by biotransformation in Liver where they are converted into inactive metabolites and are excreted in urine. Its half life is 30-50 hrs⁵.

Any decrease in the renal blood flow or function decreases the Glomerular Filtration Rate, affecting the drugs that are dependent on this route of elimination. Hepatic failure or decreased hepatic blood flow hinders the enzymatic activity of Liver, affecting the drugs that are dependent on this route of elimination and eventually leading to drug toxicity⁶.

Hemodilution on ECMO increases the volume of distribution of drug mainly the hydrophilic drugs and thereby decreasing its plasma concentration resulting in therapeutic failure of the drug. The decrease in plasma proteins due to hemodilution, particularly Albumin, affects the drugs that are highly protein-bound and increases the unbound fraction of drug leading to potential toxicity⁶. On the other hand the improved perfusion to Liver and Kidney due to

VA-ECMO support may improve the metabolism and elimination of drug that are dependent on this route of elimination thereby decreasing the potential toxicity⁶.

The most common complications of ECMO that have been reported are bleeding, Limb-ischemia and other cannulation related problems^{2,7}.

In conclusion, VA-ECMO is an effective resuscitation tool in patients with overdose of Cardiotoxic drugs. Early and appropriate timing of institution will result in excellent prognosis.

Authors declare no conflict of interest

References

- 1) Rona R, Cortinovis B, Marcolin R, Patroniti N, Isgro S, Marelli C et al. Extra-corporeal life support for near-fatal multi-drug intoxication: a case report. *J Med Case Reports*. 2011; 5: 231
- 2) Daubin C, Lehoux P, Ivascau C, Tasle M, Bousta M, Lepage O et al. Extracorporeal life support in severe drug intoxication: a retrospective cohort study of seventeen cases. *Crit Care*. 2009;13(4):R138.
- 3) Leon G. Toxicology Rounds: The Next Big Thing: ECMO for Poisoned Patients. *Emergency Medicine News*. 2015;37(4):1,30-30.
- 4) Seiler KU, Schuster KJ, Meyer GJ, Niedermayer W, Wassermann O. The Pharmacokinetics of Metoprolol and its metabolites in Dialysis patients. *Clin Pharmacokinet*.1980;5(2):192-8.
- 5) Meredith PA, Elliott HL. Clinical Pharmacokinetics of Amlodipine. *Clin Pharmacokinet*.1992;22(1):22-31.
- 6) Dzierba AL, Abrams D, Brodie D. Medicating patients during extracorporeal membrane oxygenation: the evidence is building. *Crit Care*. 2017;21(1):66
- 7) de Lange DW, Sikma MA, Meulenbelt J. Extracorporeal membrane oxygenation in the treatment of poisoned patients. *Clin Toxicol (Phila)*. 2013;51(5):385-93.