JSCR Journal of Surgical Case Reports

Journal of Surgical Case Reports, 2021;2, 1–3

doi: 10.1093/jscr/rjab014
Case Report

CASE REPORT

Extracorporeal cardiopulmonary resuscitation for the treatment of amlodipine overdose in a pediatric patient

Katherine Giuliano[1,*], Y. Julia Chen[1], Kristen Coletti[2], Caitlin O'Brien[2], Eric Jelin[1] and Alejandro Garcia[1]

[1]Department of Pediatric Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, USA and [2]Department of Anesthesiology and Critical Care Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, USA

*Correspondence address. Blalock 1265, Johns Hopkins Hospital, 1800 Orleans Street, Baltimore, MD 21287, USA. Tel: 410-614-5283; Fax: 443-287-4226; E-mail: kgiuliano@jhmi.edu

Abstract

We present the case of a 16-year-old female with systemic lupus erythematosus who presented with shock of unclear etiology, refractory to fluid resuscitation and triple vasopressors. She suffered pulseless electrical activity and underwent cannulation onto veno-arterial extracorporeal membrane oxygenation (ECMO). After cannulation, it was discovered she had intentionally overdosed on her home medication, amlodipine, a calcium channel blocker (CCB). She was supported on ECMO, treated with IV calcium and insulin, and was able to be weaned off ECMO after 4 days. She developed oligoanuric acute kidney injury, treated with continuous renal replacement therapy followed by intermittent hemodialysis. At discharge, she was neurologically intact and did not require dialysis. Herein, we review the treatment of CCB overdose, review the literature on the use of ECMO in refractory shock due to cardiovascular medication overdose, and highlight the utility of ECMO in pediatric refractory shock and/or cardiac arrest of unclear etiology.

INTRODUCTION

Calcium channel blockers (CCBs) are the sixth leading cause of substance-overdose-related death and the most frequent of the cardiovascular medications [1]. They exert their anti-hypertensive effect by binding voltage-gated channels in the heart and vascular smooth muscle, with dihydropyridines such as amlodipine primarily acting on smooth muscle, causing peripheral vasodilation [2, 3].

Herein, we present the case of a 16-year-old female with refractory shock and pulseless electrical activity (PEA) due to amlodipine overdose, who was successfully supported with extracorporeal membrane oxygenation (ECMO).

CASE REPORT

The patient is a 44.4 kg 16-year-old female with a past medical history of systemic lupus erythematosus (SLE) complicated by lupus nephritis and associated hypertension treated with amlodipine. She presented with 1 day of worsening epigastric abdominal pain, nausea, vomiting and hypotension. She was

Received: December 27, 2020. **Accepted:** January 11, 2021

admitted to the pediatric intensive care unit (PICU), where her exam was notable for overall ill appearance, pallor and epigastric abdominal pain with tenderness and guarding. Her vital signs were a temperature of 37.3°C, heart rate of 127 beats per minute, blood pressure of 84/46 mm Hg and respiratory rate of 17 breaths per minute. Her presentation labs were unremarkable, with a normal white blood cell count of 11.7 × 10^3 cells/μl, hemoglobin of 11.5 g/dl, anion gap of 15 mmol/L and normal electrolytes apart from a bicarbonate of 18 mEq/L and elevated creatinine of 1.9 mg/dl (from a baseline of 0.5 mg/dl 2 months prior). Her lipase was normal. An abdominal X-ray was unremarkable, without free air under the diaphragm, and point-of-care echocardiography showed preserved left ventricular function.

She was initiated on norepinephrine and broad-spectrum antibiotics. She remained hypotensive, requiring the addition of vasopressin, epinephrine and hydrocortisone for refractory shock. She was intubated to decrease metabolic demand. Shortly thereafter, she suffered PEA, and chest compressions were initiated. Labs drawn shortly before her arrest revealed a glucose of 247 mg/dl, lactate of 5.1 mmol/L and decreased hemoglobin to 7.5 g/dl. Given concern for an intra-abdominal process, a bedside exploratory laparotomy was performed, without evidence of intra-abdominal hemorrhage or pathology to explain her arrest. Massive transfusion protocol was simultaneously initiated. Return of spontaneous circulation (ROSC) was briefly achieved, but she again suffered PEA with resumed compressions, at which time she was cannulated onto veno-arterial (VA) ECMO via the right femoral vessels. Total time of CPR prior to ECMO was 65 min.

In the days that followed, it was discovered that the patient had overdosed on amlodipine as a suicide attempt. In addition to VA-ECMO, she was treated with infusions of calcium chloride and insulin. She developed oligoanuric acute kidney injury requiring initiation of continuous renal replacement therapy (CRRT). After 4 days, she was weaned off ECMO. She underwent decannulation with repair of the right superficial femoral artery with saphenous vein graft, sartorius muscle flap for coverage, as well as closure of the abdomen. On postoperative day (POD) one, she was extubated. On exam, she was alert without neurologic deficits and with a palpable pulse in the right lower extremity. Her post-ECMO brain MRI was normal except for microhemorrhages in the supratentorial and infratentorial brain. On POD eight, she was transitioned from CRRT to intermittent hemodialysis (HD), which she remained on until POD13, at which time she had sufficient renal recovery to come off of dialysis. By POD 27, she was transferred to inpatient Pediatric Psychiatry. At the time of discharge, she was neurologically intact except for peripheral neuropathy thought to be due to critical illness.

DISCUSSION

When a patient presents early after CCB ingestion, gastric lavage or decontamination with activated charcoal can be performed [2, 3]. Our patient presented about 20 h after symptom onset, and she did not endorse CCB ingestion. While her diagnosis was unclear, she was treated with IVF resuscitation and vasopressors, both of which are first-line therapy in CCB overdose. IV calcium—administered to overcome the calcium channel blockade—is also first-line therapy and was utilized in our patient once it was discovered she had ingested amlodipine [2, 3].

Hyperinsulinemia/euglycemia therapy (HIET), defined as administration of high-dose insulin (~0.5–1 unit/kg/h) along with glucose to maintain euglycemia, is also recommended in CCB overdose [4]. As CCBs bind voltage-gated channels in the pancreas, exogenous insulin overcomes the CCB-induced hypoinsulinemia, correcting the hyperglycemic acidosis often seen. Insulin therapy may also increase inotropy and peripheral vascular resistance by converting cellular metabolism from fatty acids to carbohydrates in the myocardium and vascular smooth muscle [2–4].

The use of ECMO for refractory shock due to cardiovascular medication overdose has primarily been described via case reports in the adult literature. In one of the largest series of 17 patients (with a mean age of 39 years), seven cases (41%) were specifically extracorporeal cardiopulmonary resuscitation (ECPR) for cardiac arrest, 88% were weaned off ECMO and 76% were discharged alive [5]. Cases in children are much more limited, with one series including a 19-year-old who ingested amlodipine and atenolol and a 17-year-old who ingested propranolol, amitriptyline, fluphenazine and gabapentin, both of whom were able to be decannulated and survived [6]. When assessing the outcomes of ECPR from all etiologies in 4945 children from the Extracorporeal Life Support Organization (ELSO) registry, 59% survived to decannulation, and 42% survived to discharge or transfer [7].

In summary, our patient is a 16-year-old with history of SLE who presented with refractory shock of unclear etiology, who then suffered cardiac arrest and was cannulated for VA-ECMO. It was discovered that she had ingested a large quantity of amlodipine, and she was treated with IV calcium and insulin. She was weaned off ECMO and was discharged with no major sequelae and a good neurologic outcome.

While the use of ECMO for cardiovascular medication overdose has predominantly been described in adult case series, borrowing from these experiences and the general outcomes of pediatric ECPR, we propose ECMO as a salvage therapy in pediatric cases of CCB overdose. This patient serves an example of the potential benefit of ECMO in refractory shock and/or arrest of unclear but potentially reversible etiology with good functional outcomes.

CONFLICT OF INTEREST STATEMENT

None declared.

FUNDING

None.

REFERENCES

1. Gummin DD, Mowry JB, Spyker DA, Brooks DE, Beuhler MC, Rivers LJ, et al. 2018 annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 36th annual Report. *Clin Toxicol* 2019;**57**:1220–413.
2. Bartlett JW, Walker PL. Management of Calcium Channel Blocker Toxicity in the Pediatric patient. *J Pediatr Pharmacol Ther JPPT* 2019;**24**:378–89.
3. St-Onge M, Dubé P-A, Gosselin S, Guimont C, Godwin J, Archambault PM, et al. Treatment for calcium channel blocker poisoning: a systematic review. *Clin Toxicol (Phila)* 2014;**52**:926–44.
4. Lheureux PER, Zahir S, Gris M, Derrey A-S, Penaloza A. Bench-to-bedside review: hyperinsulinaemia/euglycaemia therapy in the management of overdose of calcium-channel blockers. *Crit Care* 2006;**10**:212.

5. 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**:R138.
6. Vignesh C, Kumar M, Venkataraman R, Rajagopal S, Ramakrishnan N, Abraham BK. Extracorporeal membrane oxygenation in drug overdose: a clinical case series. *Indian J Crit Care Med Peer-Rev Off Publ Indian Soc Crit Care Med* 2018;**22**:111–5.
7. Extracorporeal Life Support Organization - *ECMO and ECLS* > *Registry* > *Statistics* > *International Summary*. https://www.elso.org/registry/statistics/InternationalSummary.aspx (9 December 2020, date last accessed).