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Case Report

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Case report: transcaval impella placement in a patient with acute lv dysfunction from ethylene glycol toxicity

Abstract

Introduction: Ethylene glycol is a toxic alcohol commonly found in antifreeze, or other household and industrial agents. Patients usually survive ethylene glycol toxicity when promptly treated but delay in care can cause significant morbidity and mortality. Significant metabolic acidosis can lead to multisystem organ dysfunction including Left ventricular dysfunction which can pose a unique challenge.

Case report: The patient is a young female who presented with acute encephalopathy, intraventricular hemorrhage (IVH), severe metabolic acidosis, and severe left ventricular dysfunction following acute ethylene glycol toxicity. A diagnosis was quickly made due to presence of calcium oxalate crystals in the urine. The patient received timely interventions with Fomepizole and kidney replacement therapy (KRT), which failed to reverse her severe shock. The patient required mechanical circulatory support (MCS) in the form of Transcaval peripheral ventricular assist device (pVAD).

Conclusion: This case showed the use of the transcaval approach to place an pVAD in a young patient suffering from ethylene glycol toxicity and severe left ventricular dysfunction. Although it remains an uncommon approach, it can be used when more traditional access points have failed, and the patient requires MCS.

Keywords: Ethylene glycol, Impella, percutaneous ventricular assist device

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Introduction

In this case report, we present a case of Ethylene Glycol toxicity presenting with acute encephalopathy, IVH, severe metabolic acidosis and severe left ventricular dysfunction. Timely interventions with Fomepizole and kidney replacement therapies (KRT) failed to reverse the severe shock, and the patient required mechanical circulatory support (MCS) in the form of Transcaval peripheral ventricular assist device (pVAD).

Case report

The patient is a 23-year-old female with a reported history of proximal renal tubular acidosis (RTA) and recurrent soft tissue infections who presented to the emergency department with acute encephalopathy and found to have severe metabolic acidosis. Per reports from family, the patient had a prior history of suicide attempts and was found with an open bottle of Zolpidem by her bedside.

On exam, her initial vital signs were BP 159/120, HR 101, 98% on room air. Her initial Glasgow Coma Scale was 6 and due to inability to protect her airway, she was endotracheally intubated and placed on mechanical ventilation in the emergency department. She quickly developed shock and was started on pressors. The patient had a right lower extremity healing ulcer, as well as healed lacerations on her right lower extremity and left wrist. She was also noted to have mottling of the skin and delayed capillary refill.

Pertinent laboratory values showed, high anion gaps metabolic acidosis with serum pH of 6.69, partial pressure of CO_2 30.4, partial pressure of oxygen in arterial blood 230 and serum bicarbonate of 3.8 mmol/l. Her Osmolar gap was 83. Urinalysis showed specific gravity 1.012, protein 100, glucose 50, blood 1+, ketones/bilirubin/nitrites/urobilinogen/LE negative. Her toxicological analysis was only positive for Benzodiazepines in the urine. Serum Beta-hydroxybutyrate was 0.1 and serum lactic acid was negative. Presenting Creatinine was 1.40 mg/dl up from a baseline of 0.56 mg/dl. A urine sediment was examined and is shown below showing Envelope shaped Calcium Oxalate Dihydrate crystals (Figure 1) and no amorphous casts indicating acute tubular necrosis were seen.

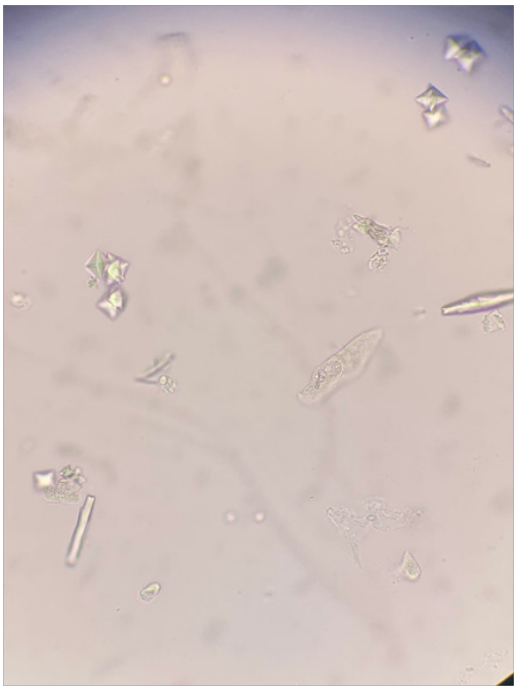

Figure 1 Urine Sediment showing Envelope shaped Ca-Oxalate Dihydrate crystals.

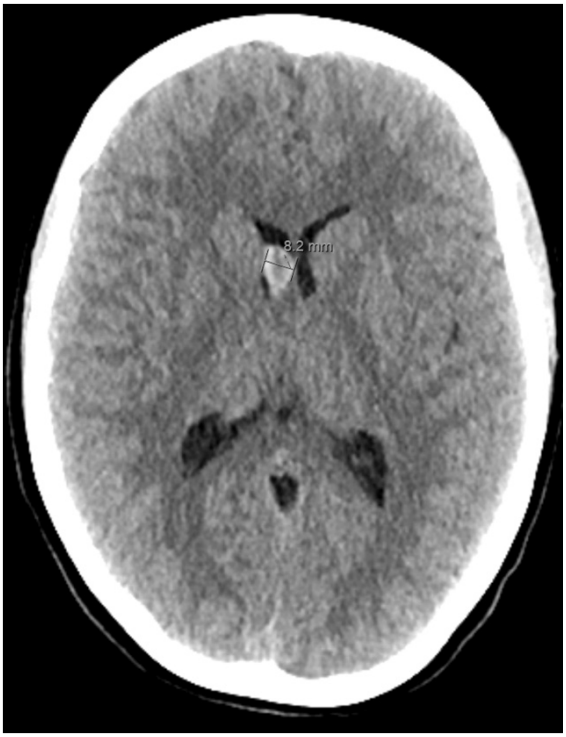

Figure 2 CT scan head without contrast showing IVH in the right lateral ventricle.

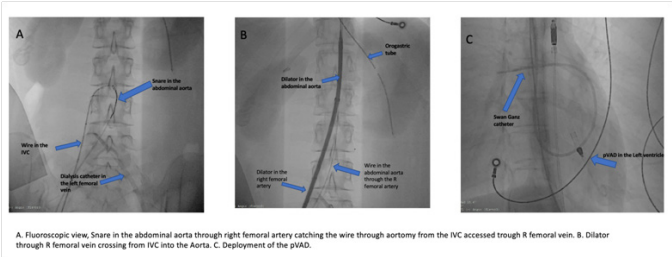

Figure 3 Angiogram Images.

CT scan of the head showed a 0.8 cm intraventricular hemorrhage (IVH) within the right lateral ventricle and third ventricles (Figure 2). Her CT Chest/Abdomen/Pelvis showed no acute abnormalities. Etiology of the IVH couldn't be found and a conservative management approach was suggested. Given the calcium oxalate crystals on urine sediment, high osmolar gap, and severe anion gap metabolic acidosis, the diagnosis of ethylene glycol toxicity was suspected, and she was given ampoules of hypertonic sodium bicarbonate, started on high dose Fomepizole, high dose (50ml/kg/hr) continuous renal replacement therapy (CRRT) and cofactor supplementation with Thiamine and Pyridoxine. CRRT was selected over intermittent Hemodialysis due to concerns for worsening IVH and severe shock. She continued to require high doses of vasopressors with Levophed and Vasopressin. A bedside transthoracic echocardiogram showed left ventricular ejection fraction (LVEF) of only 10-15 % with preserved right ventricular function. Inotropes were added without success and shock continued to get worse now requiring the addition of high dose Epinephrine gtt. MCS with Veno-Arterial ECMO was considered but presence of IVH and need for anticoagulation for the circuit was thought to be a contraindication.

Placement of Abiomed Impella CP was considered with only 7-20 ml/hr of 50 IU/ml unfractionated heparin (UFH) with the purge solution without the use of concomitant systemic anticoagulation. However, the size of her arteries proved to be a challenge. Her femoral and axillary arteries were both <4 mm bilaterally, making placement of Impella CP challenging. The smaller size of the large arteries was attributed to the use of high dose pressors, female gender, and short stature. After careful planning, placement of transcaval pVAD was considered through the right femoral vein and executed. Adequate flows were obtained, no distal perfusion cannulas were needed. Vasopressors were weaned off in the next 24 hours. pVAD support was also weaned off in the next 3 days and she was decannulated in the catheterization lab with 'plugging' of the aortotomy site without any major bleeding complications. The patient did develop self-limiting severe rhabdomyolysis which was thought to be the result of high dose pressors leading to poor peripheral perfusion; no compartment syndrome was found. She was also found to have methicillin-sensitive-staphylococcus aureus bacteremia, likely a result of right lower extremity cellulitis, which was treated with oxacillin. A transesophageal echo was negative for any vegetations.

The patient was extubated on day 4 and admitted to taking Ethylene glycol. Send-out labs returned at this point, and showed an ethylene glycol level of 1455 mg/L, which confirmed the suspected diagnosis. A repeat echocardiogram showed recovery of LVEF to normal. The rest of her hospital course was complicated by a Pulmonary Embolism, for which the patient was started on anticoagulation after confirming the resolution of the IVH. The patient was eventually discharged with close follow-up. After one month, the patient began to show signs of renal recovery, and her dialysis catheter was removed.

Discussion

This was a unique case that posed many challenges. Prompt diagnosis and focused treatment of Ethylene glycol toxicity is prudent or else it can be lethal. Treatment should be immediately initiated when clinical suspicion is high, as the definite diagnosis can take days to weeks due to the 'send out' nature of the ethylene glycol levels and other volatile alcohols at most institutions. High osmolar gap and high anion gap in the absence of more common conditions such as ketoacidosis and ethanol ingestion etc., should also prompt consideration of methanol or ethylene glycol. The key to diagnosing such challenging scenarios which are extremely rare is to always keep volatile alcohol ingestion in the differential diagnosis of unexplained high anion gap metabolic acidosis and checking an osmolar gap (will still be elevated in the absence of high anion gap, in the case of Isopropyl alcohol).

Ethylene glycol is a toxic alcohol commonly found in antifreeze, or other household and industrial agents. Due to its limited dermal absorption, ethylene glycol toxicity is primarily caused by either accidental ingestion, due to its sweet taste, or intentional ingestion in a suicide attempt.[1] It is primarily metabolized by alcohol dehydrogenase and aldehyde dehydrogenase in the liver. These steps create glycolic acid, which is responsible for causing metabolic acidosis, and its metabolites cause nephrotoxicity and depletion of thiamine and pyridoxine. Typical laboratory findings include an elevated osmolar gap that is followed by development of an anion gap metabolic acidosis.[2,3] Patients usually survive ethylene glycol toxicity when promptly treated but delay in care can cause significant morbidity and mortality, including nephrotoxicity and shock. Presence of Ca-oxalate crystals in the urine is not always found but could help in rapidly diagnosing the underlying toxicity and start emergent lifesaving treatments.

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Stress cardiomyopathy (AKA Takotsubo syndrome) is a well-recognized syndrome in the setting of severe metabolic derangements.[4] The severe metabolic acidosis was also likely responsible for the refractory shock, leading to LV dysfunction which then persisted despite the correction of metabolic derangements with KRT, alkaline therapy and Fomepizole.

When the patient has refractory shock secondary to severe LV dysfunction, options for MCS include pVAD with Abiomed Impella, VA-ECMO, temporary LVAD with trans-septal Tandem heart, and Intra-Aortic Balloon pump (IABP). These are typically used as a "bridge to recovery" or "bridge to destination" if long-term prognosis is unknown at the time of device placement.[5]

IABP usually does not give more than 500 mL of support and was not the right support for this patient who was on high doses of vasopressors. VA-ECMO works by employing a continuous flow pump to both oxygenate blood and provide MCS. Blood is drawn in from a vein, such as the femoral vein, and is oxygenated via the membrane. The oxygenated blood is pumped into an artery, such as the femoral artery, to help deliver oxygenated blood to tissue. Full dose of anticoagulation is required to keep the circuit patency for VA-ECMO which was not desired in our patient due to the concerns for worsening of her IVH. Blood flows up to 7 L could be obtained through VA-ECMO.[6]

The device that was eventually used on this patient to provide MCS was a pVAD (Impella, Abiomed Inc., Danvers, MA, USA). Utilizing the Archimedes-screw principle, the Impella rotates a small, hollow pipe to pump blood from the left ventricle to the ascending aorta. This increases the forward flow of blood, increasing tissue perfusion and mean arterial pressure. This also reduces myocardial oxygen consumption. Manufacturer's recommendation is to use a purge solution with heparin and concomitant use of systemic anticoagulation as well with either ACT, aPTT or anti Xa level goals to avoid clotting.[7] In this patient, the systemic anticoagulation had to be held due to her IVH.

The transcaval approach was first discussed in July 2013. The catheter uses a venous access to enter the Inferior Vena Cava (IVC) and crosses over into the aorta at a predetermined location, where a snare, via the femoral artery, can catch the catheter and guide it retrograde towards the aortic valve. This approach has been gaining popularity to perform TAVR on patients with poor arterial access. A prospective study showed that the transcaval approach had promising results with no late major vascular complications in patients receiving transcatheter aortic valve replacement (TAVR).[8]

Our patient tolerated MCS with transcaval pVAD without the use of systemic anti coagulation. We only used the heparin preset in the purge solution which consists of 7-20ml/hr of D5W and 50 IU/ml of UFH. We repeated the CT scan of the head after decannulating her which showed stability of the IVH. Decannulation was done in the catheterization lab where an aortotomy plugging device was used and later contrast administration showing no leak.

Conclusion

This case showed the consequences of ingesting high doses of Ethylene glycol resulting in various complications which occurred despite of prompt diagnosis and specific treatment. MCS for severe LV dysfunction for 3-4 days can be provided safely using transcaval approach where arterial access is deemed to be difficult.

Authorship declaration

I certify that all authors listed above meet the authorship criteria and all authors participated and agree with the manuscript.

Disclosure

None to disclose.

The work for this case was performed in St John's Hospital: 800 E Carpenter St, Springfield, IL 62769.

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