Case Report

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REBOA to the Rescue: Successful Endovascular Resuscitation of Methemoglobinemia-Induced Cardiac Arrest

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REBOA (Resuscitative Endovascular Balloon Occlusion of the Aorta) is an endovascular occlusion device commonly used to temporize bleeding due to traumatic non-compressible torso hemorrhage. This case report presents the successful utilization of REBOA in the resuscitation of a critically ill trauma patient that presented to the emergency department status post motor vehicle collision, later found to have methemoglobinemia. The REBOA was placed as part of a catch-all trauma workup following cardiac arrest after intubation. The timely placement of the REBOA resulted in a return of spontaneous circulation within 30 seconds of balloon inflation. While it is not a definitive treatment of methemoglobinemia, REBOA allowed us to successfully resuscitate the patient until final diagnosis and treatment of the underlying methemoglobinemia could be made. The patient would go on to regain full neurologic function. We believe that this is the first reported resuscitation of a patient with methemoglobinemia utilizing the REBOA device.

Keywords: *REBOA; Methemoglobinemia; Non-Traumatic Cardiac Arrest; Resuscitation; Shock*

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INTRODUCTION

REBOA (Resuscitative Endovascular Balloon Occlusion of the Aorta) is a minimally invasive large vessel occlusion device used as a substitute for resuscitative thoracotomy with aortic clamping [1,2]. Its application results in an increase in coronary blood flow, cardiac output, mean arterial pressure, carotid blood flow, and partial pressure of oxygen to the brain [3–5]. While REBOA has begun to carve a niche in managing hemorrhagic shock, its use in the broader treatment of hypoperfusion is in its infancy. Currently, limited data exists demonstrating its feasibility in the management of non-trauma cardiac arrest in humans [6–12]. Building on this, we present a unique case of successful REBOA deployment in a case of dissociative shock secondary to methemoglobinemia poisoning. The early initiation of REBOA led to the prompt restoration of circulation and facilitated the stabilization of the patient until definitive diagnosis and treatment.

CASE PRESENTATION

A 60-year-old male with no known previous medical history presented to the emergency department as a level one trauma activation. His car reportedly collided into a tree at between forty and fifty miles per hour. According to the emergency medical services, the patient ingested an "energy drink" immediately preceding the accident. On arrival at the emergency department, the patient's Glasgow Coma Score (GCS) was 11. He was notably diaphoretic and hypoxic at a maximum O_2 saturation of 88% on a non-rebreather. Additionally, he was notably hypotensive with an initial blood pressure of 82/50. On primary examination, the patient demonstrated no external signs of trauma.

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The patient was immediately started on high-flow oxygen, and two large-bore peripheral intravenous access points were established. A workup including chest X-ray, pelvic X-ray, and Electrocardiogram (EKG), and focused assessment with sonography for trauma (FAST) exam was notably negative for pathology. Due to the severity of hypotension, he received a blood transfusion using the 1:1:1 strategy (packed red blood cells, platelets, and plasma) which improved his systolic blood pressure to 90 mmHg. However, the patient remained hypoxic, at below 90% oxygen saturation. Endotracheal intubation was then performed to secure the airway and provide ventilatory support.

Within seconds of intubation, the patient experienced a sudden loss of pulses. One round of immediate cardiopulmonary resuscitation and epinephrine administration was initiated, and a COBRA-OS REBOA was placed via the right common femoral artery. The catheter was inserted into Zone 1 via the 4 French sheath, and placement was confirmed via chest X-ray (Figure 1). Balloon inflation was then initiated at full occlusion of 13 cc at a time of 14:34. Within 30 seconds of balloon inflation, the patient achieved return of spontaneous circulation (ROSC). The balloon was then partially deflated at 14:48, and the patient was taken for an emergent computed tomography scan, which was negative for an acute process. Although intubated, the patient remained hypoxic with a maximum oxygen saturation of 88% and notable perioral cyanosis.

A radial arterial line was then placed, yielding brown "chocolate" blood which made the clinical team suspicious for methemoglobinemia. Subsequent labs were notable for an elevated methemoglobin level of 28.7%. The REBOA balloon was then completely deflated and removed at 15:07 and supportive care was initiated. After the administration of methylene blue, the patient remained hemodynamically stable and was transferred to the intensive care unit for further management. Within 24 hours, the patient was extubated and weaned to room air. He exhibited neurological recovery and a GCS score of 15. The patient was eventually discharged following a short hospital course.

Ethical Approval and Informed Consent

As a de-identified case report, no ethical approval or written informed consent was required for this study.

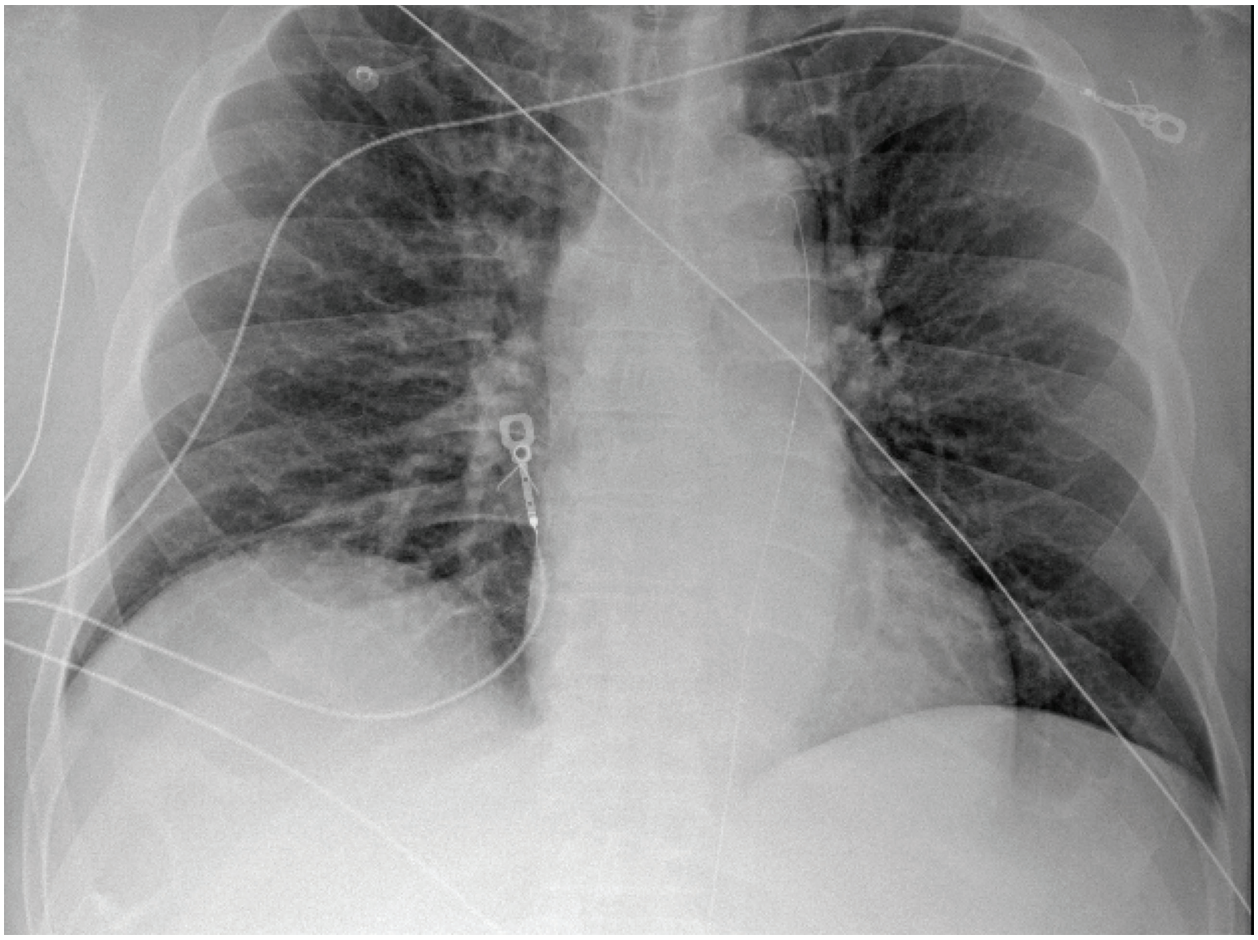

Figure 1 Chest X-ray confirming Zone 1 REBOA placement.

DISCUSSION

This case demonstrates the potential life-saving impact of REBOA in a patient suffering cardiac arrest secondary to hemoglobinopathy. While it is not a definitive treatment for methemoglobinemia, REBOA enabled us to successfully resuscitate the patient until final diagnosis and treatment of the underlying pathology could be made. Several keys to the successful use of REBOA included early placement of common femoral artery access for monitoring of hypotension, and clinician competency with the REBOA procedure. While data on the use of REBOA in non-trauma cardiac arrest is limited, the improvement in coronary and cerebral perfusion previously demonstrated in animal studies is likely responsible for ROSC with balloon inflation [6–12]. While REBOA use has been widely adopted by many trauma surgeons, its use in other populations remains limited. Emergency medicine physicians can be successfully trained in the use of REBOA through established, validated training courses [13].

Factors such as pre-existing medical conditions and anatomical considerations must be diligently evaluated prior to REBOA utilization [14]. Furthermore, vascular injuries, thromboembolism, and lower-extremity amputation due to unrecognized vascular access complications are a potential reality of REBOA treatment [15]. Many of these access site complications were associated with the use of large 12 French sheaths required for the first-generation REBOA device. However, with the recent introduction of smaller sheaths, the rate of these adverse events has been shown to lower dramatically [16].

As a retrospective case report, our study bears limitations establishing causation and generalizability, and is susceptible to human error in the electronic medical record. To our knowledge, this case report is the first to document the management of methemoglobin-induced cardiac arrest. The profound impact of REBOA on managing dissociative shockz demonstrated through this patient's trajectory, merits further investigation.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflict of Interest

Laura Moore is Chair of the Scientific Advisory board, has an equity stake, and receives consulting fees from the developer of COBRA-OS REBOA, Front Line Medical Technologies Inc.

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