Case Report

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Resuscitative Endovascular Balloon Occlusion of the Aorta to Augment Afterload in Non-Traumatic Cardiac Arrest: A Case Report

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We describe the first case report of using a REBOA catheter to augment cardiac afterload in a non-traumatic cardiac arrest patient.

Keywords: *REBOA; Non-traumatic Cardiac Arrest; Cardiac Afterload; Resuscitation; Resuscitative Endovascular Balloon Occlusion of the Aorta*

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INTRODUCTION

Resuscitative endovascular occlusion of the aorta (REBOA) has a deep history, with recent advances in technology resulting in a resurgence of interest [1,2]. This innovation was driven by an interest in advancing truncal hemorrhage control for trauma patients, and the subsequent increase in the use of REBOA has resulted in documented use predominantly in trauma patients including case series [3,4] and registry studies [5–7]. In addition, several authors have identified the potential utility of REBOA in non-traumatic hemorrhage including postpartum hemorrhage [8–10], retroperitoneal debridement [11], post-surgical and gastrointestinal bleeding [12]. As the use of this resuscitative adjunct has expanded, so too has interest in its potential application to normovolemic hypotension. In particular, the application of REBOA as an adjunct closed chest cardiopulmonary resuscitation has received significant attention, including the presentation of preliminary animal data (Pan-Am EVTM, 2018) and publication of a recent review summarizing animal research and case reports [13]. As was the case for hypovolemic hypotension prior to the development of the ER-REBOA catheter, available devices, such as intra-aortic balloon pump devices, are constrained by the need for specialized clinical environments which are generally not available in Emergency Department trauma bays. Herein we describe the use of the ER-REBOA catheter deployed in a case of non-traumatic hypovolemic shock and cardiac arrest.

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Case Description

A 26-year-old man was found lying on the ground in an abandoned building known for illicit intravenous drug use. The patient was in cardiac arrest and paramedics began cardiopulmonary resuscitation. The patient had the return of spontaneous circulation after a short course of CPR prior to transport. Paramedics noted the man had lower-abdominal bruising as well as ligature marks across his bilateral lower extremities. Although initially treated as a cardiac arrest secondary to illicit drug use, the patient was transported to an ACS verified Level 1 Trauma Center for treatment.

Upon arrival to the Emergency Department, the patient was nonresponsive with a Glasgow Coma Scale (GCS) of 3 but breathing spontaneously. The patient was intubated for airway protection after naloxone was administered with no response. The patient's pulse rate was 130 bpm and blood pressure 50/palp. Since the patient was unresponsive with extensive bruising and unclear history of events, the patient's status was escalated to a Level I trauma alert by the emergency physician who evaluated him. The trauma team arrived with the patient still in extremis and the massive transfusion protocol was activated. Given the concern for possible intraabdominal or pelvic hemorrhage as a cause for the patient's shock, the decision was made to insert an ER-REBOA™ catheter (Prytime Medical, Boerne, TX) [13–15].

The right femoral artery was cannulated percutaneously using a 7 French arterial sheath and the catheter balloon was advanced and inflated in Zone 1 at 45 cm. Based on available military guidelines at the time, Zone 1 is approximately at 45–47 cm and Zone 3 at 22–25 cm. The balloon was inflated until resistance was encountered and the patient's blood pressure responded (approximately 12 mL of saline). Immediate blood pressure improvement followed to 115/65. A FAST examination, chest x-ray, and pelvic x-ray were performed in the trauma bay at this time which showed no injuries consistent with hemorrhagic shock as well as ER-REBOA™ catheter placement in Zone 1 (Figure 1). The patient was then taken immediately to undergo a CT scan of the head, chest, abdomen, and pelvis, which also were negative for injuries, to explain his hypotension (See balloon above the diaphragm in Figure 2). A small-volume pneumomediastinum was discovered which was attributed to the patient receiving chest compressions and right middle-lobe opacities likely due to aspiration.

As the patient's state of shock was cardiogenic in nature, the catheter balloon was deflated after 30 minutes to allow perfusion of the abdominal viscera. This was an early experience with ER-REBOA™ at our institution and we did not deflate the balloon for the CT scans nor did we attempt partial inflation. We have since changed our practice to deflate the balloon at least partially just before obtaining the abdomen/pelvis portion of our scans to allow contrast flow and better identify injuries. After balloon deflation, systolic blood pressure dropped again to the 70s but was successfully augmented with vasopressors. In total, the patient received 5 units of packed red blood cells, 7 units of fresh-frozen plasma, 2 units of platelets, and 10 units of cryoprecipitate. The balloon catheter and introducer sheath were removed about two hours later at the bedside and pressure held until hemostasis was assured. We now aim to remove the ER-REBOA™ catheter within six hours of placement and the introducer sheath within 24 hours of placement.

The next morning, acute compartment syndrome of the right lower extremity was noted and the patient underwent an emergent four-compartment fasciotomy.

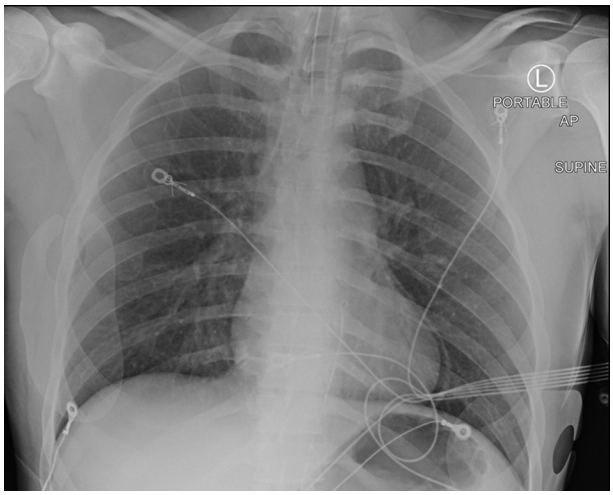

Figure 1 The ER-REBOA™ catheter can be seen left of the spine above the diaphragm.

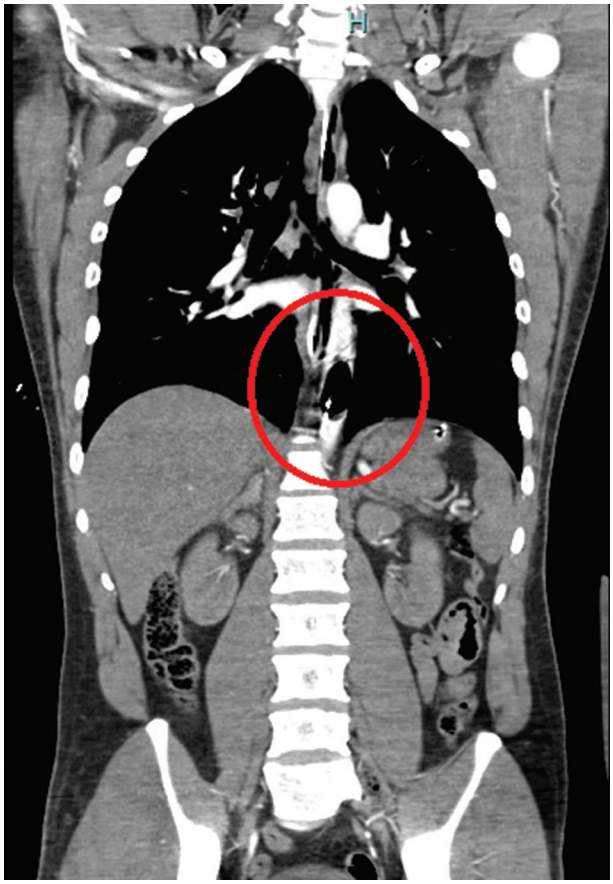

Figure 2 Trauma CT chest/abdomen/pelvis with ER-REBOA™ catheter balloon seen above the diaphragm.

An intra-operative angiogram of the right femoral artery performed at this time revealed no arterial injury or vascular abnormality to suggest catheter-related complications. Thus, the patient compartment syndrome, and

subsequent rhabdomyolysis, was attributed to a prolonged compression position after being down for an unknown period of time and low-flow state during his cardiac arrest.

Patient Outcome

The patient ultimately required an above-the-knee amputation for necrotic and non-functional tissues of his right lower extremity which failed to recover despite fasciotomies. He was discharged on hospital day 52 and was seen doing well in an outpatient clinic two weeks later.

CONCLUSIONS

Resuscitative endovascular balloon occlusion of the aorta (ER-REBOA™) has been used to temporarily occlude the aorta in Zone 1 or 3 in order to control intraabdominal or pelvic hemorrhage and to provide proactive management of life-threatening, refractory, hemorrhagic shock in addition to maximal conventional therapy [10,16]. This is the first published case report to date of ER-REBOA™ use in a non-traumatic cardiac arrest setting leading to a patient surviving. Much like an intra-aortic balloon pump inflating during diastole, the ER-REBOA™ balloon catheter augmented the patient's perfusion of the heart and brain. This allowed time to fluid resuscitate the patient, evaluate for possible traumatic injuries, and ultimately transition blood pressure support to the use of vasopressor medications. We strongly believe the use of ER-REBOA™ to augment cardiac afterload ultimately contributed to the patient surviving this incident. The ER-REBOA™ was readily available and could be placed quickly at the bedside without the need for angiography. Future uses of ER-REBOA™ in the setting of non-traumatic cardiac arrest patients should also consider partial balloon inflation to allow some distal perfusion while augmenting proximal cardiac and cerebral perfusion. Further research into the feasibility as well as outcomes for patients in non-traumatic cardiac arrest is required to better utilize this emerging technology.

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