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Case Report

The utility of resuscitative endovascular balloon occlusion of the aorta for temporary hemostasis after extensive bilateral lower extremity injuries: A case report

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ABSTRACT

A 75-year-old pedestrian was struck by a truck and in shock with both lower extremities significantly deformed, with injuries extending proximally to the inguinal region and degloving injuries. Resuscitative endovascular balloon occlusion of the aorta was performed to achieve temporary hemostasis and the patient became hemodynamically stable. Following stabilization, both lower extremities were amputated. Resuscitative endovascular balloon occlusion of the aorta may be effective to achieve temporary hemostasis in patients with extensive injuries of the lower extremities, especially with extension to the inguinal region which precludes use of a tourniquet.

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Introduction

Control of hemorrhage is essential in patients with traumatic injuries. Hemorrhagic shock could be a result of severe lower extremity trauma due to femoral artery injuries, severe multiple fractures, and a wide range of degloving injuries [1]. Although tourniquets may be effective to control of hemorrhage in many injuries, they may not be effective to achieve hemostasis in patients with severe injuries which extend proximally to the inguinal region [2,3].

Resuscitative endovascular balloon occlusion of the aorta (REBOA) has been used widely to treat patients with severe abdominal or retroperitoneal hemorrhage [4]. REBOA has been used as a minimally invasive approach instead of aortic cross clamping through an anterolateral thoracotomy. We report a patient treated with REBOA after suffering extensive bilateral lower extremity injuries to which tourniquets could not be applied due to extensive degloving wounds which extended proximally to the inguinal region bilaterally.

Case report

A 75-year-old male pedestrian with a past history of chronic renal failure treated with hemodialysis and polymyalgia rheumatica treated with corticosteroids was hit by a truck driving at 40 km/h and run over. He was brought to the emergency center 30 minutes after injury having been treated at the scene with oxygen and immobilization. Vital signs on admission showed blood pressure 51/34 mmHg, heart rate 92/min, respiratory rate 24/min, O₂ saturation 88% (10 L/min O₂ mask), and a Glasgow Coma Scale of E1V1M1. Breath sounds were equal bilaterally and the abdomen was not distended. There was significant hemorrhage from both lower extremities, which were visibly deformed by crush injuries. Manual compression alone was not effective for hemostasis due to the extensive wounds. Tourniquets were applied but they were ineffective, because the degloving wounds extended to the inguinal region bilaterally (Fig. 1). Intubation and massive blood transfusion were immediately performed. Hemorrhage in the thorax, abdomen, and pelvis were not detected by X-ray and sonographic investigations. Bilateral amputations were indicated as an immediate life-saving measure, but immediate transfer to the operating room was not possible.

REBOA was placed to achieve temporary hemostasis of the extensive lower extremity injuries while in the emergency department. The balloon was inserted and partially inflated at the level of Zone 1, above the diaphragm. The blood pressure increased to 90/50 mmHg, and the visible bleeding promptly decreased. After placing the REBOA, the patients became physiologically stable and a full-body computed tomography (CT) scan and X-rays of the lower extremities were performed. The CT scan and X-rays revealed bilateral femur fractures, bilateral comminuted tibia and fibula fractures, pubic and ischium fractures, bilateral lung contusions, maxilla fracture, and a nasal fracture (Figs. 2 and 3). The REBOA balloon imaged on the CT scan (Fig. 4) was then moved to Zone 3, distal to the renal arteries to increase perfusion of



Fig. 1 – Anterior view of bilateral lower extremity injuries showing extensive tissue destruction and degloving injuries.

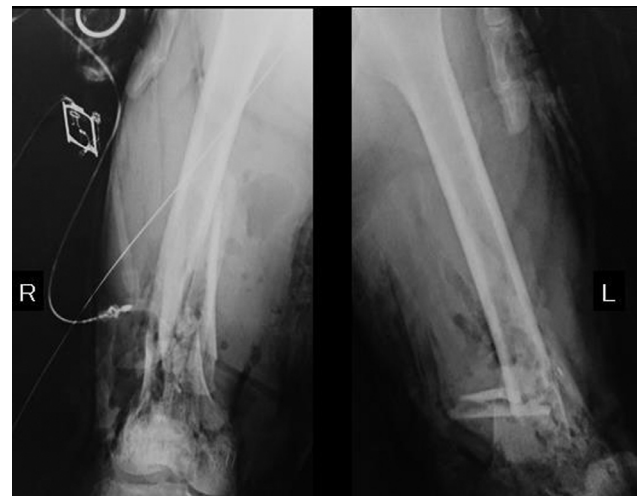


Fig. 2 – Antero-posterior radiographs showing bilateral comminuted femoral shaft fractures.

the abdominal viscera (Fig. 5). The patient was then transported to the operating room and both lower extremities amputated (Fig. 6). Final assessment showed that the injuries included degloving injuries of both lower extremities, bilateral femur fractures, bilateral comminuted tibia and fibula fractures, pubic and ischium fractures, bilateral lung contusions, maxilla fracture, and nasal fracture. The patient developed a postoperative wound infection treated with debridement and drainage. The patient improved and was transferred to the internal medicine service for optimization of hemodialysis on postoperative day 75.



Fig. 3 – Radiographs showing bilateral comminuted tibia and fibula fractures.



Fig. 4 – A post-REBOA computed tomography scan image showing the location of the balloon at the level of Zone 1, above diaphragm.

Discussion

This report describes the use of REBOA in a patient with extensive bilateral lower extremity injuries where tourniquets could not be used to achieve temporary hemostasis. Despite an extensive literature search, no similar cases were identified. REBOA is widely used in patients with hemorrhage due to injuries below the diaphragm. It is usually used for abdominal, retroperitoneal, or pelvic injuries to control hemorrhage [4]. REBOA was used to control hemorrhage from extensive extremity injuries and was effective to achieve hemostasis in this patient.

The use of REBOA promptly controlled the hemorrhage due to extensive bilateral lower extremity injuries which extended proximally to both inguinal regions. Use of a tourniquet is



Fig. 5 – A radiograph showing the location of the balloon after adjusted below the renal arteries by referring to computed tomography scan images.



Fig. 6 – Postoperative radiographs of both femurs: the right was amputated at the proximal femur level, and the left at midfemur.

generally suitable for temporary hemostasis due to extremity trauma [2]. Tourniquets are used for a wide range of indications, including many upper and lower extremity injuries and their effectiveness has been broadly demonstrated [2,3]. However, tourniquets will not be effective for wounds that extend far proximally. REBOA can limit the blood flow to both lower extremities simultaneously and decrease the rate of hemorrhage from extensive wounds. The hemorrhage decreased soon after inflation of the REBOA balloon in this patient.

The optimal location of the balloon in patients with massive hemorrhage from lower extremity injuries is just above the bifurcation of the aorta. This should minimize ischemia of

the abdominal viscera. REBOA is usually used in Zone 1, which is above the diaphragm, for hemorrhage from intra-abdominal injuries [5]. The location of the REBOA balloon can be adjusted during its use. One has to be careful to avoid ischemia due to the position of the REBOA.

Cross clamping the aorta through an anterolateral thoracotomy can reduce the rate of hemorrhage in a patient with extensive lower extremity injuries, but that may lead to other complications due to reduced blood flow in the abdomen. REBOA can decrease hemorrhage in a more noninvasive manner than aortic cross clamping [6]. Placing a cross clamp does not facilitate changing the position where the aorta is occluded, which may lead to intra-abdominal ischemia. REBOA may have the advantage of maintaining perfusion of abdominal organs [7] compared to cross clamping through a thoracotomy.

There is a possibility of ischemia of the lower extremities after inflation of the REBOA balloon. However, the extent of injuries in the present patient necessitated amputation of both lower extremities, and ischemia was not a consideration in the use of REBOA in this patient. The Mangled Extremity Severity Score is used to make the decision for amputation, and amputation is usually required if the score is over 7 [8]. Retrospectively, the scores of the lower extremities in this patient were 9 and 9 suggesting that amputation was almost certainly needed [9]. REBOA may be indicated in patients with severely mangled extremities, requiring amputation.

Conclusion

REBOA was applied to a patient in shock who had extensive bilateral lower extremity injuries to which tourniquets could not be applied for hemostasis due to proximal extension of the degloving wounds. REBOA may be effective for temporary con-

trol of hemorrhage in patients with extensive lower extremity injuries, especially if tourniquets cannot be applied.

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