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CASE REPORT

CLINICAL CASE

Aortic Balloon Occlusion in Repair of Ruptured Abdominal Aortic Aneurysm

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ABSTRACT

This case report details a novel technique implemented in Vietnam. When full equipment is unavailable, we adapt it by using aortic balloon occlusion to enhance the patient's hemodynamics and mitigate the risk of intraprocedural exsanguination. This approach effectively addresses the rupture of abdominal aortic aneurysms in patients with unstable hemodynamic conditions. (J Am Coll Cardiol Case Rep 2024;29:102331) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A male patient in his 60s was admitted to the emergency department with severe abdominal pain that had started 2 hours earlier.

PAST MEDICAL HISTORY

He had a past medical history of hypertension and had undergone thoracic endovascular aortic repair (TEVAR) for a thoracic aortic aneurysm 8 years previously.

LEARNING OBJECTIVES

- To explore the feasibility and effectiveness of using ABO as an alternative to REBOA in situations where REBOA is unavailable, with the aim of improving the patient's hemodynamics and preventing hemorrhage.
- To consider the level of partial AB inflation required to achieve permissive hypotension in the distal aorta to prevent exsanguination while maintaining distal aortic perfusion.

INVESTIGATIONS

On arrival, the patient's vital signs were as follows: blood pressure, 122/77 mm Hg; pulse, 98 beats/min; respiratory rate, 18 breaths/min; and peripheral oxygen saturation (Spo_2), 98%. Perioperative laboratory findings showed a hemoglobin level of 138 mg/dL, hematocrit at 41%, and a platelet count of 247,000/μL. Physical examination revealed a large pulsatile mass in the left upper abdomen. Emergency computed tomography angiography (CTA) was performed, revealing a ruptured 73.5-mm infrarenal abdominal aneurysm with retroperitoneal bleeding and leakage of contrast medium observed (**Figure 1**). After reviewing the images and considering the anatomy, endovascular abdominal repair (EVAR) was chosen for the patient. Just before being transferred to the cardiac catheterization laboratory, he developed severe abdominal pain, and his blood pressure

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

AB = aortic balloon

ABO = aortic balloon occlusion

Ch-EVAR = chimney endovascular abdominal repair

CTA = computed tomography angiography

EVAR = endovascular abdominal repair

rAAA = ruptured abdominal aortic aneurysm

REBOA = resuscitative endovascular balloon occlusion of the aorta

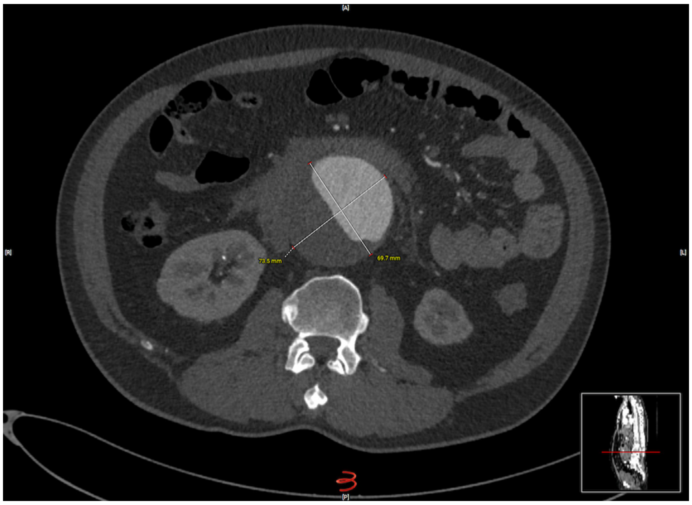
TEVAR = thoracic endovascular aortic repair

dropped from 110/72 mm Hg to 89/61 mm Hg, thus raising concern for recurrent ruptured abdominal aortic aneurysm (rAAA). Consequently, the patient was immediately transferred to the cardiac catheterization laboratory.

MANAGEMENT

To prevent bleeding in the case of an rAAA, we used the aortic balloon occlusion (ABO) technique. We accessed the right brachial artery and inserted a 12-F sheath (Figure 2). Because resuscitative endovascular balloon occlusion of the aorta (REBOA) was not available at our center, we chose to use an aortic balloon (AB) as an alternative. The patient received local anesthesia, and we introduced an AB (Medtronic) through the sheath in the right brachial artery, guided by fluoroscopy (Figure 3), to advance the AB within the thoracic stent graft (before TEVAR). The patient displayed an immediate positive hemodynamic response after balloon inflation, with the systolic blood pressure rising from 95/72 mm Hg to 120/78 mm Hg according to brachial artery pressure monitoring while decreasing from 95/72 mm Hg to 71/62 mm Hg in the femoral artery sheath. The patient's vital signs improved. Considering the anatomical characteristics, the length of the proximal landing zone (only 6 mm) was unsuitable for a standard EVAR procedure. Instead, we opted for EVAR with a single right renal artery chimney-graft (Ch-EVAR) as the preferred option (Figure 4). We performed Ch-EVAR using local anesthesia and a bilateral percutaneous femoral approach with left percutaneous brachial artery access. The right renal stent (Biotronik, 6 × 19 mm) chimney graft was inserted through a 6-F-long sheath through the left brachial artery access. Deployment of the main body of the stent graft (Medtronic, main body Endurant IIs AAA Stent graft system bifurcations ESBF 2514C103EE) with 25% oversizing was positioned below the left renal artery, and the limbs (Endurant II/IIs AAA Stent graft system Limbs ETLW 1616C124EE and ETLW1620C93EE) were deployed to both iliac limbs, thus completing a bifurcated stent graft. An angiogram confirmed the successful placement of the single Ch-EVAR with good perfusion to both kidneys and without any endoleaks (Figure 5).

FIGURE 1 **Initial Computed Tomography Angiography**



Axial computed tomography angiography demonstrating the presence of retroperitoneal hematoma suggestive of active bleeding in a ruptured abdominal aortic aneurysm.

DISCUSSION

This was the first case of ABO use during EVAR for an rAAA in Vietnam. Several crucial points emerged during the development of the optimal treatment strategy for this unique case.

INDICATION FOR ABO. ABO has the potential to help stabilize a hypotensive rAAA and control hemorrhaging during the EVAR procedure.[1,2] The decision to use ABO for rAAA depends on the patient's hemodynamic status. The ABO strategy has been used effectively for early bleeding control during intraprocedural EVAR to treat rAAA.[1]

LOCATION OF ABO IN THE AORTA TO PREVENT BLEEDING IN rAAA. The use of ABO in the aorta can carry a risk of significant vascular injuries, such as aortic dissection, perforation, or rupture, as a result of aortic disease or overinflation of the AB.[2] In this patient's case, the AB was inflated inside the thoracic stent graft, thus providing protection to the aortic wall.[2,3] Therefore, it is essential to analyze CTA findings to identify a "healthy" thoracic aortic segment from the origin of the left subclavian artery to the celiac arteries where ABO can be positioned. The position of the balloon is verified under fluoroscopy, and care should be taken not to overinflate the AB.[3,4]

AB INFLATION LEVEL. The AB, being a compliant balloon, is advanced into the aorta and then inflated.[3,4] ABO can achieve total occlusion of the aorta above the diaphragm, thereby obstructing blood flow into the distal aorta.[1,3] Balloon inflation results in reduced hepatic, mesenteric, and renal blood flow. Therefore, the AB is ideally inflated to control and maintain acceptable blood pressure levels in the distal aorta and consequently minimize the risk of end-organ damage.[2] Partial AB inflation preserves organ perfusion above the occlusion and allows for hypotension below the level of the ABO, which can aid in controlling distal hemorrhage. This method may reduce ischemia complications.[1,4] Partial AB inflation not only ensures good blood supply proximally but also maintains distal blood flow. The use of permissive hypotension to manage bleeding raised questions, and arterial pressure targets were determined on the basis of clinical review.[2,3] ABO enables safe and controlled EVAR, thus reducing the risk of bleeding during EVAR for rAAA.[1] Further studies and experience are needed to evaluate the long-term outcomes and applicability of this technique in a larger group of patients.

FOLLOW-UP

Two days after the procedure, CTA showed a patent chimney and no evidence of endoleaks. The patient's postoperative course was uncomplicated, and he was discharged after 5 days in stable condition. The patient had a repeat CTA after 6 months that revealed excellent results from a single Ch-EVAR with no endoleaks. The patient successfully regained his health and experienced a significant improvement in his overall well-being.

CONCLUSIONS

Our case report highlights that when REBOA is unavailable, the use of ABO has proven to be effective in controlling hemorrhage, thereby improving the patient's hemodynamics. Partial AB inflation should be applied carefully to maintain permissive hypotension in the distal aorta; this balances the need to prevent bleeding while ensuring controlled distal aortic perfusion. Once placed in the correct aortic zone, it has been demonstrated to enhance hemodynamics, minimize exsanguination, and reduce complications associated with AB inflation. This ABO approach appears to be feasible and offers several advantages. Further research and clinical experience will continue to refine these techniques, thus potentially leading to even greater advancements in the field.

FIGURE 2 12-F Sheath Percutaneous Brachial Artery Access

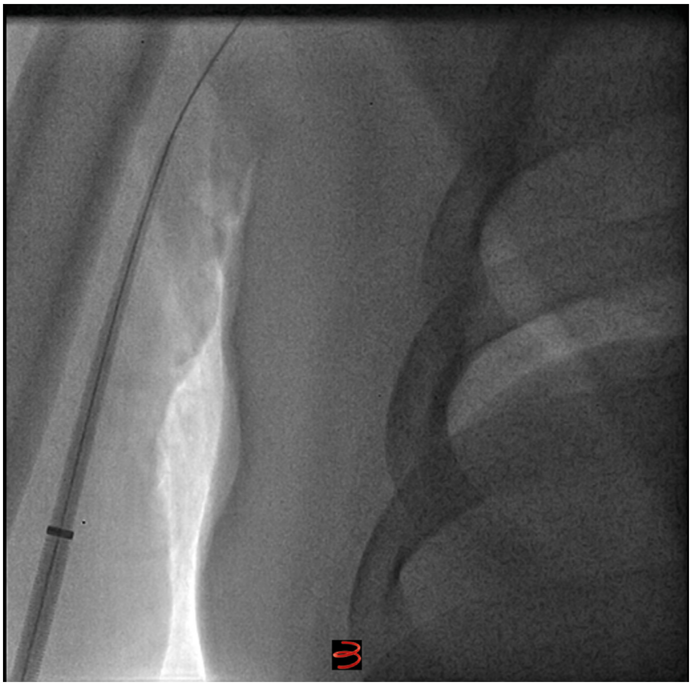


FIGURE 3 Partial Endovascular Balloon Occlusion

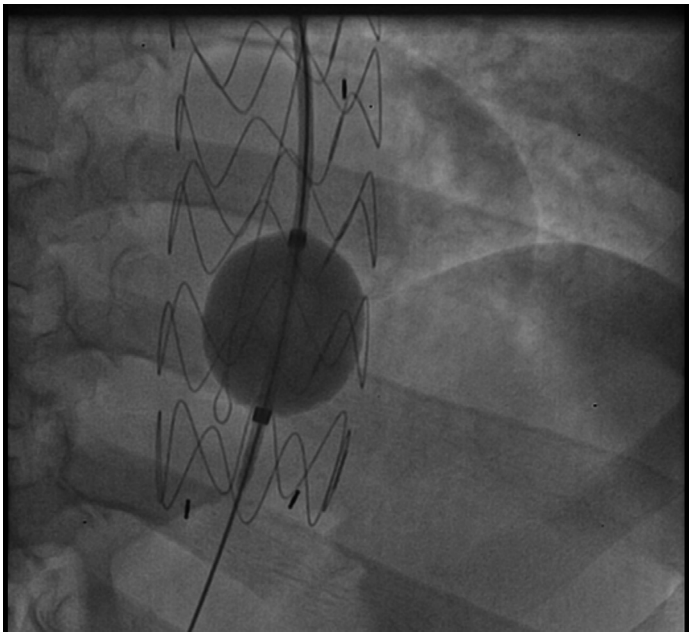


FIGURE 4 Endovascular Repair With Single Chimney Technique

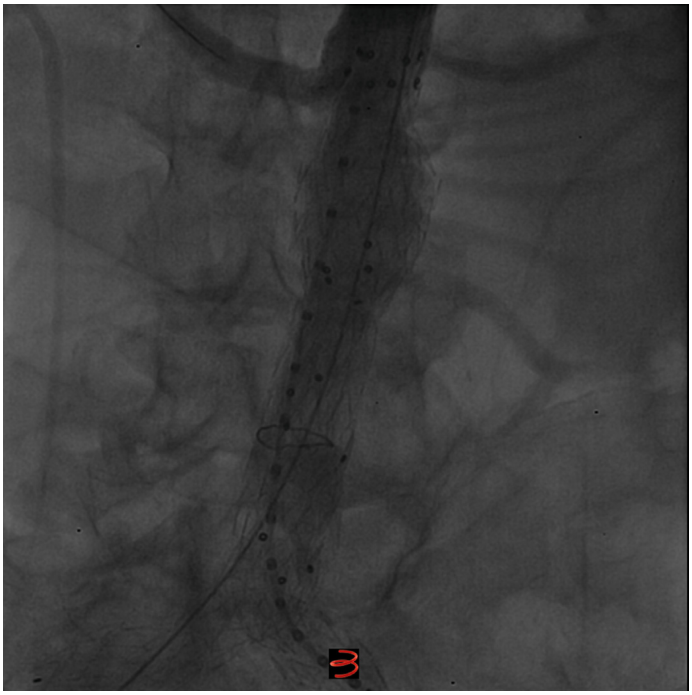


FIGURE 5 Postprocedural Computed Tomography Angiography

After the procedure, computed tomography angiography showed a patent chimney and no evidence of endoleak.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS aortic balloon occlusion, resuscitative endovascular balloon occlusion of the aorta, ruptured abdominal aortic aneurysm