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Case Report

Loop formation by an aortic occlusion balloon catheter during resuscitative endovascular balloon occlusion of the aorta (REBOA)

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ABSTRACT

A 77-year-old man was transferred to our hospital for endoscopically uncontrollable active bleeding from a duodenal ulcer. Soon after his arrival, he became hemodynamically unstable and resuscitative endovascular balloon occlusion of the aorta was performed using a 7-F aortic occlusion balloon catheter (Rescue Balloon; Tokai Medical Products, Aichi, Japan). He became hemodynamically stable and was transferred to the CT room. CT demonstrated that the distal part of the catheter shaft had made a loop in the aorta and the balloon was located at the level of the upper abdomen. We consider the low-profile occlusion balloon catheter to be less rigid than large ones, and care should be taken to prevent balloon migration and catheter shaft bending.

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Introduction

Resuscitative endovascular balloon occlusion of the aorta (REBOA) can be used for life-threatening hemorrhage below the diaphragm [1]. REBOA is a minimally invasive procedure, and is a useful alternative to resuscitative thoracotomy with

aortic cross-clamping [2]. A 7-F aortic occlusion balloon catheter (Rescue Balloon) has been developed for REBOA, and is associated with less complications than large balloon catheters [2,3]. However, this catheter is less rigid and balloon migration has been reported [3]. Here, we report a case in which the shaft of the low-profile balloon catheter made a loop in the aorta during REBOA.

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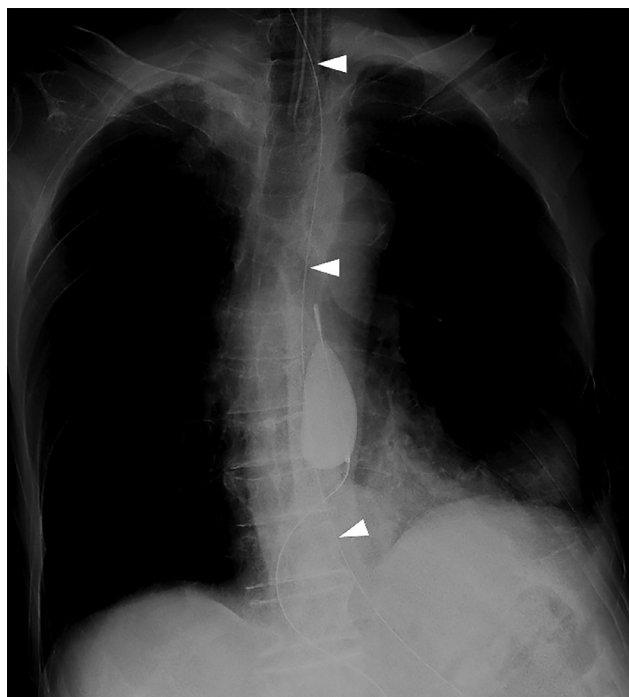


Fig. 1 – Chest X-ray reveals the inflated balloon in the descending thoracic aorta. A nasogastric tube (arrowheads) is seen.

Case report

A 77-year-old man was admitted to a hospital for hematemesis. Upper endoscopy revealed bleeding from a duodenal ulcer, which endoscopic treatment was unable to stop. The patient became hypotensive and was transferred to our hospital.

On arrival to our hospital, his heart rate was 110 bpm and blood pressure was 100/64 mmHg. A few minutes later, his heart rate rose to 120 bpm and his blood pressure dropped to 64/35 mmHg due to hemorrhagic shock. Rapid infusion of saline was started and REBOA was conducted using a 7-F aortic occlusion balloon catheter (Rescue Balloon), which is compatible with a 0.025-inch wire. This catheter can be inserted into a 7-F sheath, but it sometimes cannot be withdrawn from the sheath and an 8-F sheath is more appropriate for catheter removal. As we wanted to keep the femoral sheath after removal of the catheter, we inserted an 8-F 30-cm-long sheath into the right femoral artery. The balloon catheter was advanced into the aorta via the sheath. The balloon was inflated without radiological assistance in the emergency room. Before balloon inflation, a 0.025-inch stiff stylet was inserted into the balloon catheter. This stylet is included in the kit of the balloon catheter and should be inserted into the balloon catheter to reinforce the catheter shaft before balloon inflation. After inflation of the balloon, the patient's vital signs stabilized. He was then intubated, and a central venous catheter and arterial line were inserted. Chest X-ray revealed that the balloon was placed in the descending thoracic aorta (Fig. 1). As prolonged inflation of the balloon can cause ischemic injury, 15 minutes

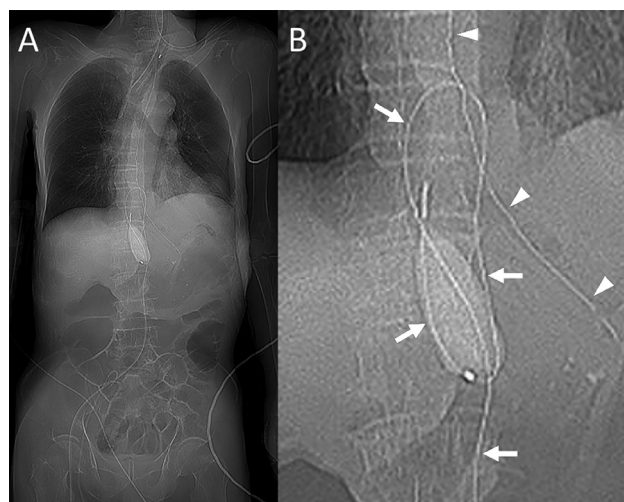


Fig. 2 – (A) Scout view on CT demonstrates that the catheter shaft has made a loop in the aorta. (B) Magnified view of (A) showing the loop (arrows) more clearly. The nasogastric tube (arrowheads) is observed again.

after balloon inflation, it was partially deflated. However, the systolic blood pressure immediately dropped to 40 mmHg and the balloon was inflated again. After this, the balloon was kept inflated.

The patient was transferred to the CT room. During this transfer, the catheter shaft came out several centimeters from the sheath due to the increased blood pressure applied to the balloon. After deflating the balloon, we advanced the balloon catheter and inflated it again. On scout view on CT, the distal shaft of the balloon catheter had made a loop in the aorta and the balloon was located in the upper abdomen (Fig. 2A and B). Contrast-enhanced CT was performed during partial deflation of the balloon and active bleeding in the duodenum was noted. The balloon was still above the level of the origin of the celiac artery. Subsequently, transcatheter arterial embolization of the gastroduodenal artery using coils was successfully performed. After the embolization, the balloon was deflated and the catheter loop was resolved by just withdrawing the stylet, and the balloon catheter was easily taken out from the sheath.

The patient was extubated and sent back to the previous hospital the same day. Hemorrhage did not recur and he was discharged home a few weeks later.

Discussion

REBOA is a technique by which an occlusion balloon catheter is inserted percutaneously into the aorta and inflated to stop active bleeding below the diaphragm for management of hemorrhagic shock [1]. REBOA has been used in many clinical settings such as trauma, ruptured abdominal aortic aneurysm, pelvic hemorrhage during tumor surgery, postpartum hemorrhage, and upper gastrointestinal hemorrhage [4].

Aortic occlusion balloon catheters are usually large (12-14-F) [5], and complications related to its large size have been reported, including lower limb ischemia and amputation, arterial dissection, and arterial thrombosis [6,7]. Open surgical exposure is recommended to remove large sheaths [5]. A low-profile (7-F) occlusion balloon catheter (Rescue Balloon) has been reported to be useful in REBOA, and may be safer than large occlusion balloon catheters due to their small caliber [2,3]. Manual compression is helpful for the successful removal of this low-profile catheter [3]. As the catheter shaft of the Rescue Balloon is narrow and soft, it is recommended to insert the stiff stylet into the catheter before the balloon is inflated [2]. This stylet is much stiffer than 0.025-inch wires and stabilizes the balloon catheter. However, even with the stylet, balloon migration (2-5 cm) can occur after balloon inflation [3]. In this case, we observed loop formation of the catheter in the aorta. To the best of our knowledge, this is the first case of the shaft of an aortic occlusion balloon catheter making a loop in the aorta. This likely resulted from increased blood pressure against the balloon after balloon inflation and blind advancement of the balloon catheter during transfer to the CT room. In this case, the loop formation of the catheter did not cause serious complications. However, if the balloon dropped below the origin of the bleeding artery, it could lead to catastrophic bleeding. This low-profile occlusion balloon catheter is less rigid than large occlusion balloon catheters. Therefore, the balloon position and bending of the catheter shaft should be monitored during REBOA.

Conclusion

We observed loop formation of the catheter shaft of a low-profile aortic occlusion balloon catheter. This catheter is less rigid, and care should be taken to prevent balloon migration and catheter shaft bending.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee, and with the 1964 Helsinki declaration and its later amendments or

comparable ethical standards. For this type of study, formal consent is not required.

Informed consent

Informed consent was obtained from the patient.

Consent for publication

Consent for publication was obtained for the patient's data included in the study.

REFERENCES

- [1] Brenner M, Bulger EM, Perina DG, Henry S, Kang CS, Rotondo MF, et al. Joint statement from the American College of Surgeons Committee on Trauma (ACS COT) and the American College of Emergency Physicians (ACEP) regarding the clinical use of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). *Trauma Surg Acute Care Open* 2018;3(1):e000154.
- [2] Shoji T, Tarui T, Igarashi T, Mochida Y, Morinaga H, Miyakuni Y, et al. Resuscitative endovascular balloon occlusion of the aorta using a low-profile device is easy and safe for emergency physicians in cases of life-threatening hemorrhage. *J Emerg Med* 2018;54(4):410–18.
- [3] Teeter WA, Matsumoto J, Idoguchi K, Kon Y, Orita T, Funabiki T, et al. Smaller introducer sheaths for REBOA may be associated with fewer complications. *J Trauma Acute Care Surg* 2016;81(6):1039–45.
- [4] Morrison JJ, Galgon RE, Jansen JO, Cannon JW, Rasmussen TE, Eliason JL. A systematic review of the use of resuscitative endovascular balloon occlusion of the aorta in the management of hemorrhagic shock. *J Trauma Acute Care Surg* 2016;80(2):324–34.
- [5] Stannard A, Eliason JL, Rasmussen TE. Resuscitative endovascular balloon occlusion of the aorta (REBOA) as an adjunct for hemorrhagic shock. *J Trauma* 2011;71(6):1869–72.
- [6] Okada Y, Narumiya H, Ishi W, Ryoji I. Lower limb ischemia caused by resuscitative balloon occlusion of aorta. *Surg Case Rep* 2016;2(1):130.
- [7] Taylor JR, Harvin JA 3rd, Martin C, Holcomb JB, Moore LJ. Vascular complications from resuscitative endovascular balloon occlusion of the aorta: Life over limb? *J Trauma Acute Care Surg* 2017;83(1 Suppl 1):S120–3.