

Intraoperative REBOA for a massive zone 1 retroperitoneal hematoma

Arthur Berg, Alexander Fortgang, Sanjeev Kaul

Trauma and Surgical Critical Care, HMH Hackensack University Medical Center, Hackensack, New Jersey, USA

Correspondence to

Dr Arthur Berg, Hackensack University Medical Center, Hackensack, NJ 07601, USA; aberg134@gmail.com

A 14-year-old man presented to the emergency department with intractable lower back pain and associated radiculopathy. He had been unsuccessfully treated in the past non-operatively for known lumbar disk herniation. He was seen and examined by the neurosurgery team and ultimately taken to the operating room for emergent microdiscectomy of L5–S1.

Postoperatively, the patient clinically deteriorated. He was lethargic, diaphoretic and was showing signs of shock. Initially, this was treated as a hypersensitivity reaction; however, a repeat labs noted a hemoglobin drop from 15.4 to >6.5. Massive transfusion protocol (MTP) was initiated, and the acute care surgery team was notified. On arrival of our service, the patient had a heart rate of 140, a blood pressure of 68/46 and was virtually unresponsive with a distended abdomen. He was reintubated and bedside ultrasound was performed which showed fluid in the pelvis. He was taken to the operating room for emergent laparotomy.

In the abdomen, there was a massive zone 1 retroperitoneal hematoma causing the intestinal contents to be pushed out of the abdominal cavity. Given the location of the hematoma, the decision was made to obtain proximal aortic control. The lesser sac was entered and supraceliac digital pressure was applied. Multiple attempts were made to pass a Crawford Clamp across the aorta; however, this was unsuccessful due to the body habitus of the patient and the remarkable size of the hematoma.

WHAT WOULD YOU DO?

- Continue digital pressure for proximal aortic control and explore the hematoma.
- Emergent thoracotomy to obtain proximal aortic control in the chest.
- Attempt endovascular balloon occlusion of the aorta.
- Continue aggressive resuscitation and observe.

WHAT WE DID AND WHY?

Given that the hematoma was midline in zone 1 of the retroperitoneum, it had to be explored. Continuing digital pressure, when a temporary solution, is impossible to sustain when exploring and considering repair. The operative circumstances required an out-of-box solution to a rapidly deteriorating clinical scenario. The right femoral arterial line that was placed prior to the procedure was exchanged over a wire and dilated up to a 14 Fr sheath. The likely injury sites was traversed with a wire and a CODA balloon was passed and brought to the level of the mid-abdomen in zone

3 of the aorta. The balloon was inflated and under fluoroscopic guidance was noted to be in good position. The patient was then resuscitated further and allowed to 'catch up'.

An angiogram was shot at that time which demonstrated extravasation of contrast at the aortic bifurcation near the right common iliac artery. After medial visceral rotation exploration of the hematoma, an infrarenal aortic injury was noted and repaired. The CODA balloon was taken down and the hemodynamic response was significant. At the conclusion of the case, the patient had improvement in his acidosis with a systolic blood pressure of 100 off pressor support. He was closed temporarily with an abdominal wound vac. He would later have his abdomen closed primarily and go on to have a full recovery.

DISCUSSION

The steps to performing resuscitative balloon occlusion of the aorta (REBOA) are as follows. By ultrasound or landmarks, the common femoral artery is accessed 2 cm below inguinal ligament with an 18-gage needle. Using the Seldinger technique, the catheter is upsized to a 7 Fr sheath. Larger sheaths (12 Fr, 14 Fr) are used with some kits but are limited by the need for guidewire and fluoroscopy.^{1,2} After the REBOA balloon is tested and the catheter is flushed, the device is passed up into the desired region of the body. There are three general zones for REBOA deployment. Zone 1 extends from descending aorta to the celiac artery (external landmark: xiphoid); zone 2 extends between celiac artery to lowest renal artery (non-inflation region) and zone 3 from lowest renal artery to aortic bifurcation (external landmark: immediately superior to umbilicus). A chest X-ray is currently the standard to confirm placement; however, new techniques using contrast-enhanced ultrasound are being explored. These studies have shown increased accuracy and even faster deployment times than is conventionally reported with fluoroscopic guidance, possibly expanding its potential to the prehospital setting.³

To the best of our knowledge, use of REBOA is not described in the setting of retroperitoneal hemorrhage from minimally invasive discectomy but has been previously described as an adjunct for hemorrhage control in a patient with limited supraceliac control. One case involving a high speed motor vehicle collision victim who, on entering the abdomen during laparotomy, was found to have a right zone 1 retroperitoneal hematoma. After a damage control laparotomy, the patient was found to be hypotensive requiring emergent

© Author(s) (or their employer(s)) 2019. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Berg A, Fortgang A, Kaul S. *Trauma Surg Acute Care Open* 2019;**4**:e000315.

re-exploration. In their report, REBOA was deployed preoperatively to achieve supraceliac control and within minutes was able to stabilize the patient's hemodynamics and discontinue the use of MTP.⁴ Another case report describes an 83-year-old man who presented for elective revascularization of mesenteric vessels who developed an iatrogenic injury to the middle colic artery. Despite resuscitation with fluid and blood products, as well as initiation of pressors, the patient remained unstable. The decision to use an ER-REBOA with a 7 Fr sheath was made and under ultrasound guidance was placed. The patient's blood pressure stabilized quickly and he underwent successful open repair and did well.⁵

One area that requires further study is the safety of deployment of a blind endovascular device such as REBOA in the setting of iliac or aortic injury. However, there are cases reported of successful deployment of REBOA when facing common femoral, iliac or aortic injury in both animal models and prehospital human trials.^{2,6,7} When feasible, preintervention imaging in the face of suspected vessel injury can help identify the non-injured side for safer placement, but blind deployment has successfully been described. One particular case deployed REBOA prehospital successfully to later discovery of bilateral iliac injuries as well as a distal thoracic aorta injury. That patient ultimately went on to a full recovery.⁷ Additionally, current ER-REBOA devices that use the 7 Fr sheath without guidewire may also be safer, resulting in less iatrogenic vascular injury than previous 12 Fr or 14 Fr sheath devices.⁸

The use of REBOA is somewhat limited given that it is only available in some centers and there is a certification process for its use. Despite these barriers, the complication rate of the use of REBOA is limited and mostly trivial.⁹ Even more appealing is its level of invasiveness compared with an open approach. However, according to conventional data, this is temporized by the borderline improvements in survival and time to aortic occlusion.⁹ We hope that our case will expand on the use of REBOA in situations where proximal aortic control is not possible. Our unique situation was a testament to the usefulness of REBOA as an adjunct and should place the device in the mental toolbox of acute care surgeons currently in practice.^{10,11}

Contributors All the authors have made substantial contributions to the design of the case report, drafting it and have had final approval of the article before being submitted.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

REFERENCES

1. Bogert JN, Davis KM, Kopelman TR, Vail SJ, Pieri PG, Matthews MR. Resuscitative endovascular balloon occlusion of the aorta with a low profile, wire free device: a game changer? *Trauma Case Rep* 2017;7:11–14.
2. Morrison JJ, Percival TJ, Markov NP, Villamaria C, Scott DJ, Saches KA, Spencer JR, Rasmussen TE. Aortic balloon occlusion is effective in controlling pelvic hemorrhage. *J Surg Res* 2012;177:341–7.
3. Chaudery M, Clark J, Morrison JJ, Wilson MH, Bew D, Darzi A. Can contrast-enhanced ultrasonography improve zone III REBOA placement for prehospital care? *J Trauma Acute Care Surg* 2016;80:89–94.
4. Rosenthal MD, Raza A, Markle S, Croft CA, Mohr AM, Smith RS, A.M. Mohr, R.S. The novel use of resuscitative endovascular balloon occlusion of the aorta to explore a retroperitoneal hematoma in a hemodynamically unstable patient. *Am Surg* 2017;83:337–40.
5. Goodenough CJ, Cobb TA, Holcomb JB. Use of REBOA to stabilize in-hospital iatrogenic intra-abdominal hemorrhage. *Trauma Surg Acute Care Open* 2018;3:e000165.
6. Biffi WL, Fox CJ, Moore EE. The role of REBOA in the control of Exsanguinating torso hemorrhage. *J Trauma Acute Care Surg* 2015;78:1054–8.
7. Sadek S, Lockey DJ, Lendrum RA, Perkins Z, Price J, Davies GE, et al. Resuscitative endovascular balloon occlusion of the aorta (REBOA) in the pre-hospital setting: an additional resuscitation option for uncontrolled catastrophic haemorrhage. *Resuscitation* 2016;107:135–8.
8. Moore LJ, Martin CD, Harvin JA, Wade CE, Holcomb JB. Resuscitative endovascular balloon occlusion of the aorta for control of noncompressible truncal hemorrhage in the abdomen and pelvis. *Am J Surg* 2016;212:1222–30.
9. DuBose JJ, Scalea TM, Brenner M, Skiada D, Inaba K, Cannon J, Moore L, Holcomb J, Turay D, Arbabi CN, et al. The AAST prospective aortic occlusion for resuscitation in trauma and acute care surgery (aorta) registry. *J Trauma Acute Care Surg* 2016;81:409–19.
10. Manzano-Nunez R, Escobar-Vidarte MF, Naranjo MP, Rodriguez F, Ferrada P, Casallas JD, Ordoñez CA. Expanding the field of acute care surgery: a systematic review of the use of resuscitative endovascular balloon occlusion of the aorta (REBOA) in cases of morbidly adherent placenta. *Eur J Trauma Emerg Surg* 2018;44:519–26.
11. Morrison JJ, Galgon RE, Jansen JO, Cannon JW, Eliason JL, Eliason JL. A systematic review of the use of resuscitative endovascular balloon occlusion of the aorta in the management of hemorrhagic shock. *Journal of Trauma and Acute Care Surgery* 2016;80:324–34.