Resuscitative Endovascular Balloon Occlusion of the Aorta for Hemorrhagic Shock Due to a Gastric Ulcer: A Case Report

Shigeto ISHIKAWA*, Masao NARITA, Makiko TAMUNE, Koki UMEDA, Michiaki KAKU and Toshihiko MAYUMI

The Department of Emergency Medicine, School of Medicine, University of Occupational and Environmental Health, Japan. Yahatanishi-ku, Kitakyushu 807-8555, Japan

Abstract: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is an adjunct procedure designed to sustain the circulation until definitive hemostasis is obtained. The device is indicated in trauma patients with abdominal trauma and/or pelvic fractures, but there is limited evidence for its use in gastrointestinal bleeding. A 76-year-old woman was admitted to the emergency department of our hospital because of shock, manifesting as hematemesis. We performed emergency endoscopy and detected active bleeding from a gastric ulcer. Achieving hemostasis was difficult, and she experienced shock again during the procedure, leading to cardiopulmonary arrest. REBOA was performed after the return of spontaneous circulation because she continued to be in a state of shock. Her blood pressure rose, and endoscopic hemostasis was continued with balloon inflation, but it didn’t stop the bleeding completely, so we shifted to emergency laparotomy and performed suture hemostasis. The patient developed no postoperative complications and was transferred to another hospital. REBOA can be effective at improving the hemodynamic status in patients with uncontrollable gastrointestinal bleeding.

Keywords: endoscopy, gastrointestinal bleeding, hemorrhagic shock, hemostasis, resuscitative endovascular balloon occlusion of the aorta.

Introduction

Resuscitative endovascular balloon occlusion of the aorta (REBOA) is an effective resuscitation option for hemorrhagic shock due to severe trauma, pelvic fractures, and obstetric diseases. There are only a few reports on the presence of gastrointestinal bleeding, but we successfully performed emergency open surgical hemostasis with REBOA to rescue a patient who had experienced shock and cardiopulmonary arrest due to gastric ulcer bleeding. Here, we report the case and review the relevant literature.

Case presentation

A 76-year-old woman was admitted to our hospital because of hematemesis (Figure 1). The patient was undergoing chemoradiotherapy for extramammary Paget’s disease. Her blood pressure was 77/40 mmHg and heart rate was 125 beats/min on arrival at our hospital. Massive fluid replacement therapy aided in maintaining her blood pressure, and emergency endoscopy was performed. Upper endoscopy revealed bleeding from a gastric ulcer in the upper posterior wall with exposed blood vessels (Figure 2). The bleeding could not be stopped with endoscopic treatment with hemo-
clipping, and the patient became hypotensive during endoscopic hemostasis. She had cardiopulmonary arrest, despite rapid resuscitation with blood transfusion.

Although spontaneous circulation immediately returned after 6 min of cardiopulmonary cerebral resuscitation, she experienced shock again. We immediately inserted a 7-Fr Rescue Balloon®-ER (Tokai Medical Products, Aichi, Japan). The REBOA catheter was inserted 45 cm into the femoral artery. Since the procedure was performed in the endoscopy room, it was placed into zone I under non-fluoroscopy. After we inflated the balloon, she recovered from the shock and her blood pressure rose to 128 mmHg. Endoscopic hemostasis was continued, but it was difficult to stop the bleeding and we decided on emergency open surgical hemostasis.

Surgical Findings: A 4-cm-long incision was created in the anterior gastric wall under the upper abdominal midline incision. A large amount of coagulated blood was aspirated. Sustained hemorrhage was observed in the exposed blood vessels. We sutured the incision and stopped the bleeding. The incision was closed with an Albert–Lembert suture (operation time: 1 h 58 min; bleeding, 665 g).

Postoperatively, she was transferred to the intensive care unit. She was extubated on postoperative day 1 and moved to the general ward on postoperative day 2. She was transferred to a rehabilitation hospital on postoperative day 10 without complications.

Discussion

Resuscitative endovascular balloon occlusion of the aorta (REBOA) was first described by Hughes CW in 1954, when it was used as a tamponade device for three wounded soldiers experiencing intra-abdominal hemorrhage during the Korean War [1]. The device is currently indicated in trauma patients with abdominal trauma and/or pelvic fractures. There is little evidence that REBOA can be used for gastrointestinal bleeding. REBOA increases coronary and cerebral blood flow, prevents circulatory collapse at the time of laparotomy, and secures the visual field intraoperatively [2].

There are very few reports in which REBOA was used for gastrointestinal bleeding. A literature search of the PubMed and Japan Centra Revuo Medicina Web databases using the keywords “intra-aortic balloon occlusion” OR “resuscitative endovascular balloon occlusion of the aorta” AND “gastrointestinal bleeding” yielded 14 case reports (Table 1). Although the details are unknown, seven cases were reported by Matsuura et al, and three cases were reported by Hoehn et al [3–11]. In our case, we switched to open surgical hemostasis with REBOA when we encountered difficulties in performing hemostasis. According to the reported cases, although blood pressure increases
after performing REBOA, there are very few cases of complete hemostasis using endoscopy. In most cases, progression to surgery or interventional radiology was noted.

Several complications are associated with REBOA. Prolonged ballooning may result in organ ischemia and lower limb ischemia. Avaro et al reported that a 40-min endovascular aortic occlusion procedure performed once was safe [12]. In our case, the total interruption time was 71 min, including the time for preparing and moving the patient to the operating room. There were no complications such as organ ischemia. The total inflation time was successfully extended, with a few minutes of deflation every 20 min and partial occlusion of the aorta arranging the infusion volume to 10–20 ml.

The risk of ischemia can be reduced by reducing the sheath size at the time of REBOA insertion relative to the diameter of the vessel [13]. In most cases, REBOA interventions are performed using a 12- or 14-Fr sheath, but 7-Fr sheaths for REBOA are currently available and frequently used in Japan.

The other complications include aortic damage and extravasation by catheters [14], stenosis of the arteries at the insertion site, and arterial thrombosis [15]. In emergency cases like ours, the procedure should be performed carefully if the balloon catheter is inserted without radiological assistance.

There is limited evidence of the use of REBOA for gastrointestinal bleeding. In cases in which endoscopic hemostasis is difficult or the blood pressure is uncontrollable, despite performing massive blood transfusion, REBOA may be useful as bridging therapy to interventional radiology and surgery.

### Table 1. Literature review of the cases of REBOA used for gastrointestinal bleeding

| Author         | Year of Publication | Age | Sex | Diagnosis                           | Total occlusion time (min) | Hemodynamics (SBP) | complications | Definitive hemostatic control | Outcome       |
|----------------|---------------------|-----|-----|-------------------------------------|---------------------------|--------------------|---------------|-------------------------------|---------------|
| Low et al [3]  | 1986                | NA  | NA  | mesenteric thrombosis              | NA                        | improved           | NA            | NA                            | Dead          |
| Karkos et al [4] | 2001               | 36  | female | duodenum ulcer                     | 30                      | 7 → 140mmHg        | none          | surgery                       | Alive         |
| Hill et al [5]  | 2010               | 9   | female | aortoesophageal fistula            | NA                        | improved           | none          | stent graft                    | Alive         |
| Shigesato et al [6] | 2015            | 79  | female | duodenum ulcer                     | 150                      | 4 → 240mmHg        | none          | surgery                       | Alive         |
| Lee et al [7]   | 2016               | 53  | male | Diulaofy ulcer Duodenal varix      | 15                       | 5 → 108mmHg        | none          | IVR                           | Dead          |
| Sano et al [8]  | 2016               | 69  | male | Gastric ulcer                      | 57                       | 60 → 97mmHg        | none          | endoscopy                      | Alive         |
| Sano et al [8]  | 2016               | 36  | male | Gastric ulcer                      | 20                       | 90 → 111mmHg       | none          | endoscopy                      | Alive         |
| Sano et al [8]  | 2016               | 83  | male | Duodenum ulcer                     | 140                      | 9 → 206mmHg        | none          | endoscopy                      | Alive         |
| Sano et al [8]  | 2016               | 64  | male | Anastomotic bleeding               | 54                       | 54 → 74mmHg        | none          | angioembolization              | Alive         |
| Sano et al [8]  | 2016               | 78  | male | Duodenum ulcer                     | 145                      | 41 → 82mmHg        | none          | angioembolization (failed endoscopy) | Died<24h       |
| Sano et al [8]  | 2016               | 69  | male | Left gastric artery aneurysm       | 95                       | 63 → 112mmHg       | none          | angioembolization (failed endoscopy) | Alive         |
| Sano et al [8]  | 2016               | 50  | male | Duodenum ulcer                     | 50                       | 6 → 140mmHg        | none          | angioembolization (failed endoscopy) | Alive         |
| Sano et al [8]  | 2016               | 79  | male | Esophageal cancer Failure          | NA                       | NA                 | none          | angioembolization              | Died<24h       |
| Hara et al [11] | 2020               | 62  | male | Gastric ulcer                      | NA                       | NA                 | none          | endoscopy                      | Alive         |
| Present case    | 2021               | 76  | female | Gastric ulcer                      | 71                       | 0 → 128mmHg        | none          | surgery                       | Alive         |

Definitive hemostatic control. Transition to Interventional radiology (IVR) and surgery in almost all cases. Systolic blood pressure (SBP) rose after Resuscitative endovascular balloon occlusion of the aorta (REBOA) insertion in all cases.
Conclusions

We experienced a case of emergency laparotomy with REBOA for hemorrhagic shock in a gastric ulcer. REBOA may aid in controlling gastrointestinal bleeding when endoscopic hemostasis is difficult or hemorrhagic shock persists.

Conflict of Interest
None.

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