



Case report

Endovascular aortic repair for abdominal aortic injury complicated with bowel injury due to blunt abdominal trauma: A case report

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ABSTRACT

Introduction and importance: Blunt abdominal aortic injury (BAAI) resulting from blunt abdominal trauma is rare; therefore, there are no standard guidelines for its treatment. Herein, we report the successful treatment of BAAI via endovascular aortic repair (EVAR) performed immediately after emergency laparotomy to repair a bowel injury.

Case presentation: A 78-year-old man was injured after being caught between a shovel car and the bumper of his own car for approximately 15 s. Upon arrival at the hospital, the patient was conscious and had stable vital signs, abdominal and low back pain, and numbness in the right lower limb. Computed tomography revealed contrast medium leakage into the mesentery, as well as aortic dissection and rupture. Hemostasis and intestinal resection were completed, and EVAR was performed immediately after abdominal closure. The patient was discharged from the hospital at 35 days after surgery.

Clinical discussion: In this case, there existed a risk of artificial blood vessel infection if reconstruction was simultaneously performed with intestinal resection. Symptoms of lower limb ischemia that were observed prior to surgery resolved. After open surgery, bleeding was controlled, and the patient's vital signs were stable. EVAR was performed as treatment for aortic injury, thereby reducing the risk of direct implant infection and enabling minimally invasive treatment.

Conclusion: EVAR may be useful for the treatment of BAAI in the presence of intestinal injuries, reduce the risk of implant infection, and allow for a one-time, minimally invasive treatment.

1. Introduction

Blunt abdominal aortic injury (BAAI) occurs in 0.03%–0.10% of patients with blunt injury and is less common than blunt injury to the thoracic aorta [1,2]. BAAI does not usually happen solitarily as damage to the abdominal aorta [3], as it is often associated with spinal fractures as well as damage to the retroperitoneal organ and abdominal wall [4]. BAAI can be treated with conservative, conventional surgical, or endovascular treatments. Because BAAI is an extremely rare condition, there is no established treatment regimen for BAAI.

Herein, we describe a case of successful endovascular aortic repair (EVAR) performed immediately after emergency laparotomy to repair an injury to the intestinal tract. Surgery was performed as a one-stage

procedure because the patient experienced hemorrhagic shock and acute lower limb ischemia.

This work has been reported in line with the SCARE 2020 criteria [5].

2. Presentation of case

A 78-year-old man was injured after being caught between a shovel car and the bumper of his own car for approximately 15 s. Upon arrival, the patient was conscious with a Japan Coma Scale score of 0 and Glasgow Coma Scale score of 15. His blood pressure was 123/63 mmHg; pulse rate, 57 beats/min; respiratory rate, 16 breaths/min; oxygen saturation, 97% in room air; and body temperature, 35.5 °C. Although

Abbreviations: BAAI, blunt abdominal aortic injury; CT, computed tomography; EVAR, endovascular aortic repair; ISS, Injury Severity Score; AIS, abbreviated injury scale.

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the patient's vital signs were stable, his right lower limb was numb and cold. No abdominal tenderness or active bleeding on the exterior was observed. Fluid collection was observed in the rectovesical pouch by Focused Assessment with Sonography for Trauma. In addition, a pelvic radiograph showed pubic symphysis detachment, for which a pelvic sling was fixed (Fig. 1). Blood tests revealed obvious abnormalities.

Because the patient's vital signs were stable, contrast computed tomography (CT) was performed. CT revealed contrast medium leakage into the mesentery of the small intestine, aortic dissection at the level of bifurcation of the inferior mesenteric artery to the right femoral artery and left common iliac arteries, retroperitoneal hematoma suggestive of an aortic rupture, and no obvious free gas in the abdominal cavity (Fig. 2).

Emergency surgery was decided based on a diagnosis of traumatic abdominal aortic injury, mesenteric injury, and pelvic fracture. Immediately before entering the operating room, the patient went into hemorrhagic shock. Laparotomy was performed after a resuscitative endovascular balloon occlusion of the aorta to avoid massive bleeding. Two lacerations in the mesentery of the small intestine, an intestinal injury, and a retroperitoneal hematoma were observed. The mesentery of the small intestine showed an approximately 20-cm-long tear from the intestinal tract to the vicinity of the ligament of Treitz. After partial resection of the small intestine, a functional end-to-end anastomosis was performed, a 19-Fr closed drain was placed in the rectovesical cavity, and the abdomen was closed.

At this point, the operative time was 66 min, and blood loss was approximately 1020 mL. Hemostasis and intestinal resection were completed, and EVAR was performed after abdominal closure. To prevent endoleak, coil embolization was performed at the left internal iliac artery. GORE Excluder® from the left to the main body (23 mm × 12 mm × 18 cm) and from the right to the contralateral leg (16 mm × 9.5 cm) was placed (Fig. 3). A thrombus observed in the right femoral artery during the final contrast examination was removed. After thrombectomy, arteriography showed resumption of blood flow in the right femoral artery, and the surgery was completed. Stenting of the right common iliac artery was not performed because of the possibility of further dissection. Finally, external fixation was performed for the pelvic ring fracture. The total operative time was 282 min, and total blood loss was 1950 mL. Transfusion of 8 units of packed red blood cells and 6 units of fresh frozen plasma was required intraoperatively.

The postoperative evaluations were as follows: ileal injury (Abbreviated Injury Scale [AIS] 3), small mesenteric penetrating wound (AIS4), aortic injury (AIS4), femoral artery dissection (AIS3), and pelvic fracture (AIS3). The Injury Severity Score (ISS) was 25, the Revised Trauma



Fig. 1. Pelvic radiograph showing pubic symphysis detachment and fixed pelvic sling.

Score was 7.1082, and the predicted survival rate (probability of survival; Ps) using the Trauma ISS method was 0.81254.

Contrast-enhanced CT performed on the first postoperative day showed no increase in endoleak or hematoma, and blood flow in the right lower limb was maintained, although the dissociation cavity of the right femoral artery persisted. No numbness of the right lower limb was observed. Because the right sacroiliac joint was highly unstable, sacroiliac joint fixation was performed at 7 days after the first surgery.

The overall postoperative course was uneventful, and the patient was discharged from the hospital at 35 days after surgery. Contrast-enhanced CT performed at 1 year after surgery showed a dissociation cavity in the right femoral artery but no endoleak or stent graft infection, and the patient was followed up as an asymptomatic outpatient.

3. Discussion

Abdominal aortic injury due to blunt trauma is rare. The strongest predictor of mortality in patients with BAAI is hemopneumothorax or inferior vena cava injury, with an ISS \geq 25. The most common cause of trauma is motor vehicle accidents (57.5%) [2], with discharge mortality rates ranging from 28% to 73% [2,6,7].

Appropriate early diagnosis and selection of treatment methods are important to improve the survival rate and prognosis of patients. BAAI can lead to death due to rupture or ischemia of organs if symptoms are overlooked or treatment is delayed. There are certain symptoms, such as abdominal pain and lower limb ischemia, that may be overlooked without contrast-enhanced CT at first diagnosis [8], or the patient may develop intermittent claudication in the chronic phase [9]. Therefore, care should be taken when making a diagnosis.

The available treatment methods for BAAI include conservative treatments aimed at blood pressure reduction, open artificial blood vessel replacement with synthetic graft, endovascular treatment, fenestration, and bypass surgery to improve symptoms of organ ischemia.

Because of the low frequency of BAAI, there is no standard choice of treatment. Dayama et al. [10] reported the results of a comparative study involving 91 endovascular treatments and 234 open surgeries for 325 cases of abdominal aortic injury due to blunt trauma. The mortality rate in the endovascular treatment group was 21%, whereas that in the open surgery group was 67%. When patients who underwent laparotomy were compared with those who received endovascular treatment, the former were reported to have a six times higher risk of death.

Branco et al. [11] reported that the use of endovascular stent grafts in trauma patients markedly increased from 2002 to 2010. In patients who underwent endovascular surgery, in-hospital mortality (12.9% vs. 22.4%) and sepsis rates (5.4% vs. 7.5%) were evidently lower.

Regarding the mechanism of lower limb ischemia due to BAAI, damage to the intima is not limited to the intima fissure. Although the intima of the aorta is separated into layers circumferentially, the separated intima inverts to the peripheral side and accumulates there. This narrows the aortic lumen and causes ischemia of the lower limbs.

Some reports actively recommend surgery for traumatic aortic dissection [12]. In this case, the inversion of the intima was unclear by intraoperative contrast, although when assessed together with preoperative contrast-enhanced CT images, the detached intima was apparently compressed by the blood flow, resulting in stenosis of the lumen. It is also possible that the patient developed lower limb ischemia.

There existed a risk of artificial blood vessel infection if reconstruction was simultaneously performed with intestinal resection, although this was necessary. Symptoms of lower limb ischemia that were observed prior to surgery resolved. After open surgery, bleeding was controlled, and the patient's vital signs were stable. EVAR was performed as treatment for aortic injury, thereby reducing the risk of direct implant infection and enabling minimally invasive treatment.

Thus far, there has been only one similar case of one-stage treatment using the kissing-stent method reported in the literature [13]. This small

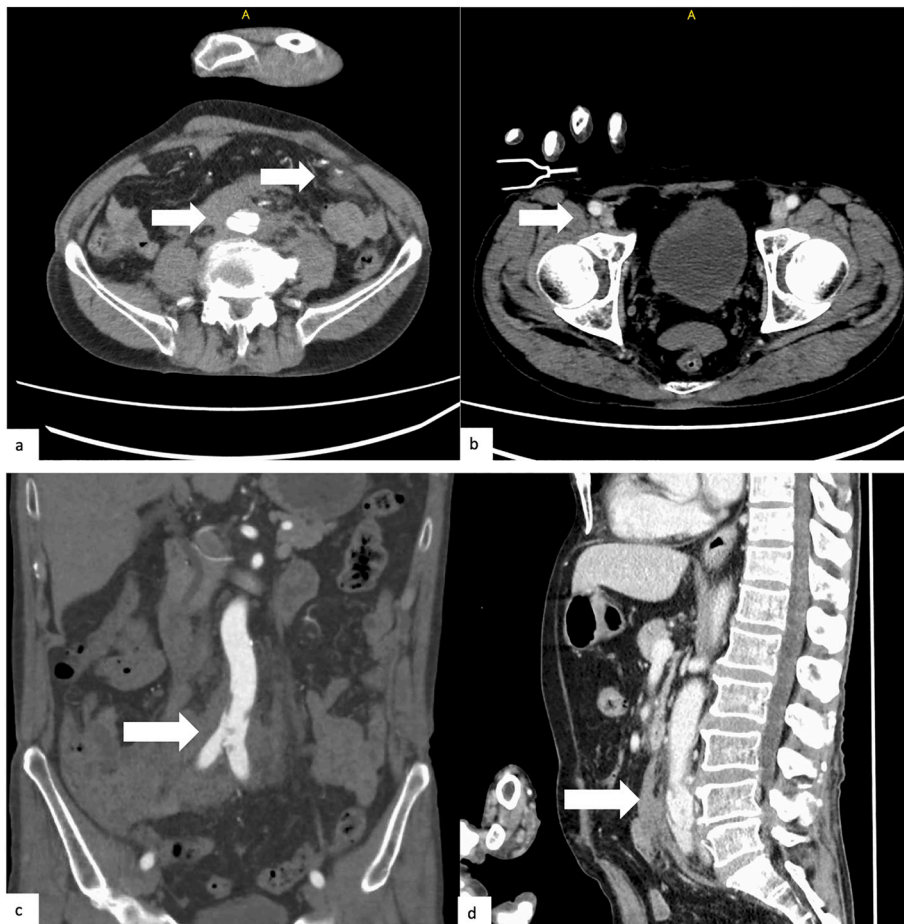


Fig. 2. Contrast computed tomography (CT) revealed contrast medium leakage into the mesentery of the small intestine, aortic dissection at the level of bifurcation of the inferior mesenteric artery to the right femoral artery and left common iliac arteries
 a. Top arrow: Extravasation of mesenteric injury. Bottom arrow: Fluid around the aorta and aortic dissection indicating aortic injury.
 b. Right femoral artery dissection.
 c. Coronal view: the site of rupture and dissection.
 d. Sagittal view: the site of rupture and dissection.

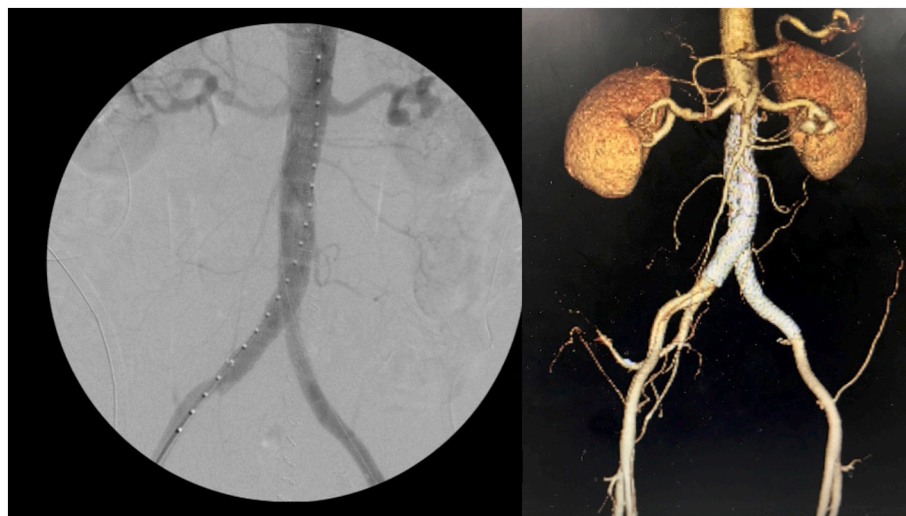


Fig. 3. After endovascular aortic repair for abdominal aortic injury.

number of cases necessitates further studies in other facilities.

4. Conclusion

We reported a rare case of abdominal aortic injury (dissection and rupture) due to blunt abdominal trauma complicated with intestinal injury, hemorrhagic shock, and acute lower limb ischemia. Emergency laparotomy and EVAR were performed in a single surgical session. EVAR

allowed for a one-time, minimally invasive treatment and might have reduced the risk of implant infection. Meaningful results were obtained using hybrid treatment comprising emergency laparotomy in combination with endovascular treatment.

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Ethics approval

Ethical approval has been exempted by our institution because this is a case report and no new studies or new techniques were carried out.

Consent

Written informed consent was obtained from the patient for the publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Takaaki Murata: Writing — Original draft preparation and performed the surgery.

H. Ogino: J. Kawachi: Writing — review & editing. N Isogai: review. H. Kashiwagi: review. R. Shimoyama: review. All authors read and approved the final manuscript.

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Declaration of competing interest

All the authors certify that there is no conflict of interest regarding the material discussed in the manuscript.

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References

- [1] S. Shalhub, B.W. Starnes, M.L. Brenner, W.L. Biffi, A. Azizzadeh, K. Inaba, et al., Blunt abdominal aortic injury: a Western trauma association multicenter study, *J. Trauma Acute Care Surg.* 77 (2014) 879–885.
- [2] B.M. Sheehan, A. Grigorian, C. de Virgilio, R.M. Fujitani, N.K. Kabutey, M. Lekawa, et al., Predictors of blunt abdominal aortic injury in trauma patients and mortality analysis, *J. Vasc. Surg.* 71 (2020) 1858–1866.
- [3] J.P. Berthet, C.H. Marty-Ané, R. Vecrapen, E. Picard, H. Mary, P. Alric, Dissection of the abdominal aorta in blunt trauma: endovascular or conventional surgical management? *J. Vasc. Surg.* 38 (2003) 997–1004.
- [4] E. Gouveia, R. Melo, P. Amorim, T.R. Soares, R.F.E. Fernandes, A. Ministro, P. Garrido, et al., Clinical aspects and present challenges of the seat belt aorta, *J. Vasc. Surg.* 72 (2020) 995–1004.
- [5] for the SCARE Group, R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, The SCARE 2020 guideline: updating consensus Surgical Case Report (SCARE) guidelines, *Int. J. Surg.* 84 (2020) 226–230.
- [6] C. de Mestral, A.D. Dueck, D. Gomez, B. Haas, A.B. Nathens, Associated injuries, management, and outcomes of blunt abdominal aortic injury, *J. Vasc. Surg.* 56 (2012) 656–660.
- [7] D. Jessica, S. Edna, F. Dale, Patient factors and operating room resuscitation predict mortality in traumatic abdominal aortic injury: a 20-year analysis, *J. Vasc. Surg.* 45 (2007) 493–497.
- [8] H. Godry, G. Rölleke, A. Mumme, T.A. Schildhauer, M. Gothner, Traumatic infra-renal aortic dissection after a high-energy trauma: a case report of a primary missed diagnosis, *Orthop. Rev.* 6 (2014) 5031.
- [9] K.M. Charlton-Ouw, J.J. DuBose, S.S. Leake, M. Sanchez-Perez, H.K. Sandhu, J. B. Holcomb, et al., Observation may be safe in selected cases of blunt traumatic abdominal aortic injury, *Ann. Vasc. Surg.* 30 (2016) 34–39.
- [10] A. Dayama, A. Rivera, O. Olorunfemi, A. Mahmoud, C.A. Fontecha, J. McNelis, Open and endovascular abdominal aortic injury repair outcomes in polytrauma patient, *Ann. Vasc. Surg.* 42 (2017) 156–161.
- [11] B.C. Branco, J.J. DuBose, L.X. Zhan, J.D. Hughes, K.R. Goshima, P. Rhee, et al., Trends and outcomes of endovascular therapy in the management of civilian vascular injuries, *J. Vasc. Surg.* 60 (2014) 1297–1307.
- [12] M. Willis, D. Neschis, J. Menaker, M. Lilly, T. Scalea, Stent grafting for a distal thoracic aortic injury, *Vasc. Endovasc. Surg.* 45 (2011) 187–190.
- [13] U. Huh, C. Won Lee, S.H. Kim, C.I. Park, S.W. Chung, S. Song, et al., Successful treatment using a kissing stent for blunt abdominal aortic injury: a case report, *Cardiovasc. Intervent. Radiol.* 41 (2018) 972–975.