Ann Vasc Dis Vol. 16, No. 3; 2023; pp 238–241

Online September 16, 2023
doi: 10.3400/avd.cr.23-00017

Case Report

Single-Stage Surgical Treatment of Acute Type A Aortic Dissection and Blunt Abdominal Trauma: A Case Report

Tomoaki Taniguchi, MD, Koji Furukawa, MD, PhD, Hirohito Ishii, MD, Katsuya Kawagoe, MD, Shuhei Sakaguchi, MD, and Risa Meiri, MD

A 53-year-old man suddenly developed chest and back pain while driving, resulting in an accident. Computed tomography revealed acute type A aortic dissection with malperfusion of the left lower extremity, retroperitoneal extravasation, hematoma in the anterior mediastinum, and ascites in the rectovesical pouch. Exploratory laparotomy before aortic repair revealed intestinal perforation and retroperitoneal bleeding, which were repaired, and an ascending aortic replacement was performed. Visceral trauma with active bleeding should be treated with priority, even if the need for systemic heparinization accompanies acute type A aortic dissection during surgery for aortic dissection.

Keywords: acute type A aortic dissection, blunt abdominal trauma, acute care surgery

Introduction

Acute type A aortic dissection (AAAD) is a life-threatening condition that can occur while driving. Patients with trauma can have other organ injuries or malperfusions and fractures in addition to aortic disease that complicates surgical treatment. Here, we present a case of nontraumatic AAAD that occurred while the patient was driving a car and a subsequent blunt abdominal trauma that required surgical intervention. The patient was successfully treated with single-stage surgery.

Department of Cardiovascular Surgery, Faculty of Medicine, University of Miyazaki, Miyazaki, Miyazaki, Japan

Received: February 21, 2023; Accepted: August 5, 2023
Corresponding author: Tomoaki Taniguchi, MD. Department of Cardiovascular Surgery, Faculty of Medicine, University of Miyazaki, 5200 Kihara, Kiyotake-cho, Miyazaki, Miyazaki 889-1692, Japan
Tel: +81-985-85-2291, Fax: +81-985-85-5563
E-mail: tomoaki_taniguchi@med.miyazaki-u.ac.jp

Case Report

A 53-year-old man suddenly started experiencing chest and back pain while driving, crashing into a utility pole. After systemic contrast-enhanced computed tomography (CT) revealed AAAD, the patient was transferred to our hospital for surgical treatment and intensive care. On arrival, the patient was conscious (Glasgow Coma Scale E4V5M6), had a pulse of 99 beats/min, and blood pressure of 115/57 mmHg, with no difference between the left and right upper extremities. The patient presented with lower abdominal pain without rebound tenderness, a pulseless left femoral artery, and a pale left lower extremity without paralysis. Laboratory tests revealed an elevated white blood cell count (12,100/μL) and fibrinogen degradation product (184.3 μg/mL) and D-dimer (76.44 μg/mL) levels, while arterial blood gas tests revealed an elevated lactic acid level (4.0 mmol/L). A focused assessment with sonography for trauma showed a small pericardial effusion and fluid collection in the rectovesical pouch.

Contrast-enhanced CT revealed AAAD extended from the aortic root to the left external iliac artery (**Fig. 1A**). The true lumen of the left common iliac artery caused dynamic obstruction owing to the expanded false lumen and malperfusion of the left lower extremity, with no other obvious organ malperfusion (**Figs. 1B** and **1C**). A massive hemorrhage was observed in the anterior mediastinum (**Fig. 1D**), whereas another hemorrhage with extravasation was observed in the retroperitoneum, anterior to the left iliopsoas muscle at the level of the first sacral vertebra (**Fig. 1C**). Other findings included a right clavicular fracture, first lumbar vertebra compression fracture, and ascites in the rectovesical pouch (**Fig. 1E**). After discussion with cardiovascular surgeons, orthopedic surgeons, and the acute care surgery (ACS) team, we decided to perform exploratory laparotomy and subsequent aortic repair in a single-stage surgery.

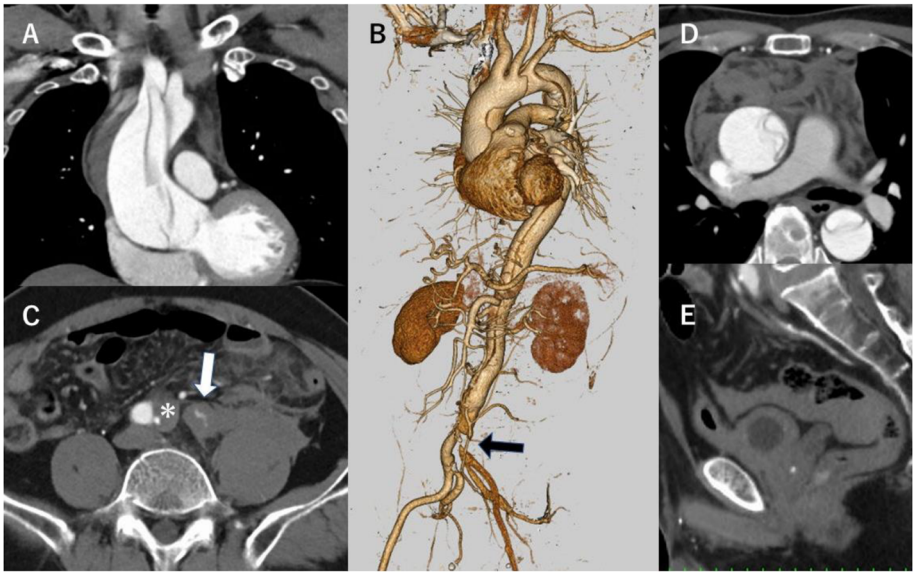

Fig. 1 Preoperative computed tomography. (**A**) Acute type A aortic dissection with entry into the ascending aorta. (**B**) The left common iliac artery's malperfusion. (**C**) Expanded false lumen of the left common iliac artery (*) and retroperitoneal extravasation (↓). (**D**) Massive hemorrhage in the anterior mediastinum. (**E**) Ascites in the rectovesical pouch.

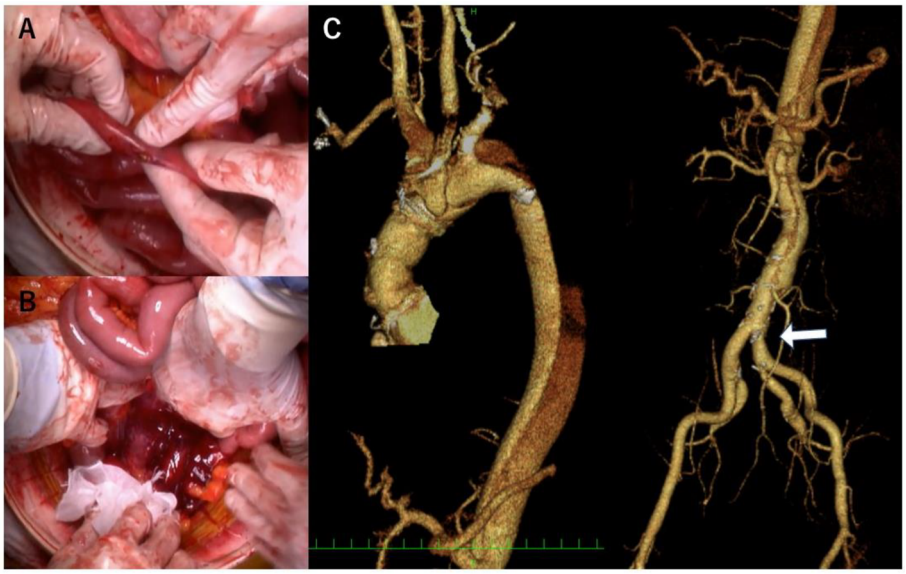

Fig. 2 Intraoperative findings and postoperative computed tomography (CT). (**A**) The ileum's intestinal perforation. (**B**) Retroperitoneal bleeding in Zones I and II. (**C**) The left common iliac artery's (↓) postoperative CT showed improved malperfusion.

Surgery was initiated with the patient in a supine position under general anesthesia. At the start of surgery, the activated clotting time (ACT) value was 128 seconds. During exploratory laparotomy, a perforation found in the ileum, 120 cm distal to the ligament of Treitz, was repaired by suturing with an absorbent thread (**Fig. 2A**). Furthermore, active bleeding was observed in retroperitoneal Zones I and II, which was stopped by suturing with a monofilament thread (**Fig. 2B**). After temporary abdominal closure, median sternotomy revealed a massive hematoma in the anterior mediastinum without active bleeding, and hemostasis was achieved by ligating the thymic tissue. After intravenous bolus administration of unfractionated heparin (30 IU/kg), the ACT value reached 455 seconds. Cardiopulmonary bypass (CPB) was established by cannulating the left common iliac artery, right axillary artery,

and superior and inferior vena cavae. We cannulated the left common femoral artery and perfused the left lower extremity using the side port of the CPB circuit because a malperfusion occurred in the left lower extremity. After initiating CPB, ventricular fibrillation occurred immediately because of moderate aortic regurgitation; thus, cardiac arrest was achieved with antegrade cardioplegia and cross-clamping of the ascending aorta. We removed the dissected ascending aorta, including the entry, and replaced it with an aortic commissural resuspension upon circulatory arrest after the patient's rectal temperature decreased to <25°C under antegrade selective cerebral perfusion. After restarting a spontaneous heartbeat, smooth weaning from CPB, and chest wound closure, a second abdominal examination revealed no missed injuries. The aortic cross-clamping, CPB time, and surgical times were 126, 205, and 646 min, respectively.

The postoperative status was hemodynamically stable. The patient was extubated uneventfully on postoperative day 3, and enteral nutrition with glucose/oligosaccharide/fiber was initiated on postoperative day 4. Right visual field constriction, hemiplegia, and dysarthria persisted immediately after extubating. Postoperative contrast-enhanced CT revealed acute cerebral infarction in the right occipital lobe. CT also showed improvement in the malperfusion in the left lower extremity and no other abnormal findings (**Fig. 2C**). The patient's symptoms improved after rehabilitation, he could walk independently, and the rest of his clinical course was uneventful without abdominal complications. The patient was transferred to another hospital for rehabilitation on postoperative day 43.

Discussion

Christian reported that natural diseases in drivers are responsible for 0.1% of traffic accidents and 24% of traffic deaths.[1] In some studies, atherosclerosis coronary artery disease was reportedly the most common (77.8%–93%) cause of drivers' death while driving, followed by cerebrovascular disease (3.3%–32.9%), aortic disease (4.1%–6.7%), bronchial asthma (4.7%), and pneumonia (2.7%).[2–4]

Yoshizaki et al. reported on 11 patients treated for acute aortic dissection that occurred while driving motor vehicles. Among them, two had coronary malperfusion, three had cerebral malperfusion, and one had kidney and mesenteric malperfusion.[5] They underwent revascularization procedures, as necessary, in addition to central aortic repair. In this regard, there are some reports of the surgical treatment of AAAD with organ malperfusion that occurred while driving. However, few reports exist on single-stage surgical treatment of nontraumatic AAAD and traumatic organ injury caused by a traffic accident. This was an extremely rare case of AAAD that occurred while driving a car and caused malperfusion of the left lower extremity and subsequent blunt abdominal trauma, each requiring surgical intervention.

AAAD is a life-threatening disease that requires prompt surgical intervention, with an average operative mortality rate of 20%–25%.[6] In the surgical treatment of type A acute aortic dissection with other organ injuries or malperfusion, it is important to evaluate injury and malperfusion severity, except for the aortic dissection, to enable decision-making considering the patient's general condition. Accordingly, it is essential to perform repeated and deliberate inspections of the cardiovascular and respiratory systems during surveys, reducing early trauma deaths.[7] Determining the intervention order according to each patient's pathological severity is reasonable. However, patients often have comorbid injuries, increasing the risk of fatal bleeding with heparin use during cardiovascular surgery with CPB, such as pelvic fracture, intracranial hemorrhage, and retroperitoneal hematoma. There are few reports of aortic rupture or acute aortic dissection, including traumatic aortic injury complicated by blunt brain injury or severe pelvic fracture. In those reports, therapeutic intervention for bleeding was a priority. Rogers et al. reported that approximately 22% of trauma patients have ongoing bleeding or injuries and are at high risk of serious bleeding complications.[8] Chiasson et al. reported that a retroperitoneal hematoma requiring transfusion increases a patient's risk of bleeding complications for 5–10 days.[9] Additionally, using heparin in patients with pelvic or acetabular fractures requires caution regarding massive bleeding, even at doses used as prophylaxis for deep vein thrombosis.[10] Therefore, identification of active bleeding on an imaging examination indicates the patient's unstable hemodynamics due to organ damage or a fracture with a risk of massive bleeding. Therapeutic interventions for these injuries should be performed before aortic repair. In this case, retroperitoneal bleeding presented with obvious extravasation, and we considered it an interventional priority and performed an exploratory laparotomy. As a result, we identified the bleeding source and performed an effective hemostatic procedure to discover and repair the intestinal injury. In addition, since the patient was young and hemodynamically stable, we decided to treat him with a single-stage surgery for abdominal trauma and acute aortic dissection. Our report may provide evidence that visceral trauma or active bleeding should be treated with priority, even if AAAD is accompanied in rare situations, such as the present case.

It is also important to discuss such cases with a multidisciplinary team, including vascular surgeons, ACS staff, anesthesiologists, and intensivists. Additionally, it is necessary to choose the treatment strategy quickly, as

the patient's hemodynamics may deteriorate rapidly; the mortality rate increases by 1%–2% each hour after the onset of acute aortic dissection. In this case, the surgeons and ACS team arrived at the hospital even before the patient arrived; therefore, we evaluated the severity of the patient's condition and determined the treatment strategy promptly and accurately.

Unfortunately, our patient experienced cerebral infarction after surgery. Preoperative CT showed no occlusion of the carotid or vertebral arteries. No obvious traumatic brain injury was observed. Intraoperative circulatory arrest, selective antegrade cerebral perfusion, or embolism may have developed into postoperative cerebral infarction during surgery.

Conclusion

This is a rare case of nontraumatic AAAD with malperfusion of the left lower extremity and blunt abdominal trauma caused by a traffic accident. Blunt abdominal visceral trauma with active bleeding should be prioritized, even if the patient has comorbid life-threatening AAAD following the need for systemic heparinization during surgery for aortic dissection. Surgical treatment of acute aortic dissection with other organ injuries or malperfusion requires careful evaluation of the patient's general condition, including hemodynamics, and prompt treatment decisions by a multidisciplinary team.

Acknowledgments

None

Informed Consent

Written informed consent was obtained from the patient to publish this case report and the accompanying images.

Disclosure Statement

All authors have no conflicts of interest to declare.

Author Contributions

Manuscript preparation: TT
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors

References

1) Christian MS. Incidence and implications of natural deaths of road users. BMJ 1988; **297**: 1021-4.
2) Antecol DH, Roberts WC. Sudden death behind the wheel from natural disease in drivers of four-wheeled motorized vehicles. Am J Cardiol 1990; **66**: 1329-35.
3) Büttner A, Heimpel M, Eisenmenger W. Sudden natural death 'at the wheel': a retrospective study over a 15-year time period (1982–1996). Forensic Sci Int 1999; **103**: 101-12.
4) Cheng LH, Whittington RM. Natural deaths while driving: would screening for risk be ethically justified? J Med Ethics 1998; **24**: 248-51.
5) Yoshizaki T, Kimura N, Hirano T, et al. Acute aortic dissection occurring 'behind the wheel,' report of 11 cases. Ann Vasc Dis 2016; **9**: 205-8.
6) Di Eusanio M, Trimarchi S, Patel HJ, et al. Clinical presentation, management, and short-term outcome of patients with type A acute dissection complicated by mesenteric malperfusion: observations from the International Registry of Acute Aortic Dissection. J Thorac Cardiovasc Surg 2013; **145**: 385-390.e1.
7) Galvagno SM Jr, Nahmias JT, Young DA. Advanced Trauma Life Support® Update 2019: management and applications for adults and special populations. Anesthesiol Clin 2019; **37**: 13-32.
8) Rogers FB, Cipolle MD, Velmahos G, et al. Practice management guidelines for the prevention of venous thromboembolism in trauma patients: the EAST practice management guidelines work group. J Trauma 2002; **53**: 142-64.
9) Chiasson TC, Manns BJ, Stelfox HT. An economic evaluation of venous thromboembolism prophylaxis strategies in critically ill trauma patients at risk of bleeding. PLoS Med 2009; **6**: e1000098.
10) Metcalf KB, Du JY, Ochenjele G. Does aspirin provide adequate chemoprophylaxis for venous thromboembolic events in operative pelvic and acetabular fractures? Iowa Orthop J 2022; **42**: 83-8.