Iliac Leg and Abdominal Aortic Cuff Stent-Graft for Blunt Thoracic Aortic Injury in Young Patient

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Thoracic endovascular aortic repair for blunt thoracic aortic injury in young adults with small aortic diameter often encounters high difficulty. We report, to our knowledge, the first case of successful treatment using combination of iliac leg and abdominal aortic cuff stent-graft.

Keywords: blunt thoracic aortic injury, small diameter aorta, thoracic endovascular aortic repair

Introduction

Blunt thoracic aortic injury (BTAI) is a life threatening condition, and has been implicated as the second most common cause of death in trauma patients.1,2) Immediate surgical repair is often difficult due to concomitant injuries. Thoracic endovascular aortic repair (TEVAR) has recently evolved as the first treatment option.3) However, it remains controversial in young patients with small aortic diameter because of anatomical considerations, device limitations and unknown long-term results.4–8) We report, to our best knowledge, the first case to successfully treat BTAI in such a patient using combination of iliac leg and “stacked” abdominal aortic cuff stent-graft.

Case Report

A 24 year old suicidal female fell from 5th storey of a building, and was transferred to trauma center with hypovolemic shock and injury severity score of 50 due to unstable pelvic fracture, BTAI, skull base fracture, and other multiple injuries. After hemodynamic stabilization including trans-arterial embolization, the patient was admitted 6 hours after injury to our hospital for BTAI treatment.

A contrast-enhanced computed tomography (CECT) showed pseudoaneurysm at the aortic isthmus, aortic arch hematoma of 25 mm, and proximal neck length of 7.5 mm distal from the left subclavian artery. The diameter of the aorta as proximal and distal landing zone and the left external iliac artery (EIA) was 18 mm, 14 mm, and 5.2 mm respectively (Fig. 1). Considering the high risk of rupture, head injury, pelvic and vertebral fracture, an urgent TEVAR was selected. Thoracic angiogram via a percutaneous right common femoral artery (CFA) confirmed pseudoaneurysm at the aortic isthmus (Fig. 2a). Advancement of an 18-Fr sheath (Nihon Kohden, Tokyo, Japan) via the exposed left CFA could be performed but not smoothly due to slight size discrepancy. Excluder iliac leg (16 mm × 9.5 cm) followed by 2 Excluder aortic cuff endoprosthesis (23 mm × 3.3 cm) (WL Gore, Flagstaff, Arizona, USA) were successfully deployed at
the injured portion (Fig. 2b) and attached to the aortic wall by Tri-lobe balloon catheter (WL Gore, USA). The final aortogram showed exclusion of pseudoaneurysm and no endoleak (Fig. 2c).

Considering the risk of iliac rupture, before removing the 18-Fr sheath, a 6-Fr balloon catheter (Selecon, 20 mm diameter, Terumo, Gifu, Japan) was placed in the terminal aorta via the right percutaneous access. A complete transection of the left EIA occurred (Fig. 3), and the bleeding was successfully controlled by balloon inflation, followed by bypass surgery from the left common iliac artery to the CFA using ringed polytetrafluoroethylene
graft (8 mm, Gore-Tex Vascular Graft, WL Gore, USA) via the retroperitoneal approach. The patient was discharged uneventfully after 2 months to treat other multiple traumas. One year later, CT revealed no stent-graft related complications (Fig. 2d).

Discussion

The majority of BTAI patients die at the scene, with only 13% to 15% arriving alive at hospitals, and thoracic isthmus is the most common site. Operative repair is associated with high morbidity and mortality. Patients with major associated injuries could be safely managed with delayed repair under effective blood pressure control. Early repair should be considered only for patients with brain injury who need a higher mean arterial pressure, and aortic arch hematoma >15 mm; our case demonstrated all of these findings.

TEVAR has become the first treatment option if anatomically suitable regardless of age; it is a bridge to definitive repair or damage control surgery in selected cases, and has lower perioperative mortality, paraplegia, operative time, operative blood loss and hospital length of stay. However, there remain some challenges among young patients with smaller aorta and access vessel, and more severe angulated aortic arch. These factors may lead to difficulty in finding appropriate stent-graft size, higher risk of migration, endoleak, device fracture and collapse, or iliac artery avulsions. Another challenge is the frequently unavoidable left subclavian artery coverage to get adequate proximal landing zone. However, several studies demonstrated the safety of its coverage if there are patent of Circle of Willis and normal right vertebral artery. In addition, the absence of atherosclerotic wall involvement of the aorta, as in young trauma patients, relies on successful aneurysm sealing even with short neck (4 mm–5 mm).

In young patients, the smallest available thoracic endograft (diameter of 22 mm) would not be greatly oversized, but would not secure the suitable apposition for severely angulated aortic arch and could potentially have higher complication rate. Sequential stacked placement of abdominal cuffs endograft (smallest available diameter of 23 mm, for emergency cases in Japan) can resolve such anatomical problems. Even though the use of abdominal cuffs endograft to treat BTAI is “off label”, no enfolding or device collapse has been reported with this technique and result in only 13% of complication rates. Nevertheless, placement in the small distal landing zone (diameter of 14 mm) would result in device oversizing of 64.3%. Therefore, iliac leg endograft was considered as the most appropriate device. Our endograft was oversized slightly more than instruction for use to minimize inadequate diameter measurement in the light of hemodynamic instability, correlating to Jonker, et al. report of significant difference in aortic diameter (range from 7.2% to 11.2%).

There are some notes of using this technique. First, combination of endografts can possibly result in device separation and type III endoleak. For this reason, the endografts are deployed from distal to proximal to improve seal and wall apposition. Second, more extensive coverage of thoracic aorta can increase the risk of spinal cord ischemia. Third, shaft of Excluder iliac leg and aortic cuff endograft delivery system are short, only 58 cm and 61 cm respectively. We should measure carefully the length from the intended access to the lesion by 3D CT. Endograft delivery without a sheath should give more chance to reach the lesion. Forth, if the iliac disruption during the sheath removal is predictable, percutaneous balloon occlusion is a simple and effective method to control the bleeding.

In summary, TEVAR using combination of iliac leg and abdominal aortic cuff stent-grafts is feasible to manage BTAI with small diameter aorta.

Disclosure Statement

The authors of this manuscript declare no conflicts of interest.

References

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