VIA MEDICA

CASE REPORT

Acta Angiol
Vol. 18, No. 1 pp. 35–39

ISSN 1234–950X
www.angiologia.pl

Blunt injury of descending thoracic aorta — complicated but successful endovascular treatment

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Abstract

We present a case-report of a young 25-year-old male patient with blunt thoracic aortic injury caused by a traffic accident. Additionally he had (as a multiple trauma patient) the contusion of both lungs, rupture of the spleen and the liver, long bone fractures, and a traumatic face injury. The patient was treated with repeated endograft replacement and a debranching operation of the common carotid arteries and left subclavian artery. After multiple trauma, a Gore TAG (26 × 100 mm) endograft was implanted because of traumatic transection of the aortic isthmus. On the second day minor proximal type I endoleak was noted by CT-angiography. Balloon-dilatation of the proximal part of the endograft was performed. On the 24th postoperative day the patient was referred to the rehabilitation centre. Three weeks later the patient had serve chest pain, and emergency CT-angiography revealed the collapse of the stent graft. On the first stage a debranching operation was performed between the common carotid arteries with supported ePTFE graft and transposition of the left common carotid artery to the left subclavian artery. Next, a COOK Zenith TX2 endograft (32 × 200 mm) was placed proximal to the aortic arch covering the left common carotid artery. Recovery was uneventful and one year after the trauma no endoleak has been detected.

Key words: blunt trauma of thoracic aorta, endovascular treatment, endograft collapse

Acta Angiol 2012, 18, 1: 35–39

Introduction

The first successful case of endovascular repair of the thoracic aorta (TEVAR) was published in 1994 by Dake et al. [1] and the first successful TEVAR for the thoracic traumatic aortic rupture in 1997 by Semba et al. [2]. According to the literature, there is an increasing tendency to use TEVAR as a treatment for blunt traumatic aortic injuries [3]. Especially in young trauma patients the specific anatomical features (like small diameter of the aorta, serve angulation of the aortic isthmus) and off-label usage of endografts are the main reasons for the collapse of endoprosthesis [4].

In this paper we describe an interesting endovascular treatment of the traumatic aorta including a short discussion. Despite the fact that the TEVAR was complicated due to type I endoleak and the late collapse of the endograft, the reintervention has been successful.

Case report

A 25-year-old male patient had multiple system trauma caused by a traffic accident. Splenectomy and suturing of the liver and fixation of the right femoral bone was performed promptly after admission in the

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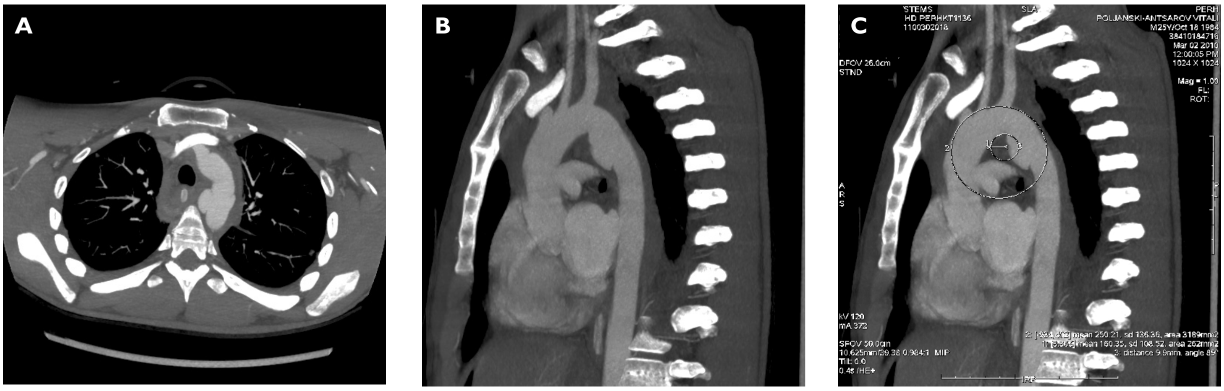

Figure 1A, B, C. CT-angiography showed the traumatic dissection in the region of the aortic isthmus. IIC class according to Schumacher is characterized as traumatic dissection, no complete aortic laceration with active haemorrhage, the pseudoaneurysm is developing. Radius of inner curve of the aortic arch is 3.4 cm; the diameter of the aorta is 20 mm

North Estonia Medical Centre. After the first emergency operation (splenectomy and sutures of the liver) and stabilisation of the patient, CT-angiography revealed multifractures of the facial bones, contusion of the lungs, and blunt traumatic injury of the descending thoracic aorta (according to the classification by Schumacher — please see Figure 1 legend) [5] (Figure 1).

Description of TEVAR (thoracic endovascular aortic repair)

The right common femoral artery was exposed surgically. A standard angiographic pigtail catheter was inserted through a percutaneous puncture (5Fr) into the contralateral common femoral artery to permit angiographic control throughout the procedure. A 260-cm, 0.035-inch Terumo guidewire (Terumo Medical Corporation, Tokyo, Japan) was placed, under fluoroscopic control, into the ascending aorta through a sheath in the common femoral artery, and a 5F measuring pigtail catheter was advanced into the ascending aorta over the Terumo guide. This pigtail catheter was used to exchange the Terumo guide wire for a 0.035-inch-diameter Lunderquist (Cook, Inc., Bloomington, Ind) to guide the passage of the 20F sheath facilitated by the application of a small amount of mineral oil. Gore TAG (W.L. Gore and Associates, flagstaff AZ) 26 × 100 mm endograft (second generation) deployment was performed under fluoroscopic control; the orifice of the subclavian artery was covered. A control angiography was performed, and no obvious endoleaks were detected. Finally, the introducer was removed from the groin, and the arteriotomy was sutured (Figure 2).

A type I endoleak was noted on the CT-angiography 36 hours later (Figure 3). The balloon-dilatation of the proximal part of endograft was performed via the left common femoral artery with a Tri-Lobe balloon (W.L. Gore and Associates, Flagstaff AZ). A minor endoleak (I type) in region of the inner curve of the aortic arch was still detected. Subsequently, a conservative treatment strategy was chosen, and the patient recovered under anti-hypertensive and antibacterial treatment. The patient was discharged on the 24th postoperative day.

Figure 2. Aortography immediately after employment of the Gore TAG (26 × 100 mm)

Repeated endografting of the aortic arch

Due to a moderate chest pain the patient was admitted to our hospital three weeks later. New CT-angiography showed the collapse of the GORE-TAG endograft (but no occlusion of the thoracic aorta) (Figure 4). As a first step, supra-aortic branch revascularisation

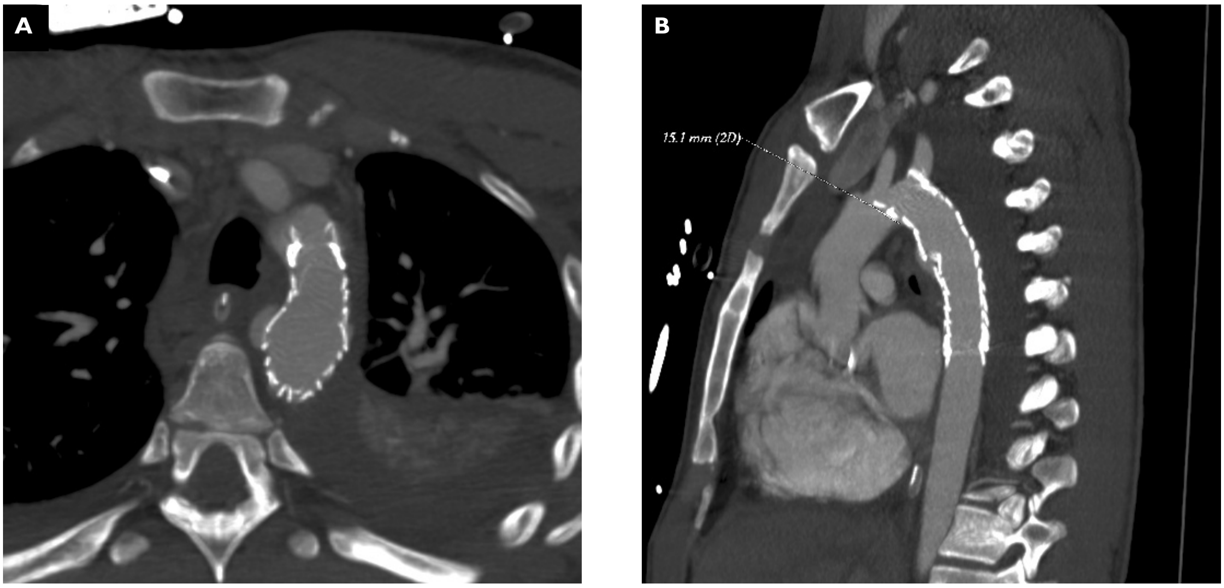

Figure 3A, B. Type I endoleak was described by CT-angiography; the pseudoaneurysm was filled with the contrast medium; the length of lip of the endograft was measured as 15 mm

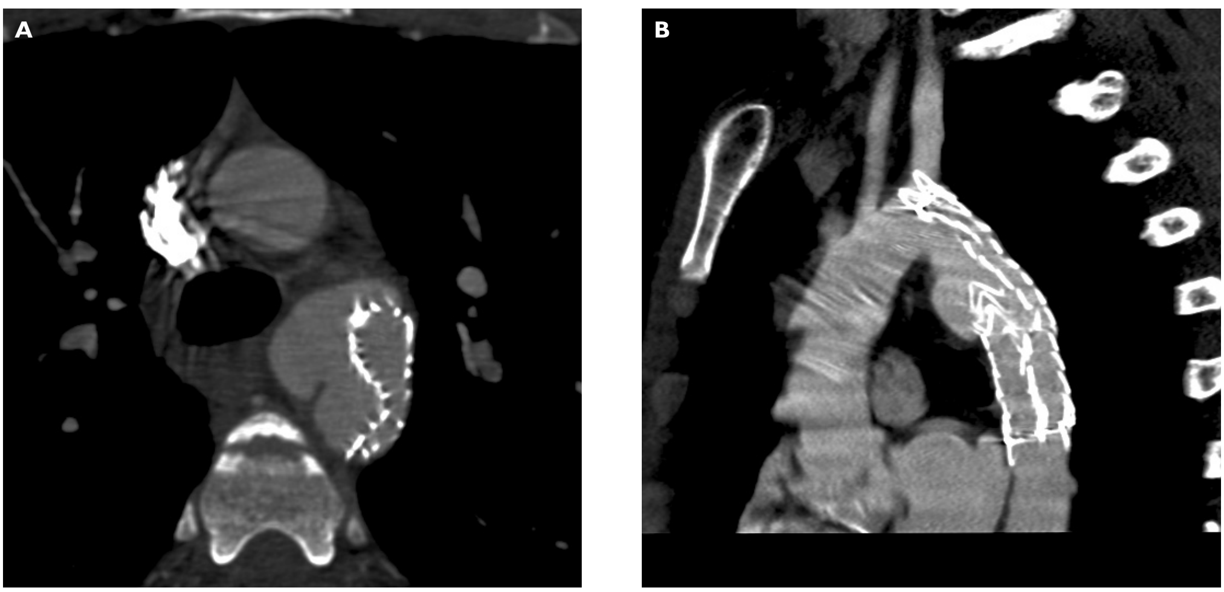

Figure 4A, B. Collapse of the endograft (Gore TAG 26 x 100 mm) was observed by CT-angiography

(debranching) was performed as follows: crossover from the right aCC (common carotid artery) to the left aCC with a supported ePTFE 8 mm graft (IMPRA, Carboflo, C. R. Bard, Inc). Also, transposition of the proximal part of the left aCC to the left subclavian artery was performed. As a second step, a new endoprosthesis, a Zenith TX2 (Z-Trak-Plus), 32 × 200 mm (Cook, Inc., Bloomington, IN), was inserted via the right common femoral artery following the same endovascular principles as described above. Angiography was performed via right brachial artery with a diagnostic pigtail catheter. After the implantation of the Zenith TX2 endograft (covering left aCC), a type I endoleak was still noted, and balloon-dilatation of the proximal part of the endograft with CODA balloon (Cook, Inc., Bloomington, IN) was performed. After the dilatation no endoleak was detected (Figure 5).

The patient's recovery was uneventful and he was discharged on the 15th postoperative day.

One year later a planned follow-up control CT-angiography showed patent crossover PTFE vascular graft. There were no endoleaks of the endograft (Figure 6).

Figure 5. Aortography after reimplantation of another endograft (Zenith TX2 - Z-Trak-Puls). No endoleak was noted

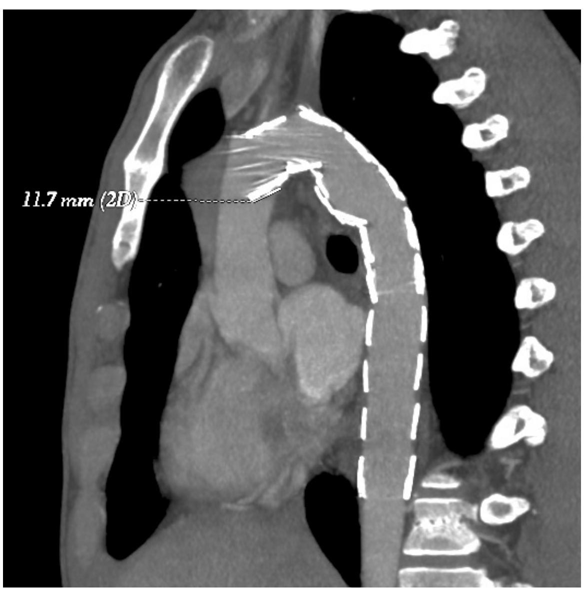

Figure 6. One year later, follow-up CT-angiography showed no endoleaks. The length of the lip of the endograft was observed as 11 mm

Discussion

A patient suffering multiple trauma with thoracic blunt aortic injury is very challenging for any medical centre dealing with these kinds of traumas. It is worth mentioning that a patient with a minor injury of the thoracic aorta could be treated in a conservative way (an aggressive anti-impulsive treatment). This is especially important in young patients and maybe the best solution would be to avoid endograft employment into the thoracic aorta [6]. At the moment we can only speculate about the possible changes in the wall of the thoracic aorta and about the long-term behaviour of the endograft (under consisted pulsative movements and blood pressure forces).

Meanwhile, open surgery might include considerably high risk in the case of multiple trauma patients. Blunt trauma (especially after traffic accidents) consists of significant forces frequently associated with injuries such as traumatic brain injuries, (intra) abdominal injuries, pulmonary contusions, long-bone fractures, etc. When thoracotomy, thoracic aortic clamping (with or without left-heart bypass), and attendant haemodynamic and coagulation fluctuations are added, the population's perioperative management becomes even more challenging. Under these circumstances, the intraluminal placement of an endograft for these patients as mini-invasive treatment seems to be the optimal clinical solution.

Considerations about the clinical decisions with regard to the employment of the stent graft should be based on thorough calculations with high-quality CT--angiography. Dynamic CT-angiography has shown the difference of the diameter of the thoracic aorta to be as much as 18% between the systol and the diastole, and, additionally, the diameter of the thoracic aorta is smaller in haemodynamically unstable patients [7]. This could lead to the mismatching of diameters between a real diameter of the thoracic aorta and the endoprosthesis. Thus, undersizing an endograft could cause insecure fixation and sealing.

Conversely, an excessive oversizing may result in attachment site endoleak, device infolding, collapse, and even death from aortic occlusion [8]. The "bird beak" deformity as a phenomenon of endografting has been described after employment of endografts. This sign characterizes the proximal lip of an endograft that is not placed against the inner wall of the thoracic aorta [9] (Figure 3).

In our case, we used the second generation of TAG device, which, unfortunately, has been frequently associated with endograft collapse. In fact the smallest diameter of GORE TAG (II generation) was 26 mm and it was indicated for use in aortas with an inner wall diameter of 23–24 mm (according to instructions). The diameter of the thoracic aorta of 19–20 mm as in our case could lead to a mismatch between the endograft and the aortic wall. Muhs et al. (2007) showed that no collapse of the second generation devices occurred in patients treated with aortic diameters of ≤ 23 mm [4]. One issue is a small diameter of the aorta, but should it be combined with a small radius of curvature of the aortic arch the most challenging anatomical situation would lead to the collapse of endograft [10]. We would like to emphasize that the Gore TAG device was chosen (off-label) because the patient was severely injured and unfit for major aortic reconstruction. Nowadays, the third generation of Conformable GORE® TAG® device and other devices are available especially designed to avoid sealing problems related to the relativity small diameters of the thoracic aorta and the tight aortic arch.

Should collapse of an endograft occur, there are several treatment possibilities to resolve this clinical situation. We decided to performed extra-anatomical crossover bypass and then to employ the second new endograft which was proximal compared to the previously implanted device.

Finally, we would like to emphasize the importance of knowing the specific requirements of the endovascular devices (now available third-generation) as well as the basic knowledge on anatomical specific features in young patients after blunt thoracic aortic injury.

Conclusions

In this case report, we would like to emphasize the importance of knowledge about the specific anatomical features in young trauma patients. Additionally, it is mandatory to obtain the detailed information on the new generation of devices for the thoracic aorta. We hope that the third generation and new endografts (including such features as built-in angulation capability) will significantly diminish these kinds of problems in the treatment of young multiple trauma patients.

Acknowledgements

We would like to thank Dr. Georg Pimenoff (Department of Radiology, Tampere University Hospital) for his collaboration and technical support.

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