

Case Report

Hybrid Approach for Distal Stent Graft-Induced New Entry After Frozen Elephant Trunk: Case Report

Boris N. Kozlov , Dmitri S. Panfilov , Evgeniya V. Lelik *  and Elizaveta A. Petrakova

Cardiology Research Institute, Tomsk National Research Medical Center, Tomsk 634012, Russia;
pand2006@yandex.ru (D.S.P.)

* Correspondence: eva00@list.ru

Abstract

This case demonstrates the efficacy and feasibility of visceral–renal debranching with endovascular repair for the treatment of a distal stent graft-induced new entry (dSINE) that occurred 47 months after a frozen elephant trunk procedure in a patient with chronic aortic dissection type B. There were no perioperative complications. Postoperative computed tomography scans confirmed sealing dSINE and the patency of visceral and renal arteries.

Keywords: aortic dissection; dSINE; thoracoabdominal aorta; frozen elephant trunk; visceral–renal debranching; endovascular repair

1. Introduction

Distal stent graft-induced new entry (dSINE) is considered a manifestation of negative remodeling of the thoracoabdominal aorta with an incidence up to 35% predominantly in females and in patients with chronic aortic dissection [1,2]. The clinical significance of dSINE is high mortality rate primarily caused by aortic rupture [3].

In recent years, attention has been paid to the treatment of this entity. Open surgery is a reliable approach; however, it puts the patient at additional risk of morbidity and mortality. Endovascular repair has several solutions: dissection-specific stent graft implantation (with some distal stents removed), tapered stent graft implantation, and simultaneous implantation of a bare metal stent or a smaller stent graft [2–5]. Although endovascular procedures are associated with lower periprocedural risk, they significantly decrease the pressure gradient in abdominal aortic branches in 25–50% of patients. This may contribute to ischemic complications of viscera [4].

We described the case of the treatment of dSINE after a frozen elephant trunk procedure using a hybrid approach.

2. Case Report

A 49-year-old male patient was admitted to the cardiovascular department with chest pain. According to computed tomography (CT) scans, chronic aortic dissection type B with the primary entry site distal to the left subclavian artery and aneurysmal remodeling of the proximal part of the descending aorta was revealed. Given this, thoracic endovascular aortic repair (TEVAR) for sealing the primary entry site was refused. The patient was scheduled for an elective frozen elephant trunk (FET) procedure.

The FET procedure was performed according to a surgical protocol adopted in our clinic [6]. It includes unilateral antegrade cerebral perfusion via the innominate artery with a flow rate of 8–10 mL/kg/min, a perfusion pressure of 60–80 mmHg, moderate



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hypothermia (25–28 °C), hematocrit values above 25%, and the maintenance of a mean pressure of 80–100 mmHg for the first 3 days after the surgery. Our monitoring strategy includes arterial pressure measurements in both radial and femoral arteries and cerebral neuromonitoring using near-infrared spectroscopy. We do not perform cerebrospinal fluid drainage and pressure monitoring during the procedure.

Specific surgical steps are as follows. After establishing a cardiopulmonary bypass, body cooling was started. When the target temperature was achieved, lower body circulatory arrest and unilateral antegrade cerebral perfusion were initiated. Then, the aortic arch was transected. After visual assessment of the aortic lumen, the 28 mm E-vita open hybrid graft (150 mm length) was implanted into the true lumen of the descending aorta. After graft deployment, it was fixed to the aortic wall using 4/0 polypropylene continuous suture in zone 2. The graft was implanted without oversizing with respect to the true aortic lumen. Proximal aortic anastomosis was performed beyond the left common carotid artery. Thereafter, the cardiopulmonary bypass was reinstituted with rewarming of the patient's body up to 36 °C. During this stage, ascending aorta-left subclavian artery rerouting was performed.

The intra- and postoperative period was uneventful. Postoperative CT scans revealed complete false lumen thrombosis along the hybrid graft and expansion of the downstream true lumen without increasing total aortic diameter. The distal landing zone was at the T10 level (Figure 1).

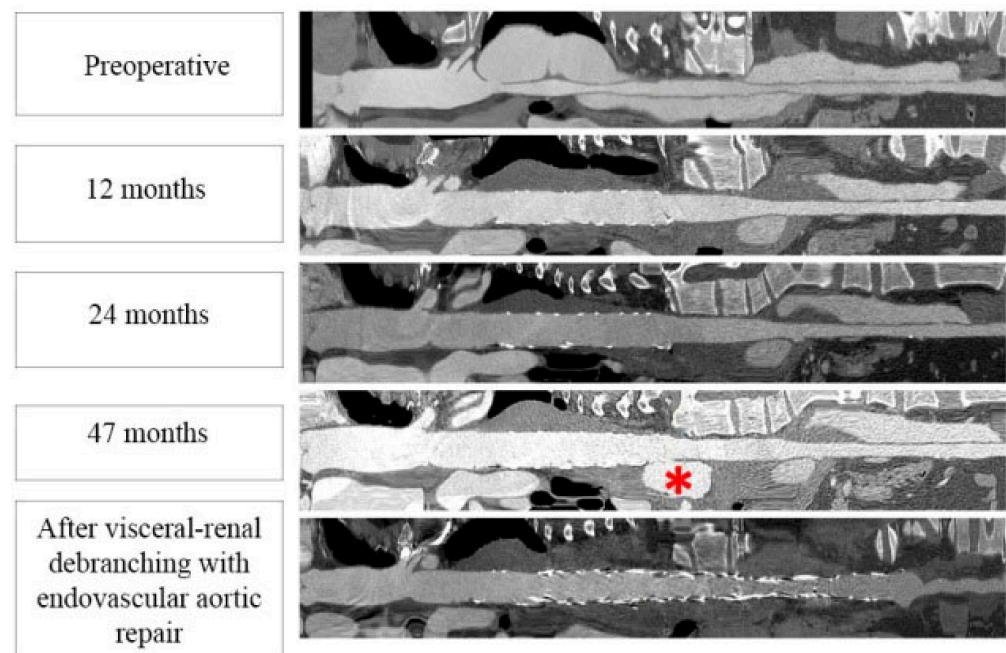


Figure 1. CT scans. Chronic aortic dissection type B. First line—preoperative image; second line—12 months after the frozen elephant trunk procedure, with completely thrombosed false lumen thrombosis along descending aorta and persistent stable dissection of abdominal aorta; third line—24 months after frozen elephant trunk procedure; fourth line—47 months after frozen elephant trunk procedure, with dSINE at the distal landing zone of a hybrid graft (asterisk); fifth line—early postoperative period after hybrid visceral-renal debranching with endovascular repair.

During the next three years of follow-up there were no signs of negative aortic remodeling, with complete false lumen thrombosis extended down to the diaphragm level. However, 47 months later the patient was urgently re-admitted to our center with new-onset acute backpain. The performed CT revealed that dSINE led to a partially thrombosed

false lumen and an increased size of the thoracoabdominal aorta at the distal landing zone level (60 × 54 mm) compared to previous CT examination (48 × 46 mm).

Taking into account emergent events and limited experience in open thoracoabdominal surgery, the patient was referred to visceral–renal debranching with endovascular repair of the thoracoabdominal aorta. At the first stage of hybrid surgery, the abdominal aorta was replaced. Then, visceral–renal debranching was performed using two customized 8 mm Y-shaped grafts with inflow from an abdominal aortic prosthesis. Lastly, Valiant Thoracic Captiva (Medtronic, Minneapolis, MN, USA) aortic stent grafts were implanted with continuous spinal fluid drainage monitoring.

There were no perioperative complications in the early postoperative period. Postoperative CT scans confirmed the patency of all abdominal aortic branches with complete false lumen thrombosis along the entire thoracoabdominal aorta (Figure 2).



Figure 2. CT scan and three-dimensional reconstruction of the aorta. The early postoperative period after hybrid visceral–renal debranching with endovascular repair. Patent aortic lumen and aortic branches, no dSINE.

The timeline of the disease and interventions is summarized in Figure 3.

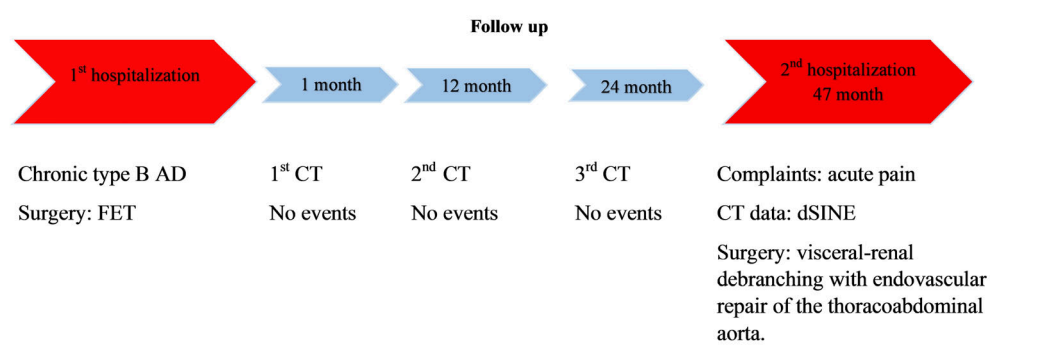


Figure 3. Timeline of the disease and interventions.

3. Discussion

The FET procedure is one of the options in the surgical treatment of aortic dissection. The main goal of the FET procedure is to exclude the primary entry tear and stabilize the descending aorta by inducing FL thrombosis along the stent graft and downwards as far distally as possible [7]. Thoracic aortic surgery using the FET technique provides satisfactory early- and mid-term results [8,9]. At the same time, the need for distal aortic re-interventions, mainly endovascular, is around 10–15% [10,11].

Some studies reported that the frequency of re-interventions is expected to be higher in chronic aortic dissection compared with acute AD [12,13]. Similarly, Leone et al. [14] reported that patients with acute AD received a significantly lower rate of reoperation at 5 years of follow-up. However, in our previous series, the FET technique was associated with a low re-intervention rate during the follow-up in all cohorts of patients, with no significant difference between acute and chronic AD [15]. In a larger study, Wu et al. [16] also did not find differences between similar groups.

dSINE is one of the causes for distal aortic reintervention. The incidence of dSINE, this complication, is up to 35% after TEVAR, with prevalence in women and patients with chronic aortic dissection [1,2]. The occurrence of dSINE is associated with high mortality (up to 26%), primarily due to aortic rupture [3,17]. There are several major causes of dSINE after stent graft implantation: (i) excessive oversizing, (ii) expansive force influence (spring effect), and (iii) uncontrolled blood pressure in the early postoperative period [3–6].

Open and endovascular approaches are available for the dSINE treatment. The open stage is considered a more reliable method for eliminating the complication, but it exposes the patient to additional risk. The endovascular approach to overcoming this complication involves several solutions: implantation of a stent graft lacking several distal links, implantation of an additional stent graft with a non-standard shape (tapered distal end), and simultaneous implantation of a bare metal stent or a smaller stent graft [2–6]. However, additional endovascular manipulations significantly reduce the pressure gradient in the visceral branches of the abdominal aorta in 25–50% of cases, which can lead to ischemic complications in the internal organs [2].

Overall, endovascular approaches to treating dSINE are only in the initial stages of clinical testing, with limited volume and observation periods [1,18]. In cases with aortic dissection type B, we intentionally used the FET procedure instead of TEVAR. According to the literature, there is a risk of retrograde aortic dissection after stent graft deployment. Although the incidence of this adverse outcome is low (1.3–6%), the mortality rate is high (42%) [19,20]. In these patients the FET procedure was used to minimize the risk of aortic-related complications such as retrograde aortic dissection and graft migration. Thus, the FET procedure possesses advantages of TEVAR without intrinsic aortic-related complications. In our opinion it is a viable alternative for the treatment of aortic dissection type B in lieu of TEVAR.

In summary, this case demonstrates the feasibility and reproducibility of a visceral-renal debranching with endovascular repair for the treatment of a dSINE that occurred 47 months after a frozen elephant trunk procedure in a patient with chronic aortic dissection type B. The probable contributing factors of dSINE in the patient were underestimation of the stent graft stiffness properties in combination with inadequate selection of the graft size during initial operation. These factors could increase the hybrid graft radial force to the intimomedial flap, resulting in a new entry tear. Bearing this in mind, in chronic aortic dissection, one should take into consideration graft stiffness and the size of device, striving to mitigate them for prevention of dSINE.

4. Conclusions

Our case demonstrates the feasibility of reproducing the hybrid approach in dSINE treatment that could be implemented in centers with limited experience in open thoracoabdominal surgery.

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