CASE REPORT

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Visceral hybrid reconstruction of thoracoabdominal aortic aneurysm after open repair of type A aortic dissection by the Bentall procedure with the elephant trunk technique – A case report

Visceralna hibridna rekonstrukcija torakoabdominalne aneurizme aorte nakon otvorene rekonstrukcije aortne disekcije tipa A procedurom Bentall uz pomoć tehnike *elephant trunk*

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Abstract

Introduction. Reconstruction of chronic type B dissection and thoracoabdominal aortic aneurysm (TAAA) remaining after the emergency reconstruction of the ascending thoracic aorta and aortic arch for acute type A dissection represents one of the major surgical challenges. Complications of chronic type B dissection are aneurysmal formation and rupture of an aortic aneurysm with a high mortality rate. We presented a case of visceral hybrid reconstruction of TAAA secondary to chronic dissection type B after the Bentall procedure with the 'elephant trunk' technique due to acute type A aortic dissection in a high-risk patient. **Case report.** A 62 year-old woman was admitted to our institution for reconstruction of Crawford type I TAAA secondary to chronic dissection. The patient had had an acute type A aortic dissection 3 years before and undergone reconstruction by the Bentall procedure with the 'elephant trunk' technique with valve replacement. On admission the patient had coronary artery disease (myocardial infarction, two times in the past 3 years), congestive heart disease with ejection fraction of 25% and chronic obstructive pulmonary disease. On computed tomography (CT) of the aorta TAAA was revealed with a maximum diameter of 93 mm in the descending thoracic aorta secondary to chronic dissection. All the visceral arteries originated from the true lumen with exception of the celiac artery (CA), and the end of chronic dissection was below the origin of the superior mesenteric artery (SMA). The patient was operated on using surgical visceral reconstruction of the SMA, CA and the right renal artery (RRA) as the first procedure. Postoperative course was without complications. Endovascular TAAA reconstruction was performed as the second procedure one month later, when the 'elephant trunk' was used as the proximal landing zone for the endograft, and distal landing zone was the level of origin of the RRA. Postoperatively, the patient had no neurological deficit and renal, liver function and functions of the other abdominal organs were normal. Control CT after 6 months showed full exclusion of the aneurysm from the systemic circulation without endoleak and good flow through visceral anastomosis. **Conclusion.** In patients with comorbidities, like in the presented case, visceral hybrid reconstruction of chronic dissection type B with TAAA could be the treatment of choice.

Key words:
aortic aneurysm, thoracic; vascular surgical procedures; treatment outcome; comorbidity.

Apstrakt

Uvod. Rekonstrukcija hronične disekcije tipa B i aneurizme torakoabdominalne aorte (TAAA), zaostale nakon urgentne rekonstrukcije ascendentne aorte i luka aorte zbog akutne disekcije tipa A, predstavlja jednu od najvećih izazova u hirurgiji. Komplikacije hronične disekcije tipa B su nastanak aneurizme aorte i njena ruptura sa visokom stopom smrtnosti. Prikazana je visceralna hibridna rekonstrukcija TAAA nakon hronične disekcije tipa B i procedure Bentall tehnikom *elephant trunk* zbog akutne aortne disekcije tipa A, kod bolesnika sa visokim rizikom od peroperativnog mortaliteta. **Prikaz bolesnika.** Bolesnica, stara 62 godine, primljena je u našu ustanovu radi rekonstrukcije Crawford tipa I TAAA nakon hronične disekcije. Bolesnica je imala akutnu aortnu disekciju tipa A ranije, zbog čega je operisana. Učinjena je procedura Bentall tehnikom *elephant trunk* sa zamenom valvule. Na prijemu bolesnica je imala koronarnu bolest (in-

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farkt miokarda, dva puta u protekle tri godine), zastojnu srčanu bolest sa ejekcionom frakcijom od 25% i hroničnu opstruktivnu bolest pluća. Na kompjuterizovanoj tomografiji (KT) aorte TAAA je prikazana sa maksimalnim prečnikom od 93 mm u descendentnoj grudnoj aorti nakon hronične disekcije. Sve visceralne arterije poticale su iz pravog lumena sa izuzetkom celijačne arterije (CA), i završetak hronične disekcije nalazio se ispod ishodišta gornje mezenterične arterije (GMA). Bolesnica je podvrgnuta prvo otvorenoj hirurškoj rekonstrukciji GMA, CA i desne bubrežne arterije (DBA). Postoperativni tok protekao je bez komplikacija. Endovaskularna rekonstrukcija TAAA sprovedena je kao druga procedura jedan mesec kasnije, pri čemu je za proksimalnu zonu fiksiranja endografta korišćena procedura *elephant trunk*, a za distalnu zonu fiksiranja nivo odvajanja DBA. Postoperativno, bolesnica nije imala neurološki deficit, a funkcija bubrega, jetre i ostalih abdominalnih organa bila je normalna. Kontrolna KT nakon šest meseci pokazala je potpuno isključenje aneurizme iz sistemske cirkulacije bez *endoleak*-a i dobar protok krvi kroz visceralne anastomoze. **Zaključak.** Kod bolesnika sa komorbiditetima, kao što je kod prikazane bolesnice, visceralna hibridna rekonstrukcija hronične disekcije tipa B sa TAAA može predstavljati terapiju izbora.

Ključne reči:
aneurizma, torakalna; hirurgija, vaskularna, procedure; lečenje, ishod; komorbiditet.

Introduction

Open surgical repair of extensive thoracic aortic aneurysms and thoracoabdominal aortic aneurysm (TAAA) in elderly and in patients with comorbidities remains unsatisfactory due to considerable mortality and morbidity. After introducing the 2-stage approach to complex aortic aneurysm reconstruction [1], and thoracic endovascular aortic repair (TEVAR) as a minimally invasive procedure [2], the mortality rate higher than 31% in TAAAs repair has been decreased [3]. When TAAAs involving the visceral aorta or in cases with chronic type B aortic dissection of TAAA, encouraging results revealed with combining lesser open abdominal operation to bypass the visceral and renal vessels with the placement of an endovascular stent graft [3, 4]. This combination of endovascular exclusion with visceral revascularization for treatment of TAAAs involving the visceral aorta, termed the visceral hybrid procedure.

We presented a case of visceral hybrid the TAAA reconstruction secondary to chronic dissection type B after the Bentall procedure with 'elephant trunk' technique due to acute type A aortic dissection.

Case report

A 62 year-old woman was referred to our institution for repair of the Crawford type I TAAA secondary to chronic dissection. The patient had undergone repair of acute type A aortic dissection by the Bentall procedure with the elephant trunk technique and valve replacement 3 years before in other medical institution, when the left subclavian artery was ligated.

Computed tomography (CT) of the aorta, performed in our institution revealed TAAA with a maximum diameter of 93 mm in the descending thoracic aorta secondary to chronic dissection. The true lumen of distal part of descending aorta was with the maximum diameter of 12 mm. CT scan also showed that all the visceral arteries were originated from the true lumen with exception of the celiac artery (CA), and the end of chronic dissection was below the origin of superior mesenteric artery (SMA). The origin of the left renal artery (LRA) was 2 cm below the origin of the right renal artery (RRA). The distal, normal infrarenal aorta (without dissection) was 25 mm in diameter (Figure 1).

Fig. 1 – Computed tomography scan before the operation: chronic type B dissection with thoracoabdominal aortic aneurysm.

On admission, the patient had a lot of comorbidities: coronary artery disease (myocardial infarction, 2 times in the past 3 years), congestive heart disease with ejection fraction of 25%, and chronic obstructive pulmonary disease.

Due to the patient condition we decided to make visceral hybrid TAAA reconstruction like 2-stage procedures, with 3-vessel reconstruction (SMA, CA, RRA).

Open surgical visceral reconstruction was performed as the first procedure in general anesthesia with thoracic epidural analgesia. The distal aorta and the origins of the visceral arteries were exposed through transperitoneal abdominal ap-

proach. For the visceral bypass debranching we used a Dacron® bifurcated graft of 16 × 8 mm, and a Dacron® limb of 8 mm for the RRA which was anastomosed end-to-side with a bifurcated graft. All visceral anastomoses between grafts and arteries were done by end-to-side anastomosis with proximal ligation of the origin of the arteries after Doppler sonographic confirmation of flow through anastomosis. Ischemia of the right kidney during RRA reconstruction was 16 min, SMA reconstruction lasted 12 min and celiac trunk reconstruction 16 min. The visceral bypass grafts were anastomosed end-to-side to the normal distal part of the aorta. Postoperative course of the patient was without complications.

CT scan one month after the first operation showed chronic dissection type B with TAAA without increasing the maximum diameter and orderly flow through the reconstructed visceral arteries (SMA, CA, RRA) (Figure 2).

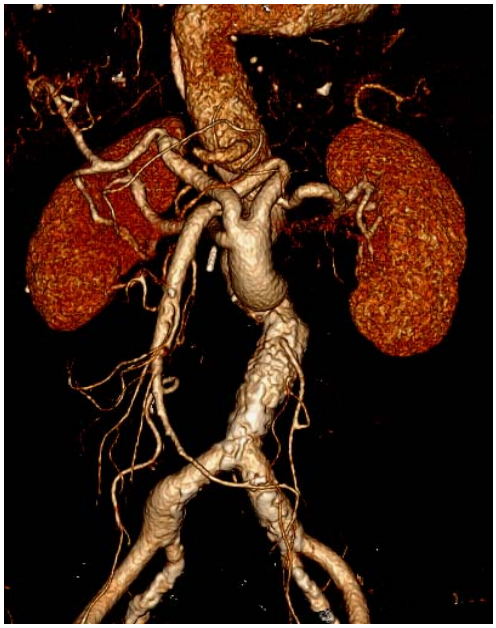

Fig. 2 – Control computed tomography scan after the 3 vessels visceral debranching.

The second endovascular stage procedure was performed after control CT. In general anaesthesia the right femoral artery was exposed and a 22 French delivery system was inserted. Through the percutaneous right brachial artery approach a 5 French pigtail in the aortic arch was placed. Aortography was performed through this pigtail catheter to determine the level of the proximal lending zone, the level of distal lending zone and the level of origin of the LRA. After administration of 5,000 IU of heparin sodium, the endovascular two stent-grafts (TGE 343420; W. L. Gore , Flagstaff, Arizona, USA) were inserted over the guide wire with overlapping of two stent-grafts in the lenght of 5 cm. The proximal lending zone of the stent-graft was 28 mm Dacron graft from the elephant trunk procedure (Figure 3). The distal landing zone of the stent-graft was the level of the origin of RRA where the aortic diameter was 27 mm. Control aortography was performed to verify aneurysm exclusion and to show free perfusion of the stent-graft. Finally, all catheters were removed and arteriotomy of the right femoral artery was sutured. Postoperative course was without complications. The patient was discharged on the day 5 postoperatively, with no neurological deficits. Renal function, liver function and functions of the other abdominal organs were normal.

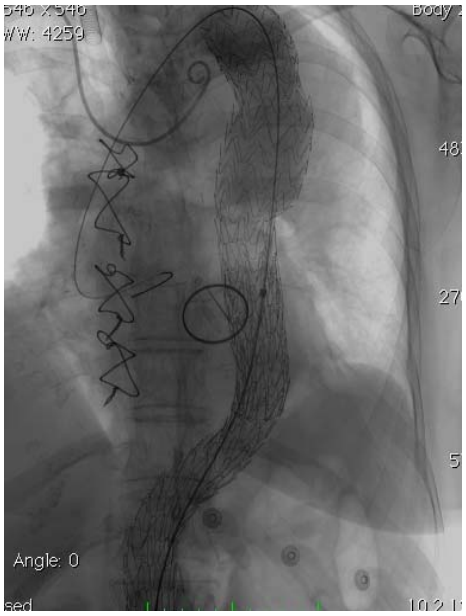

Fig. 3 – Endovascular reconstruction of thoracoabdominal aortic aneurysm with 2 stent-grafts.

On control examination 6 months after endovascular procedure, CT scan showed full exclusion of the aneurysm from the systemic circulation without endoleak and good flow through the visceral anastomosis. Also, CT scan showed complete thrombosis of the false lumen and aneurysm (Figure 4).

Fig. 4 – Control computed tomography scan 6 months after the endovascular repair.

Discussion

TAAAs as well as extensive thoracic aortic aneurysms that involve the ascending aorta, aortic arch and descending aorta require challenging repairs associated with the high rate of morbidity and mortality. Since the introduction of the 2-stage approach to reconstruction of complex aortic aneurysms by Borst et al. [1], the elephant trunk technique has become the standard surgical treatment for reconstruction of these aneurysms. In the 2-stage approach to acute type A aortic dissection treatment, the first step includes aortic valve replacement and reconstruction of ascending, arch and descending segments of aorta with a graft, so that the portion of the graft is left suspended within the lumen of the proximal descending thoracic aorta (elephant trunk) for a subsequent distal aortic reconstruction [1]. The second stage could be completed with open reconstruction, but more desirable with endovascular repair, especially in high risk patients [5, 6]. In this approach, the elephant trunk is used as the landing zone for the endograft. The key features of this technique are safer aortic clamping, reduced aortic clamp time, reduced risk of ischemic consequences and lower cumulative mortality rate [5].

There is a significant incidence of comorbidities in patients with lesions of thoracic and/or thoracoabdominal aorta [7, 8]. After initially described by Dake et al. [2], TEVAR was accepted in many medical centers as a minimally invasive approach, especially in high risk patients. It was reported that TEVAR provides a reduction of operative mortality rates nearly 75% as compared to open surgical repair where the mortality rate was described up to 31% [3, 9]. However, total endovascular grafting of more extensive TAAAs was limited by the presence of the visceral and renal arteries. The visceral hybrid procedures of TAAA includes open visceral vessels debranching and their revascularization, and endovascular exclusion of TAAA. The extent of visceral reconstruction include 1–4 vessels. Complications after open visceral debranching are acute renal disease, ischemic colitis and paraplegia in the most patients. Mortality rates are higher when 3 or more vessels are reconstructed [10]. However, visceral graft patency range from 85% to 97% in more than a year follow-up in large series [10–12]. This minimally invasive surgical approach offers a possible alternative treatment option for patients who are unfit for the open repair or who have unfavourable anatomy for total endovascular repair [13]. Our patient was well-favored for visceral debranching and reconstruction because of the end of chronic dissection in the level of visceral vessels. Further advantages of visceral hybrid repair of TAAA include avoiding the need for thoracotomy, supracoeliac aortic clamp, left or full heart bypass and extensive tissue dissection associated with open repair [14]. Black et al. [3] showed a series of 25 patients with TAAA who underwent visceral hybrid reconstruction. They identified an elective mortality of 17% and no paraplegia with the procedure. Zhou et al. [15] performed 31 hybrid procedures in high-risk patients that included 15 patients with TAAA and with hybrid visceral debranching aortic repair. The perioperative mortality rate in their series was 3.2%, without postoperative paraplegia. Unlike total endovascular reconstruction for chronic aortic dissection when it is possible that false lumen dissection retrograde still blood fills, in hybrid visceral repair of TAAA with chronic dissection type B the false lumen is always excluded and there is no problems with retrograde flow. Although this kind of treatment is most suitable for patients with comorbidities, there is still significant morbidity of 30% and mortality rate of 13% to 23% [3, 16].

In our patients with a large number of concomitant diseases open TAAA reconstruction would be accompanied with a high risk and difficult to perform. Because of the involvement of the origin of SMA, CA and RRA by dissection total endovascular TAAA reconstruction was not appropriate to do. Visceral hybrid TAAA reconstruction has proven to be the best solution in this patient due to minimal invasive reconstruction and less trauma.

Conclusion

Open surgical repair of extensive thoracic aortic aneurysms and thoracoabdominal aortic aneurysm remains the surgical approach in medical centers worldwide, but in elderly and patients with comorbidities this approach carries considerable mortality and morbidity rates. Total endovascular reconstruction of chronic dissection type B with thoracoabdominal aortic aneurysm is not always possible to perform. In such cases, visceral hybrid reconstruction is the treatment of choice. In future larger series should demonstrate the true value of such surgical treatment as an alternative method for open surgical reconstruction.

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