



Endovascular treatment of the subclavian artery aneurysm in high-risk patients – A single-center experience

Endovaskularno zbrinjavanje aneurizme supklavijalne arterije kod visokorizičnih bolesnika – iskustvo jednog centra

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Abstract

Background/Aim. Subclavian artery aneurysm (SAA) is a rare disease, but with serious complications. Recently, besides open surgical procedure, appearance of the stent-grafts enables endovascular reconstruction. We presented our first experience with endovascular treatment of 6 SAA occurring in five male and one female patient. **Methods.** All the patients, in our studies, according to ASA classification were at high risk of open repair of SAA. The etiology of all aneurysms was atherosclerotic degeneration of the artery. Two aneurysms were at intrathoracic location, and the other ones were extrathoracic. Symptoms related to SAA were present in two of the patients, compression and chest pain in one, and hemorrhage shock in another one. Other patients were asymptomatic. We preferred the Viabhan endoprosthesis for endovascular repair in 5 cases. In one patient with rupture of

SAA, who was at high risk of open repair we performed a combined endovascular procedure. First of all, we covered the origin of the left subclavian artery with thoracic stent graft and after that put two coils in a proximal part of the subclavian artery. **Results.** There was no operative mortality, and the early patency rate was 100%. The follow-up period was from 3 months to 3 years. During this period, one patient died of heart failure and another one required endovascular reoperation due to endoleak type I. **Conclusion.** Endovascular treatment is recommended for all patients with SAA whenever it is possible due to anatomical reasons especially in high-risk patients with intrathoracic localization of aneurysm, to prevent potential complications.

Key words:

subclavian artery; aneurysm; aneurysm, ruptured; vascular surgical procedures; stents; transplants; prognosis; mortality.

Apstrakt

Uvod/Cilj. Aneurizma arterije supklavije se retko javlja, ali su komplikacije ozbiljne. U novije vreme, pored otvorenog hirurškog zahvata, pojava stent-graftova omogućava i endovaskularnu rekonstrukciju. Prikazali smo naše prvo iskustvo sa endovaskularnom rekonstrukcijom aneurizme supklavijalne arterije kod šest bolesnika, pet muškaraca i jedne žene. **Metode.** Svi bolesnici u našoj studiji bili su visoko rizični za otvorenu rekonstrukciju prema ASA klasifikaciji. Aterosklerotska degeneracija arterije bila je uzročnik nastanka aneurizme kod svih bolesnika. Dva bolesnika imala su aneurizme supklavijalne arterije intratorakalno, dok su kod ostalih bolesnika aneurizme bile ekstratorakalno. Kod dva bolesnika aneurizma supklavijalne arterije bila je simptomatska, sa simptomima u vidu pritiska i bola u grudima kod jednog i hemoragičnog šoka i bola u grudima kod drugog, dok su kod preostalih bolesnika aneurizme bile asimptomatske. Za endovaskularnu rekonstrukciju koristili smo Viaban stent-graft. Kod jednog bolesnika sa rupturom aneurizme supklavijalne arterije koji je bio visokorizičan za otvore-

nu rekonstrukciju, primenili smo kombinovani endovaskularni postupak. Prvo smo pokrili ušće supklavijalne arterije torakalnim stent-graftom, a zatim smo postavili dva klemu u proksimalni deo supklavijalne arterije. **Rezultati.** Nije bilo operativnog mortaliteta tokom endovaskularne rekonstrukcije, a uspešnost izvođenja procedure bila je 100%. Period praćenja bio je od tri meseca do tri godine. Tokom ovog perioda, jedan bolesnik je umro zbog srčanog popuštanja, a kod jednog bolesnika smo izveli novu endovaskularnu proceduru zbog pojave endolika tipa I. **Zaključak.** Endovaskularno lečenje aneurizme supklavijalne arterije preporučuje se kod bolesnika kod kojih anatomske karakteristike same aneurizme omogućavaju izvođenje iste, a posebno se preporučuju kod visokorizičnih bolesnika sa intratorakalnom lokalizacijom aneurizme radi prevencije komplikacija.

Ključne reči:

a.subclavia; aneurizma; aneurizma, ruptura; hirurgija, vaskularna, procedure; stentovi; graftovi; prognoza; mortalitet.

Introduction

Subclavian artery aneurysm (SAA) is a rare disease, thus it represents only 0.1% in relation to all other aneurysms of the aorta or peripheral arteries^{1,2}. Possible complications of SAA are rupture, distal embolization, compression and thrombosis, and therefore should be considered for surgical treatment³. Atherosclerosis is the most common cause of these aneurysms. Other causes that can lead to SAA are: thoracic outlet syndrome, degenerative connective tissue disorders, infection and trauma. The only way to treat SAA was open, surgical aneurysm reconstruction, until the appearance of stent-grafts and endovascular reconstruction. Open surgical procedure in the treatment of SAA depends on whether aneurysm affects the intrathoracic or extrathoracic segment of the artery⁴. For endovascular reconstruction of SAA localization of aneurysm is not so important but it is very important that aneurysm has adequate anatomical characteristics for the endovascular procedure. That means that SAA has adequate proximal and distal zone for stent-graft fixation.

Methods

We reported our single-center experience with endovascular treatment of 6 SAAs in the period January 2009 – December 2013. Four aneurysms were at extrathoracic location,

while two of them were intrathoracic. Most of them were asymptomatic. Symptoms were present in two patients, compression and chest pain in one, and massive hemorrhage and chest pain in another one (Figure 1).

We preferred the Viabahn endoprosthesis (W.L. Gore, Flagstaff, USA) for endovascular repair in 5 cases. In one case, we covered the origin of the left subclavian artery with thoracic stent graft (TAG 3110, W.L. Gore, Flagstaff, USA) and after that we put two coils (Azur 35 Helical Hydrocoil 10 mm, Terumo, Tokyo, Japan) in the proximal part of the subclavian artery because the aneurysm did not have enough proximal neck (Figures 2 a and 2 b).

Under the local anesthesia we combined the transfemoral approach to endovascular treatment with the transbrachial approach to put the diagnostic catheter.

The follow-up period was from 3 months to 3 years. The patients were monitored postoperatively by physical examination, doppler ultrasonography at 3-, 6- and 12-month intervals, and once yearly thereafter. Control computed tomography (CT) angiography was performed in the patients after the first year of operation or more often if there was a need.

Results

Six presented patients were between 72 and 84 years old (five males and one female). All aneurysms were athero-



Fig. 1 – Rupture of subclavian artery aneurysm in the intrathoracic part with massive hemothorax.

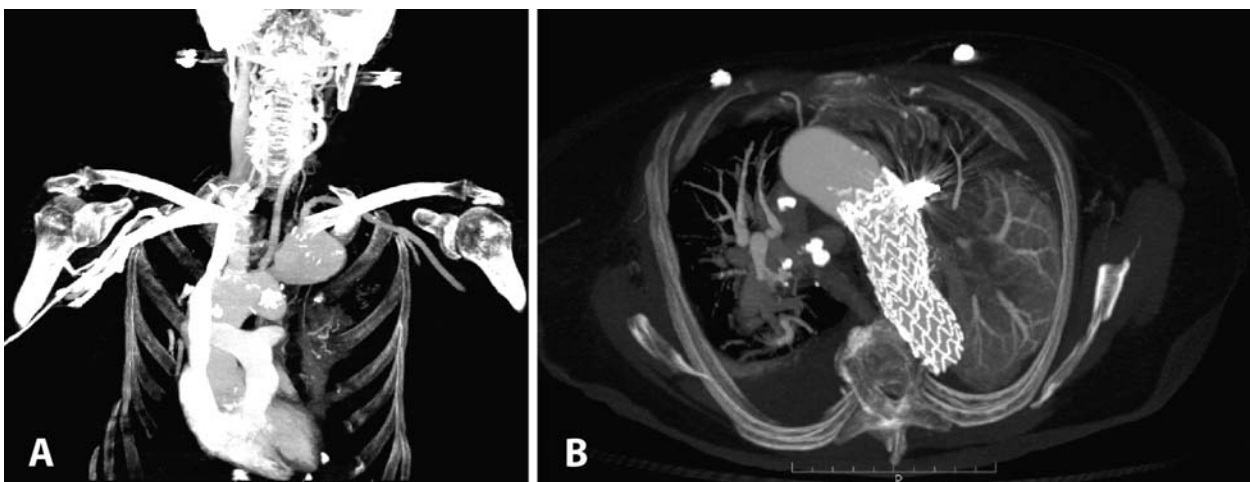


Fig. 2 – A) Short neck of subclavian artery aneurysm; B) Control computed tomography shows good position of the thoracic stent-graft covered origin of the subclavian artery and coils into the proximal part of the subclavian artery.

sclerotic true aneurysm. The diagnosis was established using CT angiography and duplex ultrasonography of the aortic arch and branches. The diameter of SAA ranged from 3.6 cm to 12 cm (mean 5.2 cm).

The most common comorbid conditions in the presented patients were: arterial hypertension, coronary artery disease, cerebrovascular insult, chronic cardiomyopathy, diabetes mellitus, peripheral arterial occlusive disease and chronic obstructive pulmonary disease. All the patients in our group were active smokers. It is interesting that none of the patients in our group had no medical history of aneurysmal aortic disease, nor a peripheral artery aneurysm. Medical history of the patients showed no chest injury, nor other types of trauma in the subclavian artery region (Table 1).

There was no operative mortality, and the early patency rate during the first tree months was 100%. During this follow-up period there was no need for open reconstruction of SAA and there were no complications such as stent graft thrombosis or distal embolization and ischemia.

During follow-up period of 3 years, one patient died of heart failure and another one required endovascular reoperation due to endoleak type I (Figures 3a and 3b).

Discussion

Elective surgical repair is mandatory for subclavian aneurysms, even when asymptomatic, because they tend to increase in size with increased risk of rupture, thrombosis, distal embolization and compression of surrounding structures.

Although aneurysms of SAA are rare, potential risk of rupture and secondary ischemic complications are complications which require surgical treatment. Open repair of SAA, especially of the intrathoracic segment in patients with previous median sternotomy or lateral thoracotomy, is a technical challenge with a lot of postoperative complications. Davidović et al.³ reported a series of 14 patients with SAA treated with the supraclavicular or trans-sternal approach, depending on aneurysm location. No mortality occurred and the postoperative complication rate was 21%. During the follow-up period one patient required reoperation because he developed aneurysmal degeneration of a saphenous vein graft.

Endovascular techniques offer a minimally invasive option especially in high risk patients. Endovascular repair of SAA have been reported in a small series⁵. MacSweeney et al.⁶ appear to be the first to use a stent-graft in endovascular repair of

Table 1

Clinical manifestations and comorbidity of patients with subclavian artery aneurysm (SAA)

Patient	Sex	Age (years)	Loc	Symptoms	Comorbidity	Procedure	Patency
1	M	72	I	Compression and chest pain	CVI, HTA	Viabhan	6 months
2	M	74	E	Asymptomatic	HTA, PAOD	Viabhan	3 years
3	M	78	E	Asymptomatic	CAD, DM	Viabhan	2 years
4	F	84	I	Massive hemorrhage	CAD, COPD, DM, HTA	TAG and coils	3 months*
5	M	76	E	Asymptomatic	CMP, COPD, HTA	Viabhan	1 year
6	M	75	E	Asymptomatic	CAD, HTA	Viabhan	1 year

M – male; F – female; Loc – localization; I – intrathoracic; E – extrathoracic; CVI – cerebrovascular insult; HTA – arterial hypertension; CAD – coronary artery disease; DM – diabetes mellitus; CMO – cardiomyopathy; COPD – chronic obstructive pulmonary disease; PAOD – peripheral artery obstructive disease. *Tree months later, the patient died with patent graft.

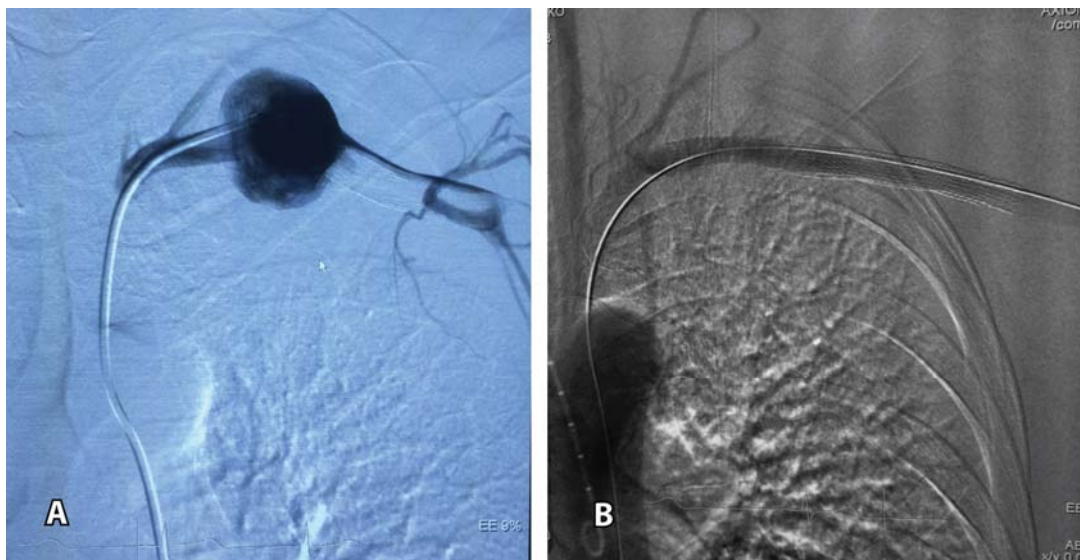


Fig. 3 – A) Aneurysm of the subclavian artery above the previously placed stent-graft with endoleak type I one year after the first reconstruction; B) Endovascular reoperation with one more placed stent-graft.

subclavian artery aneurysm in larger series of patients.

Preoperative duplex ultrasonography and CT angiography are always mandatory for diagnostic and planning the endovascular treatment of SAA^{7,8}. These diagnostic procedures are necessary to determine the proximal and distal neck diameter and proximal and distal landing zone, as well as to determine appropriate the length of the stent-graft.

We preferred a Viabahn stent-graft for endovascular repair of SAA. It is a flexible nitinol stent frame covered internally with polytetrafluoroethylene (PTFE) graft. The flexibility of the Viabahn adapted well to the tortuosity of the subclavian artery, with minimal alteration in the native vessel curvature.

In our series, we successfully treated SAA in five patients with Viabahn stent-graft. All the patients were treated with Viabahn stent-graft placed endovascularly as an elective operation, but there are studies that present emergency stent-graft repair of SAA with Viabahn due to rupture⁹. In one patient with ruptured giant intrathoracic SAA who did not have

an adequate proximal landing zone of the aneurysmal neck, we placed emergently thoracic stent-graft to cover the origin of subclavian artery, and after that we put two coils in the proximal part of the subclavian artery to prevent endoleak type II. Amiridze et al.¹⁰ have already described the use of coils for treatment of the subclavian artery pseudoaneurysm and arteriovenous fistula. But it seems that endovascular treatment only with coils is reserved for pseudo-aneurysm and small saccular aneurysm.

Conclusion

Endovascular treatment of subclavian artery aneurysm may be a valuable, less invasive alternative to open surgical approach. This treatment is especially good for high risk patients with aneurysm of the intrathoracic part of the subclavian artery. However, long-term results of this technique have not yet been established.

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