



Endovascular repair of posttraumatic multiple femoral-femoral and popliteal-popliteal arteriovenous fistula with Viabahn and excluder stent graft

Eendovaskularno zbrinjavanje posttraumatske multiple femoralnofemoralne i poplitealnopoplitealne arteriovenske fistule primenom Viabahn i ekskluder stent grafta

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Abstract

Background. Traumatic arteriovenous (AV) fistula is considered to be a pathologic communication between the arterial and venous systems following injury caused mostly by firearms, sharp objects or blasting agents. Almost 50% of all traumatic AV fistulas are localized in the extremities. In making diagnosis, besides injury anamnesis data, clinical image is dominated by palpable thrill and auscultator continual sounds at the site of fistula, extremities edemas, ischemia distally of fistula, pronounced varicose syndrome, and any signs of the right heart load in high-flow fistulas.

Case report. We presented a male 32-year-old patient self-injured the region of the right lower and upper leg by shotgun during hunting in 2005. The same day the patient was operated on in a tertiary traumatology health care institution under the diagnosis of *vulnus sclopetarium femoris et cruris dex*; AV fistula *reg popliteae dex*; *fractura cruris dex*. The performed surgery was *ligatura AV fistulae*; *reconstructio a. popliteae cum T-T anastomosis*; *fasciotomia cruris dex*. Postoperatively, in the patient developed a multiple AV fistula of the femoral and popliteal artery and neighboring veins. The patient was two more times operated on for closing the fistula but with no success. Three years later the patient was referred to the Clinic for Vascular Surgery, Military Medical Academy, Belgrade, Serbia. A physical examination on admission showed the right upper leg edema, pronounced varicosities and high thrill, signs of the skin

induration and initial ischemia with ulceration in the right lower leg, as well as numerous scars in the inner side of the leg from the previously performed operations. Due to the right heart load there were also present easy getting tired, tachypnoea and tachycardia. CT and contrast angiography verified the presence of multiple traumatic AV fistulas in the surface femoral and popliteal artery and neighboring veins of the highest diameter being 1 cm. Also, numerous metallic balls – grains of shotgun were present. After the preoperative preparation under local infiltrative anesthesia, transfemoral endovascular reconstruction was done of the surface femoral and popliteal artery by the use of stent grafts Viabahn 6 × 50 mm and excluder PXL 161 007. Within the immediate postoperative course a significant reduction of the leg edema and disappearance of thrill occurred, and, latter, healing of ulceration, and disappearance of signs of the foot ischemia. Also, patient's both cardiac and breathing functions became normal.

Conclusion. In patients with chronic traumatic AV fistulas in the femoropopliteal region, especially with multiple fistulas, the gold standard is their endovascular reconstruction which, although being minimally traumatic and invasive, offers a complete reconstruction besides keeping integrity of both distal and proximal circulation in the leg.

Key words:
arteriovenous fistula; leg injuries; therapeutics;
vascular surgical procedures; stents.

Apstrakt

Uvod. Smatra se da je traumatska arteriovenska (AV) fistula patološka veza između sistema arterija i vena nastala posle povrede izazvane vatrenim oružjem, oštrim predmetima ili eksplozivnim sredstvima. Gotovo 50% svih AV fistula nala-

zi se na ekstremitetima. Pri postavljanju dijagnoze, osim istorije povrede, kliničkom slikom dominiraju palpabilni tril, auskultatorno neprekidni zvuci na mestu fistule, edemi ekstremiteta, ishemijska distalna od fistule, izraženi varikozni sindrom, kao i bilo koji znak opterećenja desnog srca kod visokoprotoknih fistula. **Prikaz bolesnika.** Prikazali smo bo-

lestnika, u dobi od 32 godine, koji se samoranio u desnu nogu 2005. godine u lovu. Istog dana bolesnik je operisan u traumatološkoj zdravstvenoj ustanovi tercijalnog nivoa sa dijagnozom *vulnus sclopetarium femoris et cruris dex*; AV fistula *reg popliteae, fractura cruris dex*. Urađena je operacija ligatura AV fistule, *reconstructio a. popliteae cum T-T anastomosis*; fasciotomija *cruris dex*. Postoperativno, kod bolesnika razvila se multipla AV fistula u zoni femoralne i poplitealne arterije i okolnih vena. Bolesnik je još dva puta operisan zbog zatvaranja fistule, ali bez uspeha. Tri godine posle povrede bolesnik je upućen u Klinikum za vaskularnu hirurgiju Vojnomedicinske akademije, Beograd, Srbija. Na pregledu, prilikom prijema uočen je edem desne butine, upadljive proširene vene i tril, znaci induracije kože i početna ishemija sa ulceracijama na desnoj potkolenici, kao i mnogobrojni ožiljci sa unutrašnje strane noge, od prethodnih operacija. Zbog opterećenja desnog srca dolazilo je do lakog zamora, tahipneje i tahikardije. Na CT i kontrastnoj angiografiji potvrđeno je prisustvo multiplih traumatskih AV fistula na površnoj femoralnoj i poplitealnoj arteriji i okolnim venama, sa najve-

ćim prečnikom od 1 cm. Takođe, bile su prisutne i mnogobrojne metalne kuglice – lovačka sačma. Posle preoperativne pripreme pod lokalnom infiltrativnom anestezijom izvršena je transfemoralna endovaskularna rekonstrukcija površne femoralne i poplitealne arterije primenom stenta Viabahn 6 × 50 cm i ekskludera PXL 161 007. U neposrednom postoperativnom toku došlo je do znatnog smanjenja edema noge i prestanka trila i, kasnije, izlječenja ulceracija i nestanka znakova ishemije stopala. Takođe, normalizovali su se srčana i disajna funkcija. **Zaključak.** Kod bolesnika sa hroničnim traumatskim AV fistulama u femoropoplitealnoj regiji, naročito sa multiplim fistulama, zlatni standard predstavlja njihova endovaskularna rekonstrukcija koja, kao minimalno traumatska i invazivna, omogućava ne samo kompletnu rekonstrukciju, već i očuvanje integriteta i distalne i proksimalne cirkulacije noge.

Ključne reči:

arteriovenska fistula; noga, povrede; lečenje; hirurgija, vaskularna, procedure; stentovi.

Introduction

Traumatic arteriovenous (AV) fistula is a pathologic communication between arterial and venous blood flow due to a penetrating injury, mostly caused by firearms, sharp objects or blasting agents^{1, 2}. Also, AV traumatic fistula could be caused by fracture of other bones of extremities when sharp fragments of bones lead to laceration of neighboring vascular structures^{3, 4}, sport activities^{5, 6}, and, less frequently, after orthopedic injuries⁷⁻⁹.

To make the diagnosis of traumatic AV fistula, except for adequate anamnesis and physical examination it is required to do color duplex scan, CT angiography, as well as classical angiography. It is significant to note that these diagnostic procedures do not exclude one another, but, on the contrary, they complement each other, and help in making a final plan for the treatment method of patients with traumatic AV fistula¹⁰.

The therapeutic strategy before the endovascular era included artery reconstruction or ligation with autologous material, external compression^{11, 12}, coil embolization, or echo-guided thrombin injection^{13, 14}.

Parodi et al.¹⁵ and Marin et al.¹⁶ have described the treatment of complex peripheral lesions with satisfactory results for arterial injuries of the arms and the neck.

Case report

A 32-year-old patient referred to the Clinic for Vascular Surgery, Military Medical Academy (MMA), Belgrade, Serbia due to additional diagnostics and surgical treatment of traumatic AV fistula in the right lower limb.

The patient had himself-injured by accident during hunting three years before. Then the patient was primary managed in another institution under the diagnosis: *Vulnus sclopetarium femoris et cruris dex*; AV fistula of the right lower extremities; Fracture of the right tibia. The then per-

formed operation was: ligation AV fistula; reconstruction of popliteal artery with end to end anastomosis; *fasciotomia*.

After that, the patient was hospitalized two more times and operated in specialized vascular surgery institution. Due to the presence of traumatic AV fistula in the right lower limb the patient was firstly operated: ligation of multiple AV fistula transvenosum. Next, due to further presence of AV fistula in the right lower and upper limb regions the surgery was performed new operation: ligation AV *fistulae et ligation posterior tibialis artery*. The patient was then dismissed from the hospital with a further verified presence of traumatic multiple AV fistula in the right leg.

At admittance to the Clinic for Vascular Surgery of MMA, the patient was in the vascular condition as follows: the right leg extensively voluminous, almost of two times higher circumference than the left leg, with the presence of palpable thrill and auscultator sounds along the whole upper limb and the dilated surface veins of the upper limb. The pulse was weaken, in the anterior tibial artery, in the right foot, while pulse posterior tibial artery was not palpable at all. The skin in the right lower limb was dark, indurate, having a blistering ulceration at the medial side. The foot was cool, livid – discolored. The patient got tired after a few steps, showing the signs of tachycardia and tachypnoea. A radiogram showed the presence of cardiomegaly in the right heart.

The performed diagnostic procedures, color duplex scan, MSCT angiography and classical angiography confirmed the presence of multiple post-traumatic AV fistula within the area of distal third of the right superficial femoral artery, as well as the popliteal artery and the neighboring deep veins (Figures 1 and 2). The largest of the fistula had the diameter of about 10 mm, while many of them up to 2 mm both distally and proximally from it. There was also dilatation of the superficial femoral artery above the site of the most proximal fistula, having the diameter of about 12 mm at that site, as well as the occlusion of the tibial posterior

artery. The popliteal artery diameter below the site of the most distal fistula was 5 mm. In the soft tissues of the upper and lower leg, and in the knee joint there were numerous foreign bodies – metallic balls (lead rounds).



Fig. 1 – The artery and veins with multiple arteriovenous (AV) fistulas

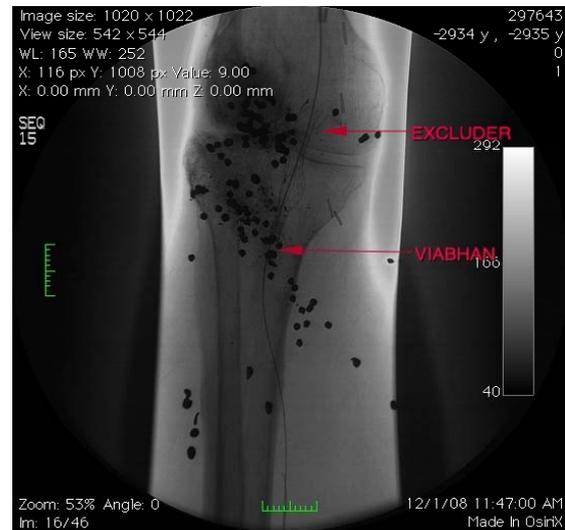


Fig. 3 – The placed stent grafts

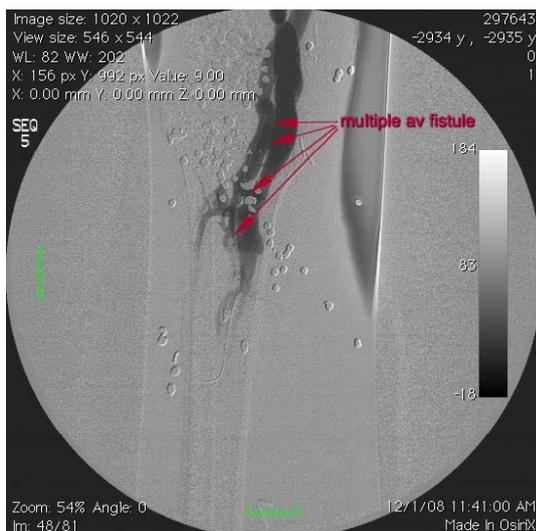


Fig. 2 – Multiple arteriovenous (AV) fistulas

After the adequate preoperative procedure, with local infiltrative anesthesia and transfemoral approach under radiography control endovascular surgery was performed: endovascular reconstruction of superficial femoral artery and popliteal artery with Viabahn and excluder stent graft.

After local anesthetic administration (2% xylocain 20 mL) in the right femoral area, firstly was done open approach to the right common femoral artery to a typical site. Then, puncture was made to the artery complete with placing a catheter for angiography to identify a site of most proximal and most distal AV fistula (Figure 2). The first to place was a Viabahn stent graft 6 × 50 mm through a dilators of 7 Fr, and after that was placed excluder-iliac extender stent graft

PXL 161007 through a dilator of 12 Fr with overlapping of the two stents for 1 cm so that the distal portion of the excluder was placed in the proximal part of a viabahn stent graft (Figure 3). Each of the placed stent grafts were of Gore-Tex production.

A control angiography showed a complete reconstruction of superficial femoral artery and popliteal artery, as well as transient anterior tibial artery up to the foot, while the deep and superficial venous system was not presented – there is no signs of AV fistula (Figure 4).



Fig. 4 – The reconstructed arteries (superficial femoral artery and popliteal artery)

Nearly after the surgery a significant reduction of edema of the leg occurred and disappearance of thrill and auscultator sound, and, later, initial healing of ulceration started and disappearance of the signs of the foot ischemia (Figure 5).



Fig. 5 – The leg after surgery

Control examination after six month (including CT angiography) showed that there was no more AV fistulas (Figure 6). The right leg was absolutely with normal function.



Fig. 6 – The knee: X-ray image after the surgery

Discussion

In the era of daily increase in traffic traumas and peacetime injuries with firearms and side arms, there are more often injuries of the vascular structures, especially lower extremities. As complication of the said due to inadequate open surgical reconstruction of the blood vessels there appear traumatic AV fistulas. Any next surgery, the so-called redo operation, is especially difficult due to fibrous tissue that forms around blood vessels after previous interventions. Also, there is a possibility of disturbing integrity of walls of the blood vessels provoking further complications².

The incidence of AV fistulas in blood vessels injuries ranges from 2.3% to 3.9% according to the published large series worldwide. According to the Vietnam Vascular Register, out of 7 500 war injuries of blood vessels 262 patients

had traumatic AV fistulas that is 3.5%¹. The incidence of AV fistulas in civilian vascular injuries was similar: 6 (2.3%) of 256 injuries in a review by Patman et al.¹⁷ and 7 (3.6%) of 192 patients in a review by Sirinek et al.¹⁸. The most frequent localization of traumatic AV fistula are lower extremities, in almost 50% of cases, out of which injuries of femoral blood vessels with AV fistulas are present in 17% of cases^{2,16}. The second place is taken by the region of the neck with carotid blood vessels, and then the head (carotid-cavernous fistulas)¹⁷.

Clinical image of traumatic AV fistula in the extremities is dominated by the presence of palpable thrill and auscultation systolic-diastolic sounds in the skin above a fistula, as well as a visible scar from injury. Then, there is a pulsate mass, dilated surface veins of the extremities, weaken artery pulse distally to the site of fistula, edema of the extremities, while in chronic fistulas there is a possibility of skin indurations, ulceration, even ischemia of the extremities followed by gangrene. Also, there is a possibility of positive Branham-Nicoladoni sign: manual compression to the artery prior to a fistula leads to arterial excitement of baroreceptors due to sudden reduced inflow of blood in the right heart, and, thus, to the subsequent bradycardia and hypotension^{1,2,19}.

In the literature, the combined endovascular treatment of AV fistula has been reported for different large arterial territories, including iliac, subclavian, and carotid arteries. Good early and midterm results have been described. To treat pseudoaneurysms or AV fistulas of the popliteal artery, the surgical approach has been preferred even recently, with direct ligation of the injured vessel or reconstruction of the vessel wall².

Following the development of new technological and technical accomplishments in vascular surgery, including stent grafts, solving that kind of problems is possible by the use of endovascular approach. It means that a site of problem in the blood vessel (AV fistula, aneurysm) is approached through the blood vessel itself, but at the site at which it is not damaged, thus avoiding approach through scary tissue^{5,20}. So, endovascular reconstruction of a blood vessel is minimally invasive and traumatic to a patient. Endovascular reconstruction itself requires determination of appropriate stent size to be placed in accordance with a precise determination of blood vessel size through CT angiography. It is primarily referred to the necessity to fix a stent graft in its distal and proximal part to a healthy wall of the artery (so-called neck) along minimally 10 mm in order to prevent migration of a stent graft.

The current problem is an unavailable conus stent graft for major arteries that is stent grafts with lumen diameter that uniformly reduces from proximal to distal end. This problem we solve by simultaneous application of both, excluder iliac extender and Viabahn stent graft (made by Gore-Tex) by interposing one in another. Furthermore, as innovations in stent technology evolve, there will probably be more flexible, longer, and less thrombotic and immunogenic stents available in the near future.

Conclusion

In patients with post-traumatic AV fistulas in the femoral-popliteal or another region, particularly in multiple fistulas and redo operation endovascular treatment is safe, simple, and less traumatic. Procedure should be applied when it is technically feasible, taking into account the findings as well as local extensiveness of AV fistulas.

Endovascular treatment provides a complete reconstruction and maintaining integrity of both distal and proximal blood flow in the extremities.

Consequently, the success rate and efficacy of endovascular treatment of peripheral AV fistulas and pseudoaneurysms shall rise.

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