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Endovascular treatment of abdominal aortic aneurysm with a short proximal neck using endoanchors – case report

Wewnątrznaczyniowe leczenie tętniaka aorty brzusznej o krótkiej proksymalnej szyi przy użyciu wewnątrznaczyniowych wkrętów – opis przypadku

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Słowa kluczowe

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Summary

Endovascular treatment of the abdominal aortic aneurysm in case of adverse anatomical features of the proximal aneurysmal neck, still represents a major therapeutic challenge. Although, endovascular aortic repair (EVAR) compared to open surgery repair is characterized by a reduced perioperative mortality, the reintervention incidence after EVAR is still higher than after open surgery repair. One of the main reason of that result is an increased risk of type Ia endoleak development and/or the stentgraft migration after the endovascular treatment when unfavorable anatomy is present. From among many of techniques which are used in the treatment of AAA with a "hostile neck" anatomy, the results of the stentgraft fixation with the endoanchors seem to be particularly encouraging. The assumption of this technique is to combine the advantages of minimally invasive endovascular procedure with the durability of an open surgery repair. The aim of this article is to report the case of the successful endovascular treatment of symptomatic, unruptured abdominal aortic aneurysm with a short proximal neck using endoanchors.

Streszczenie

Leczenie wewnątrznaczyniowe tętniaków aorty brzusznej (TAB) wciąż stanowi duże wyzwanie terapeutyczne w przypadku występowania niekorzystnych cech anatomicznych proksymalnej szyi tętniaka. Mimo że w porównaniu do otwartej operacji naprawczej leczenie wewnątrznaczyniowe TAB cechuje się zmniejszoną śmiertelnością okołooperacyjną, ilość reinterwencji jest wciąż wyższa po leczeniu wewnątrznaczyniowym. Jedną z głównych przyczyn jest zwiększone ryzyko wystąpienia zacieku typu Ia i/lub migracji stentgraftu w związku z obecnością niekorzystnych cech anatomicznych proksymalnej szyi tętniaka. Spośród wielu technik leczenia stosowanych w powyższym przypadku, wyniki mocowania stentgraftu przy użyciu wkrętów wewnątrznaczyniowych wydają się szczególnie obiecujące. Założeniem tej metody jest połączenie zalet małoinwazyjnego leczenia wewnątrznaczyniowego z trwałością otwartej operacji naprawczej. Celem pracy jest przedstawienie opisu przypadku leczenia objawowego pacjenta z niepękniętym TAB o krótkiej proksymalnej szyi, przy użyciu wkrętów wewnątrznaczyniowych.

INTRODUCTION

Abdominal aortic aneurysm (AAA) is a localized enlargement of the abdominal aorta to the diameter ≥ 30 mm. The prevalence of AAA is estimated to 1.3-12.5% in men and 0-5.2% in women. AAA formation known risk factors are age (prevalence significantly increases with age, especially > 65 years old), male, family history of AAA, smoking, hypercholesterolemia and hypertension (1, 2). Unruptured AAA symptoms may include atypical abdominal or back pain, and sometimes a palpable pulsatile abdominal mass. However, in most cases a course of the disease is asymptomatic until rupture of AAA. Then an acute abdominal pain and shock usually occur.

According to the European Society of Cardiology Guidelines on the diagnosis and treatment of aortic diseases from 2014, ultrasonography (US) is a recom-

mended AAA screening examination. Screening for AAA with US is recommended in all men > 65 years of age, may be considered in woman > 65 years of age with a history of tobacco smoking. CT and MRI are the reference methods for pre- and postoperative assessment of AAA. Aortography may be a useful imaging modality, if CT and MRI results are unclear and ambiguous.

AAA repair is indicated if it's diameter exceeds 55 mm or an aneurysm growth exceeds 10 mm/year (3). Although endovascular aortic repair (EVAR) is a safe, effective, and currently the most widely used AAA treatment method, there are still issues which need to be resolved to significantly improve this treatment (4). EVAR compared to open surgery repair is characterized by a reduced perioperative mortality, but the reintervention incidence after EVAR is still higher than after open surgery repair. Additionally, results of many studies indicate that the difference in mortality rate between EVAR and open surgery is reduced in a few years after the treatment (5). Successful endovascular treatment depends largely on the anatomical factors. The presence of an unfavorable anatomy like proximal aneurysmal neck length < 10 mm, diameter > 28 mm and angle > 60 degrees, conical shape, calcification or thrombus thickness > 2 mm covering > 180 degree of the circumference of the aorta belong to the adverse anatomical features. This challenging proximal aortic neck anatomy is called a "hostile neck". This condition reduces the efficacy of endovascular treatment and predisposes to the stentgraft migration and/or increases the risk of type Ia endoleak development, blood inflow between the stentgraft and the aortic wall in the proximal landing zone (6, 7).

A variety of techniques are used in the treatment of AAA with a "hostile neck" anatomy. In order to adjust to the anatomical variability a suprarenal bare stents, stentgrafts with barbs and hooks, fenestrated stentgrafts, chimney graft technique or polymer-injected sealing rings have been deployed over the years (8, 9).

The idea of combining the advantages of minimally invasive endovascular procedure with the durability of an open surgery repair has led to the emergence of endovascular staples, also called endoanchors. The endoanchor objective is to tack the stentgraft through all three layers of the aortic wall. The aim is to provide the durability of the stentgraft fixation similar to that obtained with a sutured anastomosis during open surgery repair (10).

CASE REPORT

AAA was detected accidentally during the ultrasound examination of the 64 years old patient. Initially the aneurysm diameter was approximately 40 mm. Surveillance US examination performed after the 6 and 12 months revealed an aneurysm diameter increase to 50 mm. Another US examination performed because of the emergence of an abdominal pain, further expansion of the sac to 65 mm in diameter and tenderness during the pressure with a probe was observed.

Patient was sent to a vascular surgeon and an urgent CT angiography was performed. Due to the systematic enlargement of the AAA sac and the presence of abdominal pain during physical examination the patient was qualified for urgent stentgraft implantation.

CT angiography revealed a short aneurysmal neck and a thrombus placed on the right and anterior side of the aortic wall just below the renal arteries, comprising approximately 40% of the circumference of the abdominal aorta (fig. 1a, b). Moreover, the CT angiography presented a thrombus defect ("thrombus ulceration") on the anterior wall of the AAA and an aneurysmal dilatation of the right common iliac artery proximal to the iliac bifurcation with a diameter of approximately 28 mm harbouring a small mural thrombus (fig. 1c). There were no obvious imaging features of the aneurysm rupture.

Based on the described CT angiography images, which presented a short conical neck and a thrombus in the neck, it was found that the implantation of a standard stentgraft entails the possibility of type Ia endoleak development already during the procedure and if not, high risk of distal migration of the stentgraft in the future. Due to the young age of the patient and a favorable renal arteries anatomy, a fenestrated stentgraft implantation was considered. However, because of the AAA pain symptoms the plan was abandoned because of the required waiting time of at least 4 weeks to receive the "custom-made" fenestrated stentgraft. Therefore, the patient was offered a standard Zenith (Cook

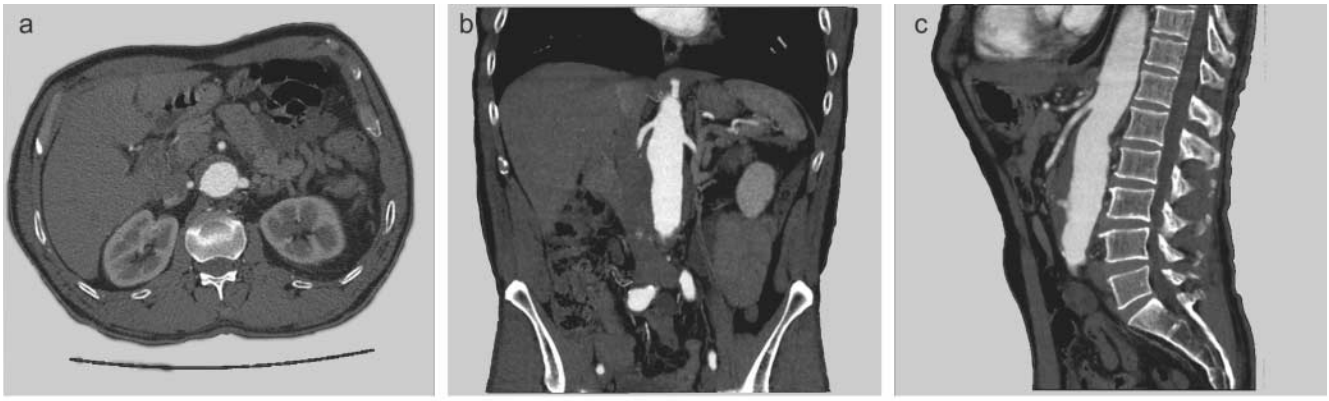

Fig. 1a-c. Images of CT angiography before the treatment: a) a thrombus visible just below the renal arteries on the right side of the abdominal aorta; b) a short length and a conical shape of the proximal aneurysmal neck; c) a thrombus defect visible on the anterior wall of the AAA in the sagittal projection

Inc., Bloomington, IN, USA) stentgraft implantation with endoanchors to fix the stentgraft to the aortic wall. The Zenith stentgraft was chosen due to its design – a suprarenal fixation (bare stent with hooks), which reduces the risk of type Ia endoleak and a stentgraft migration.

The procedure was performed typically under conduction anesthesia after bilateral surgical preparation of femoral arteries in the groins. A covered part of the stentgraft was placed just below the left renal artery, which was the lower one. Then, the suprarenal portion of the stent, which is not covered with graft fabric, was released above the renal arteries. In the next step iliac legs of the stentgraft were deployed – the orifice of the right internal iliac artery was covered due to the concomitant right common iliac artery aneurysm, on the left side the distal sealing zone of the left iliac leg was located proximal to the left iliac bifurcationc (fig. 2a-c).

Thereafter, the Heli-FX system (Aptus, Medtronic) was used. From the right femoral access, a steerable sheath for the endoanchor deployment was introduced through the lumen of the stentgraft. The tip of the sheath was placed perpendicularly to the wall of the stentgraft. Then an endoanchor applier was introduced several times and the endoanchors implanted. The endoanchors were implanted mostly on the left and the posterior side of the stentgraft (fig. 2d-f). Due to the presence of a thrombus, the stentgraft was not tacked on the right and anterior side.

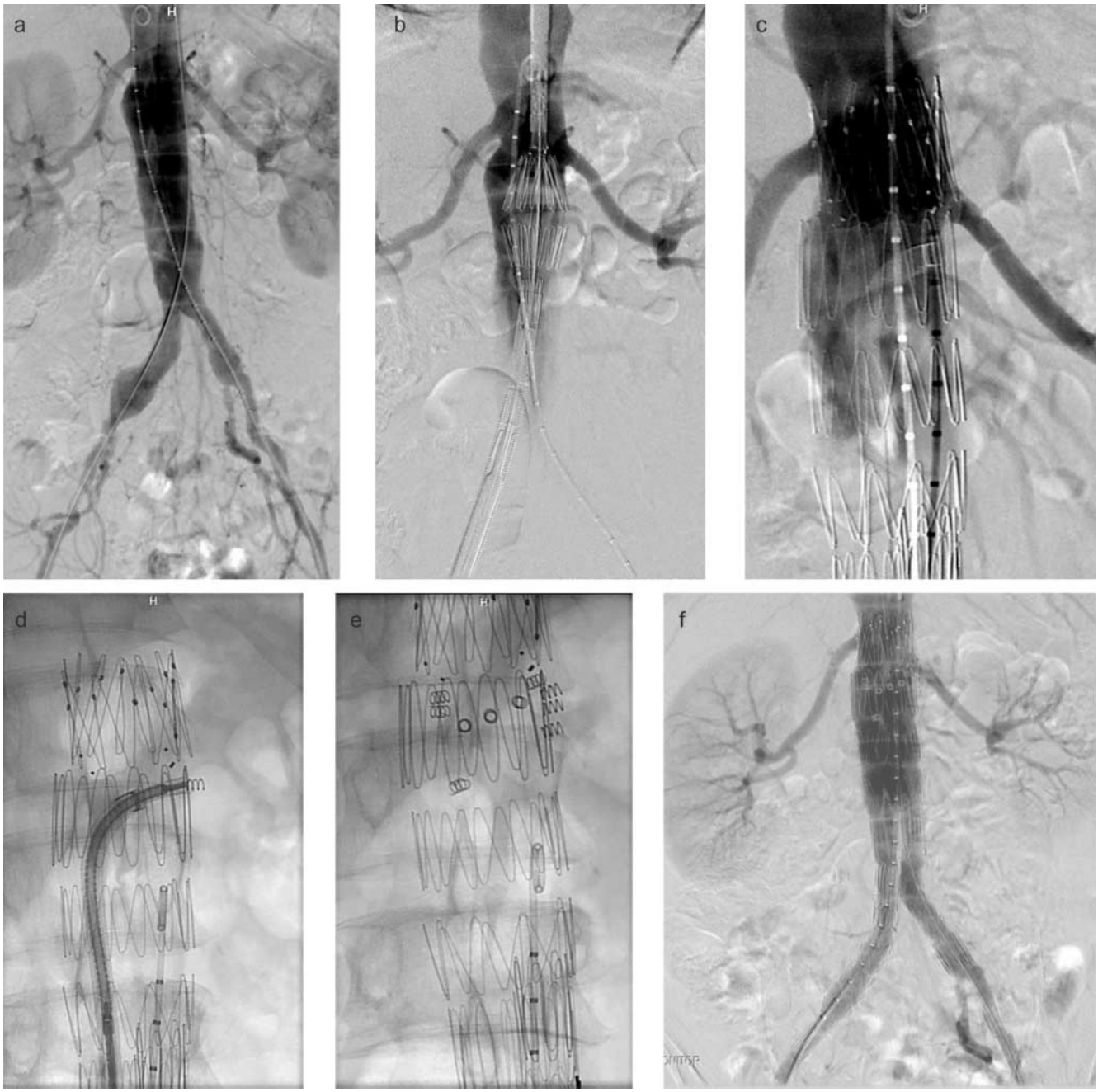

Fig. 2a-f. The stentgraft implantation procedure: a) an initial aortography with the calibrated catheter; b) the covered part of the Zenith™ stentgraft deployed just below the left renal artery; c) control aortography after the deployment of the proximal bare stent (suprarenal fixation); d) the endoanchor applier set in position – fixation of the stentgraft to the aortic wall, below the left renal artery with the first endoanchor; e) image after the deployment of all 10 endoanchors (endoanchors deployed mainly on the left and posterior side of the aortic wall); f) the final aortography – correct position, patency and robustness of the stentgraft

After the treatment the final aortography presented correct position and patency of the stentgraft, no endoleak was observed.

The patient was discharged from the hospital on the 5th postoperative day in good general condition, and no complain of an abdominal pain.

During the follow-up after 3 and 6 months, ultrasonography showed a correct position and patency of the stentgraft as well as a completely thrombus filled aneurysm sac which shrunk to approximately 47 mm (fig. 3a, b).

DISCUSSION

Endovascular treatment in case of adverse anatomical features of the proximal aneurysmal neck, still represents a major therapeutic challenge. Patients with the aneurysm features that are unfit for standard stentgrafts implantation represent up to 20% of patients with AAA. Additionally, due to the increased number of reinterventions in this numerous group of patients, methods providing the durability of the open surgical repair during EVAR are unquestionably necessary and could significantly improve the EVAR outcomes (11).

Procedures using custom-made fenestrated stentgrafts are demanding both technically and economically, further characterized by a prolonged waiting time to create and provide an custom-made fenestrated stentgraft. The use of fenestrated stentgrafts is also limited when the adverse anatomical features are present, such as target vessels diameter < 4 mm, acute take off angle of the vessels, extensive atherosclerotic disease and high aortic bifurcation (9).

In 2002, Aptus EndoSystem was founded, providing both aortic stentgraft (Aptus Endovascular AAA Repair System) and endovascular stapling system (Aptus Endostapling System). The helical shaped endoanchors are composed of a metallic alloy (MP35N LT) and measure approximately 3 mm in diameter by 4.5 mm in length. The HeliFX Aortic Securement System include a 16F/18F Aptus Guide with deflectable tip (a steerable sheath) and an Aptus Applier with a two-stage endoanchor deployment system controlled electronically which allows potential for repositioning of the endoanchor in a different spot when necessary. Stentgrafts that are approved both in Europe and in the USA to be used with endoanchors are Aptus aortic endograft (Aptus Fortevo), AneuRx (Medtronic Cardiovascular, Santa Rosa, CA, USA), Endurant (Medtronic Cardiovascular) Talent (Medtronic Cardiovascular), Excluder (WL Gore & Associates, Flagstaff, AZ, USA) and Zenith (Cook Inc., Bloomington, IN, USA) (10).

In 2005, in Venezuela Drs. Jose Condado, David Deaton, and Takao Ohki used the Aptus Endovascular AAA Repair System for the first time for the treatment of 2 patients with AAA and unfavorable characteristics of aortic neck (first patient: neck length 5 mm, neck angulation 63 degrees; second patient: neck length 9.9 mm) and achieved successful outcomes without any stentgraft migration evidence or other complications associated with stentgraft implantation (12).

The results of 2 clinical trials a STAPLE-1 (July 2006 to May 2007) and a STAPLE-2 (September 2007 to May 2009) have demonstrated the safety and efficacy of Aptus endostapling system during the 5 (STAPLE-1) and 3 (STAPLE-2) years follow-up. In the process of the studies, a total of 176 patients were treated with a total of 906 endoanchors deployed. During the follow-up, elongation of the aortic neck was reported in 3 patients, without migration of the stentgraft. In 1 patient the stentgraft migration occurred, which was probably due to the presence of a blood clot in aortic aneurysm neck and insufficient endoanchor fixation in a pathological tissue as a result. Two out of 906 implanted endoanchors migrated into the circulation, but were removed using snares and other devices (13).

The results of the subsequent research – ANCHOR study reported by Jordan et al. also show the high effectiveness of this method both in the primary treatment and during the revision. During the primary treatment endoanchors are deployed when there

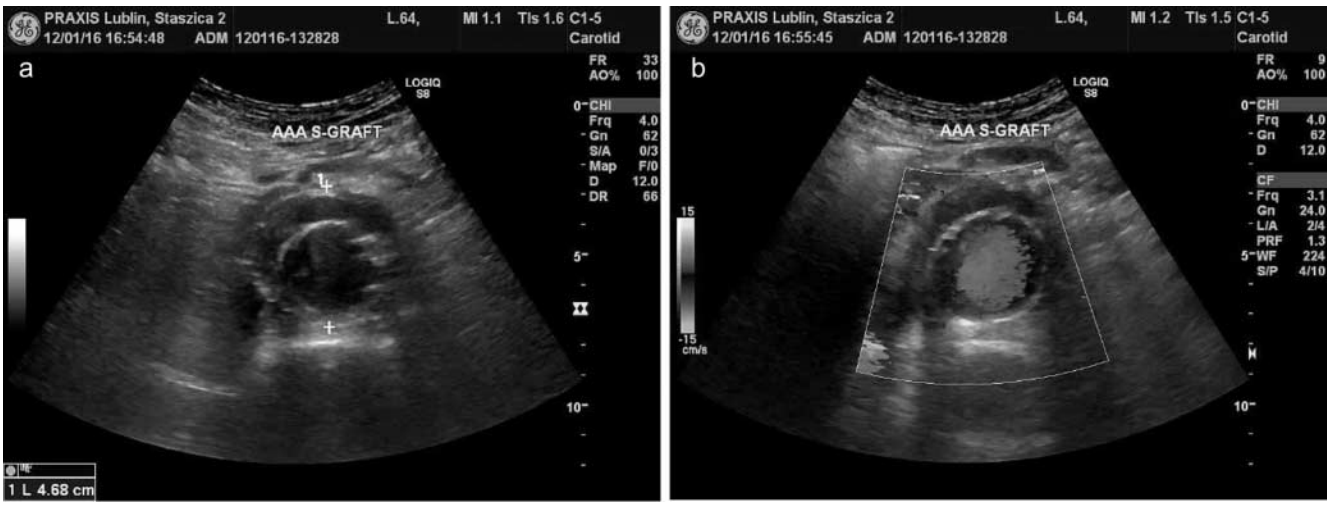

Fig. 3a, b. Doppler US examination 6 months after the treatment: a) B-mode image presenting the stentgraft inside the AAA sac, maximal aneurysm sac diameter of 4.68 cm; b) color Doppler US image – no features of an endoleak in the AAA sac

is a high risk of the type Ia endoleak development and/or stentgraft migration, or when these complication already appear during the primary procedure. Endoanchors are used for the reintervention when mentioned complications are presented during the follow-up examination after the primary treatment. Out of the 319 patients enrolled in the study till December 2013 in 84.1% of patients criteria of hostile neck were present. Reinterventions after primary treatment with endoanchors were performed in 4.5% of patients. Reinterventions after the revision with endoanchors were performed in 14% of patients. A mean follow-up was 16 months (2014 Jordan Results of the ANCHOR). In the next stage of the ANCHOR study another 100 patients were enrolled to July 2014 and followed for one year. There were 73 patients treated initially and 27 in the revision. Aneurysm-related reinterventions were performed respectively in 6 and 15% of patients (8, 14).

The initial course of the AAA is usually asymptomatic and patients are often diagnosed accidentally during imaging examination, same as it was reported in the present case. However, according to the literature, screening for AAA in men > 65 years of age is recommended and cost-effective. Significant enlargement of the aneurysm during surveillance US examinations, aneurysm diameter of approximately 65 mm, and the emergence of AAA symptoms were the reasons to submit the patient for the treatment. Due to the short proximal aneurysmal neck, and the presence of a thrombus just below the renal arteries take off, endoanchors were used to improve proximal fixation and to reduce the risk of type Ia endoleak and/or migration of the stentgraft (2).

Although, the final results of the studies assessing the efficacy of endoanchors will come out in a few years, the initial results of this method are promising.

CONCLUSIONS

Implantation of endoanchors improves the proximal stentgraft fixation in patients with AAA and in cases of an increased risk of type Ia endoleak development and/or the stentgraft migration due to the unfavorable anatomical features of the proximal aneurysmal neck offer an attractive solution.

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