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Case Report / Olgu Sunumu

Treatment of outflow graft stenosis in left ventricular assist device patients: Endovascular approach

Sol ventrikül destek cihazı olan hastalarda çıkış grefti stenozunun tedavisi: Endovasküler yaklaşım

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ABSTRACT

Left ventricular assist device outflow graft stenosis is a rare, but a lethal complication. Device replacement or thrombolytic treatments are associated with serious mortality and morbidity. Implantation of covered stents is a less invasive option. Herein, we represent a successful stent placement of two cases with outflow graft stenosis, which we performed by leaving the stents on the aortic side of the anastomosis line 5 to 10 mm. This treatment option can be used reliably in cases of stenosis of the outflow graft with part of the stent leaving the aorta.

Keywords: Left ventricular assist device, outflow stenosis, stent, thrombosis.

ÖZ

Sol ventrikül destek cihazlarındaki çıkış greftinin stenozu nadir, ancak ölümcül bir komplikasyondur. Cihaz değişimi veya trombolitik tedaviler, ciddi mortalite ve morbidite ile ilişkilidir. Kaplı stent implantasyonları daha az invazif bir seçenektir. Bu yazıda, stentleri anastomoz hattının 5 ila 10 mm aortik tarafta bırakarak gerçekleştirdiğimiz çıkış greft stenozu olan iki olgunun başarılı stent yerleştirilmesi sunuldu. Bu tedavi seçeneği, çıkış grefti stenozunda stentin bir kısmı anastomozun aortik kısımda bırakılarak güvenli olarak uygulanabilir.

Anahtar sözcükler: Sol ventrikül destek cihazı, çıkış stenozu, stent, tromboz.

Stenosis in outflow graft in patients with left ventricular assist device (LVAD) is an important complication. The approach involves thrombolytic drug administration or device exchange according to the clinical presentation and the presence of thrombus formation.[1]

In this article, we present a successful endovascular intervention in two cases with stenosis located near the aortic anastomosis of the outflow graft.

CASE REPORT

Case 1- A 54-year-old male patient who underwent HeartWare® (Medtronic Inc., MN, USA) implantation in May 2013 due to dilated cardiomyopathy (DCM) was followed without any complaints after discharge. Six years later, he was admitted to our clinic with shortness of breath and pump alarm. The international normalized ratio (INR) was 2.7. The LVAD flow was 1.9 to 2.2 L/min with 2,600 rpm, power was 3.6 Watt, and lactate dehydrogenase (LDH) (normal range: 120 to 246 U/L) was 680 U/L. Hematocrit, white blood cell, and platelet counts were 32%, 9,200/μL, and 250,000/μL, respectively. There was no infection. Transthoracic echocardiography (TTE) revealed no intracardiac thrombus, and aortic valve opening was seen in every heartbeat. Computed tomographic angiography (CTA) revealed thrombosis in the outflow graft at the aortic anastomosis level (Figure 1a). Initially, the tissue plasminogen activator was administered. Although device parameters returned to normal values, in a short period of time,

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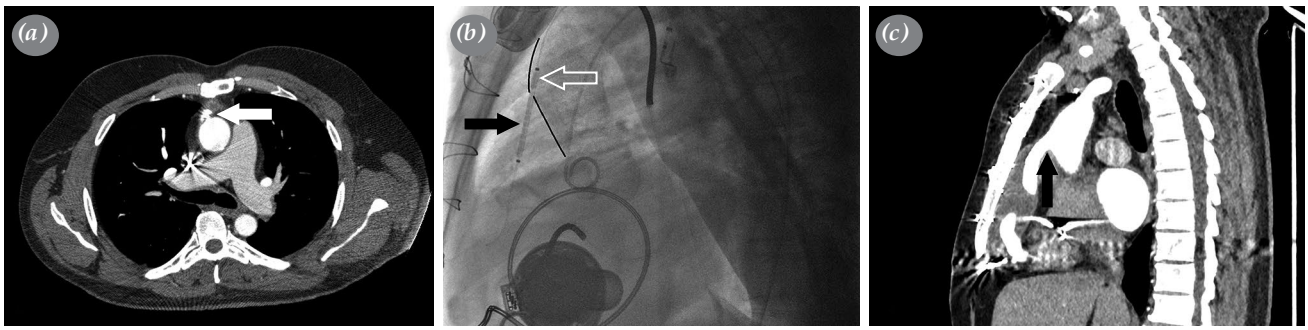


Figure 1. (a) Before stent implantation. White thick arrow indicates outflow graft thrombosis and severe stenosis on aortic anastomosis level. **(b)** Stent implantation. Angiographic view of the unopened stent's extension to aorta during implantation. 5 to 10 mm of stent was left in aorta (arrow). Thick arrow indicates main stent body left in outflow graft. **(c)** After stent implantation. Thick arrow indicates opened outflow graft-aorta anastomosis.

the device parameters again dropped down the level of the admission level. In this case, we decided to perform outflow graft stenting. A written informed consent was obtained from the patient.

Under local anesthesia, after the administration of 5,000 units of unfractionated heparin, the femoral arteries were accessed bilaterally with sheaths via the Seldinger technique and, from the right side, a 5Fr pigtail catheter (Terumo Corporation, Leuven, Belgium) was placed to the ascending aorta. Angiography was performed. The LVAD pump speed was reduced gradually. From the left groin, a 0.035-inch guidewire (Terumo Corporation, Leuven, Belgium) and a 5Fr vertebral catheter (Terumo Corporation, Leuven, Belgium) were used to navigate into the outflow graft across the stenosis. The pump was stopped temporarily and a 10×38-mm balloon expandable covered stent (Atrium Medical Corp., NJ, USA) was subsequently placed across the stenosis and post-dilated with a 12-mm balloon. The LVAD was set to its original settings. Approximately 5 to 10 mm of the stent was left in the aorta and did not cause any problems in hemodynamics (Figure 1b). The pump parameters returned to the normal values. No neurological or occlusive vascular injury was detected in the early post-procedural course.

Follow-up CTA confirmed the patency and proper positioning of the stent (Figure 1c). Outpatient visits of the patient were uneventful and, six months later, the patient was bridged to heart transplant and he is still alive.

Case 2- A 62-year-old male patient with DCM who underwent HeartWare® (Medtronic Inc., MN, USA) implantation three years ago was admitted to our clinic. His complaint was progressive fatigue and the pump was found to be on low-flow alarm. The INR was within the therapeutic range. The LVAD flow was fluctuating between 1.1 and 1.4 L/min, power

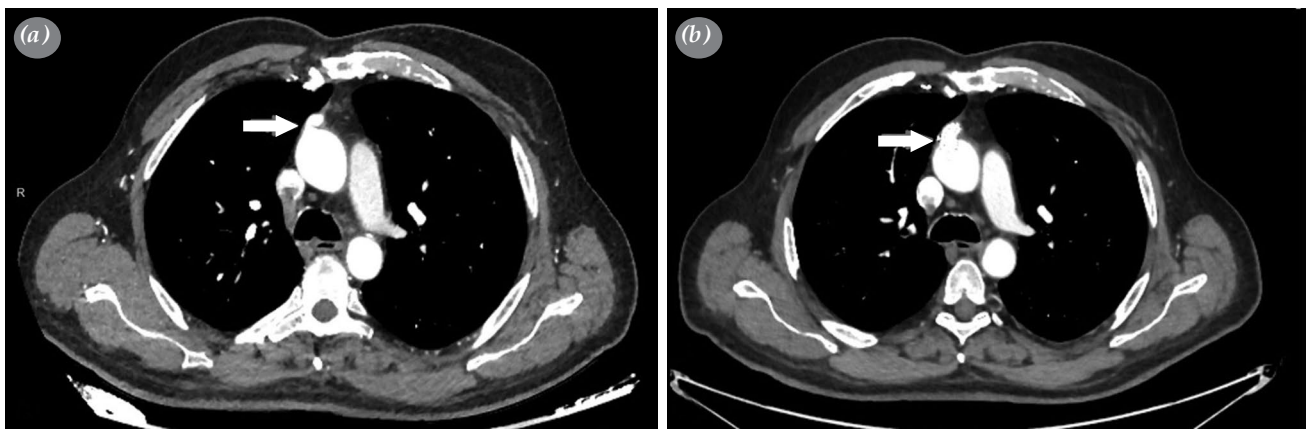


Figure 2. (a) Before stent implantation. Arrow indicates outflow graft severe stenosis on aortic anastomosis level. **(b)** After stent implantation. Arrow indicates opened outflow graft-aorta anastomosis.

was 2.8 Watt, and LDH was 283 U/L. No infectious process was seen. The TTE examination revealed no signs of intracardiac thrombus and aortic valve opening was seen in every heartbeat. The CTA did not reveal inflow cannula obstruction, but yielded severe stenosis in the outflow graft at the aortic anastomosis level as in the previous patient (Figure 2a). The same stent implantation procedure (10×38-mm balloon expandable covered stent, Atrium Medical Corp., NJ, USA) was performed. The pump settings had reached the normal level (3.8 L/min, 4.2 Watt on 2,700 rpm). On follow-up CTA, there was no residual stenosis (Figure 2b). Six months later, the patient remained free of symptoms and without evidence of device dysfunction or neurological event.

DISCUSSION

Stenosis in the outflow graft may be due to a thrombus or kinking which causes positional change of the heart with ventricular remodeling.[2] Medical thrombolysis or surgical replacement of the device are the treatment options. However, surgery, itself, bears a high risk. Therefore, endovascular interventions may be a feasible alternative for these patients.[3,4]

Hemolysis parameters are very valuable in pump thrombosis. In our clinical practice, blood samples measuring the LDH levels are taken from all patients with changes in pump parameters and TTE is routinely performed. In addition, log-files are imported to examine long-term parameter changes and should be sent to the manufacturer for elaboration of the data. The definitive diagnosis was made using CTA in both cases.

Stenosis in the shaft of the outflow graft is usually seen within the first three years and stenosis can be treated with endovascular interventions.[4,5] In previous cases, all the stents were left within the outflow graft (not extending beyond the graft). In our first case, a very late thrombotic stenosis was encountered six years after LVAD implantation. Since the stenosis was close to the aortic anastomosis line in both cases, the stents were extended to the aorta and did not cause a hemodynamic problem during follow-up.

Pump thrombosis is a common complication in LVAD patients. Although outflow graft stenosis is rarely seen, it can be distinguished from thrombosis in the impeller with different values in the pump settings. In-impeller thrombus, power consumption is expected to increase significantly and, in a given speed, the pump flow is increased falsely. Contrary, in case of outflow graft thrombosis, power consumption and pump flow are reduced. In these patients, it is of utmost importance to perform differential diagnosis correctly in terms of whether there is a thrombus in the impellers or not.

Thromboembolism is one of the most threatening complications of endovascular treatment of outflow graft thrombosis. Some methods have been used in the literature to prevent this complication such as a balloon occluder, embolic filter, or manual compression.[5-7]

In conclusion, in case of outflow graft stenosis which is close to the anastomosis line accompanied by in-device thrombus, endovascular intervention, in addition to thrombolytic therapy, can be a safe alternative, if the hemodynamic parameters are stable and the device exchange is risky for the patient. In addition, when the pump output and power are low, possible stenosis of the outflow graft should be considered.

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REFERENCES

1. Goldstein DJ, John R, Salerno C, Silvestry S, Moazami N, Horstmanshof D, et al. Algorithm for the diagnosis and management of suspected pump thrombus. J Heart Lung Transplant 2013;32:667-70.
2. Abraham J, Remick JD, Caulfield T, Puhlman M, Evenson K, Ott G, et al. Left ventricular assist device outflow cannula obstruction treated with percutaneous endovascular stenting. Circ Heart Fail 2015;8:229-30.
3. Wiedemann D, Schlöglhofer T, Haberl T, Riebandt J, Dimitrov K, Schima H, et al. Interventional Treatment of LVAD Outflow Graft Stenosis by Introduction of Bare Metal Stents. ASAIO J 2018;64:e3-e7.
4. Hanke JS, ElSherbini A, Rojas SV, Avsar M, Shrestha M, Schmitto JD. Aortic Outflow Graft Stenting in Patient With Left Ventricular Assist Device Outflow Graft Thrombosis. Artif Organs 2016;40:414-6.
5. Abraham J, Remick JD, Caulfield T, Puhlman M, Evenson K, Ott G, et al. Left ventricular assist device outflow cannula obstruction treated with percutaneous endovascular stenting. Circ Heart Fail 2015;8:229-30.
6. Hubbert L, Forssell C, Baranowski J, Lindgren B, Holm J, Ahn H. Endovascular Stenting of a LVAD Outflow Graft Thrombosis. ASAIO J 2017;63:e3-e5.
7. Kemaloğlu C, Altekin RE, Bayezid Ö. First successful percutaneous treatment of a totally occluded HeartWare outflow graft: Case report and literature review. Anatol J Cardiol 2018;19:341-5.