

Intravascular ultrasound with blood flow visualization to detect pseudo intimal graft dissection as a cause of left ventricular assist device outflow graft stenosis

Łukasz Kalińczuk¹, Kamil Zieliński¹, Gary S Mintz², Jarosław Szymański¹, Małgorzata Sobieszczkańska-Matek¹, Mariusz Kuśmierczyk¹, Marcin Demkow¹

¹National Institute of Cardiology, Warszawa, Poland

²Cardiovascular Research Foundation, New York, NY, USA

Correspondence to:

Łukasz Kalińczuk, MD, PhD,
Institute of Cardiology,
Alpejska 42, 04–628 Warszawa,
Poland,
phone +48 505 794 691,
e-mail:

lukasz.kalinczuk@gmail.com

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A 54-year-old man with chronic ischemic left ventricular heart failure treated with a left ventricular assist device (LVAD; HeartMate III, Abbott Laboratories, Abbott Park, IL, USA) 5 years ago was admitted due to the exacerbation of heart failure symptoms, low-flow alarms, and an LVAD flow that had decreased to 3.8 l/min. Transthoracic echocardiography revealed a left ventricular diastolic diameter of 76 mm, an increased right ventricular systolic pressure (50 mm Hg), increased blood flow velocity to 3.7 m/s at the site of the outflow graft, and aorta anastomosis versus blood velocity of 1.5 m/s at the LVAD inflow. 384-multi slice angio computed tomography (MSCT; SOMATOM, Siemens Healthineers, Erlangen, Germany) revealed a tissue flap crossing the lumen of the outflow graft at the site of its anastomosis with the aorta where invasive angiography showed eccentric haziness and a 55 mm Hg mean pressure gradient (Figure 1 and Supplementary material, Figure S1A). Intravascular ultrasound (IVUS) manual pullback performed with a 20 MHz, 24 mm imaging field PV0.018" digital catheter (Philips Volcano, San Diego, CA, USA) and ChromaFlo (an algorithm of ultrasound that shows areas of blood flow in red) excluded thrombus formation and documented blood flow limited by an intimal flap in both true and false outflow graft lumens (Figure 1). Imaging was consistent with a pseudo intimal dissection of 2.32 cm in length narrowing the outflow graft lumen near the anastomosis site with a minimal lumen cross-sectional area of 0.28 cm² (versus distal reference lumen area of 18.3 cm²). Based

on IVUS-measured reference diameters of 13 × 16 mm, an ev3 IntraStent Large Diameter Max Stent (36 mm/12 mm; Medtronic, Minneapolis, MN, USA) was introduced through a 14 F sheath via the right femoral artery and deployed using the balloon-in-balloon catheter (16 mm/4 mm; NuMED, Hopkinton, NY, USA) covering the distal part of the outflow graft and the anastomosis and protruding by 2 mm into the aorta (Supplementary material, Figure S2A). IVUS minimal stent cross-sectional area measured 1.89 cm² (inner stent diameters of 13.6 × 15.1 mm) (Supplementary material, Figure S2A). Immediately afterward, LVAD flow increased to 4.8 l/min; and the pressure in the distal outflow graft dropped from 252 to 102 mm Hg. Transthoracic echocardiography showed a reduction of maximal flow velocity from the outflow graft to the aorta to 1.6 m/s, with an immediate decrease in left ventricular diastolic diameter to 72 mm and RVSP to 28 mm Hg, as well as improved patient symptoms. At 1-year follow-up, maximal flow velocity from the outflow graft to the aorta was 1.4 m/s, along with the durable effect of stenting seen on control angio-MSCT. Using IVUS with blood flow visualizing software, we documented the mechanism of outflow graft narrowing at the site of its anastomosis with the aorta that was associated with inner lumen presence of a hyperechogenic tissue flap caused by a localized pseudo intimal graft dissection detached from the textured inner surface of a Dacron graft. This dissection propagated in the blood flow direction with the space between the inner graft surface and

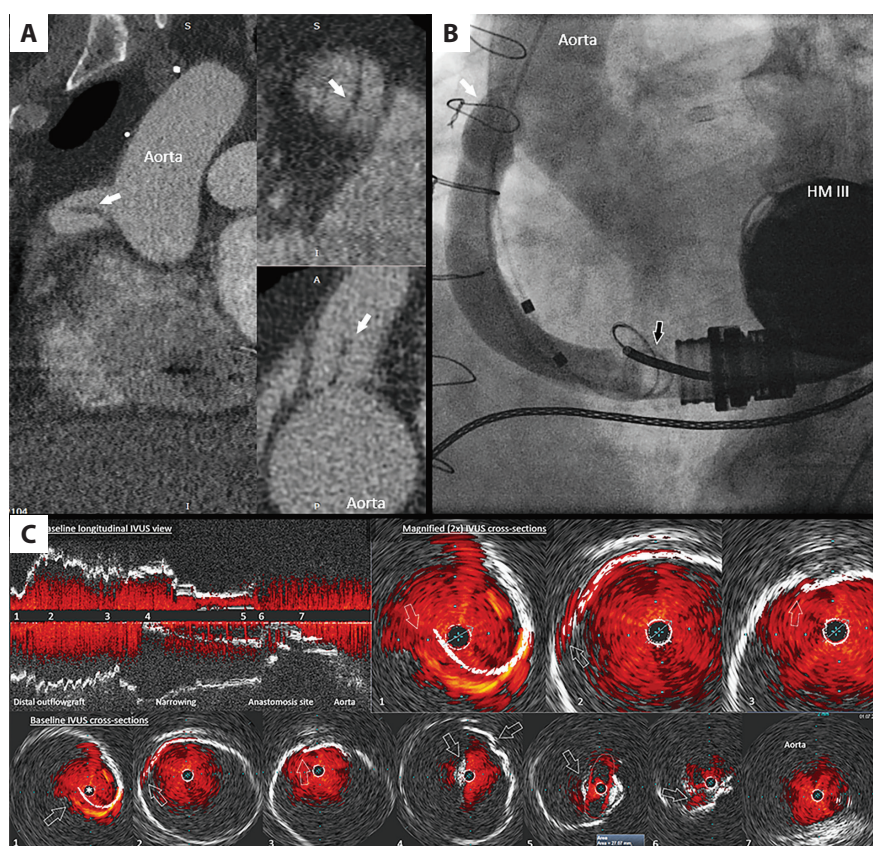


Figure 1. **A.** Baseline multi-slice angio computed tomography revealing filling defect at the site of the outflow graft anastomosis with the aorta (arrows). **B.** Corresponding invasive angiography of the entire graft length, with the marked distal position of the pigtail catheter and the anastomosis site (black and white arrows, respectively). **C.** Baseline IVUS longitudinal view of the distal outflow graft with indicated sites of the relevant cross-sections shown in the lower row (no. 1–7, correspondingly). ChromaFlo documented the presence of a distal pseudo intimal dissection near the left ventricular assist device outflow and a smaller tear in the mid outflow graft segment, not compromising the lumen (cross-sections no. 1 and no. 2, respectively, arrows). The 3rd site of the pseudo intimal dissection in the anastomosis region (cross-section no. 3) gradually increased in its size with a ChromaFlo signal seen on both sites of the occlusive flap (cross-section no. 4) with the lumen cross-sectional area narrowed to 0.28 cm² (cross-section no. 5). The presence of the blood flow in the false channel was also seen at the site of graft insertion into the aorta (cross-section no. 6)

Abbreviations: IVUS, intravascular ultrasound; HM III, HeartMate III

the flap that was filled with the flowing blood (thus not excessive tissue ingrowth, thrombus formation nor kink) [1, 2]. Using IVUS, we also documented pseudointimal ingrowth along the entire outflow graft length and identified other sites of dissection located distally, but near the LVAD outflow (Supplementary material, *Figure S2A*, cross-section no. 1), and a smaller tear (Supplementary material, *Figure S2A*, cross-section no. 2) in its mid segment that did not propagate and did not cause lumen narrowing. Using the aortic graft anastomotic device could probably stabilize more the site of increased motion, preventing pseudo intimal dissection and propagation and thus precluding occurrence of the currently presented serious late LVAD complication [3].

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

Conflict of interest: None declared.

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