



Peer-Reviewed Case Report

A Case of HeartMate 3 Outflow Graft Twisting with Extraluminal Thrombosis: Is Computed Tomography Angiography Helpful?

Karim Saleb,^{1*} Marianna Zagurovskaya,² Michael Sekela,² and Maya Guglin³

Citation: Saleb K, et al. A Case of HeartMate III Outflow Graft Twisting with Extraluminal Thrombosis: Is CT Angiography Helpful? *The VAD Journal*. 2020; 6 [Epub ahead of print].

¹ Ascension St. John Hospital, Detroit, MI

² University of Kentucky, Lexington, KY

³ Indiana University School of Medicine, Indianapolis, IN

*Corresponding author: kderias89@gmail.com

Editor-in-Chief: Maya Guglin,
University of Kentucky

Received: July 27, 2019

Accepted: February 22, 2019

Published Online: March 12, 2020

© 2020 The Author(s). This is an open access article published under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided that the original author(s) and the publication source are credited.

Funding: Not applicable

Competing interests: None

Keywords: Heart failure, ventricular assist device, cardiac imaging, outflow graft obstruction

Abstract

Twists in the outflow graft of the HeartMate™ 3 device (Abbott) have recently been described as a sporadic, late complication. We present a case with a unique combination of external compression of the HeartMate 3 outflow graft by a surgical scar compounded by thrombus formation in the space between the band relief and the outflow graft with associated twist of the outflow graft and severe flow limitation. Computed tomography angiogram (CTA) of the chest was suggestive of outflow graft thrombosis. Our case sheds additional light on the limited specificity of gated CTA in distinguishing the outflow graft twisting from thrombotic obstruction and kinking.



Case Report

A 55-year-old female with a past medical history of post-partum cardiomyopathy underwent left ventricular assistive device (LVAD) implantation with HeartMate™ 3 (Abbott). She presented nine months later to the hospital because her LVAD had been logging in persistent low flow alarms, as low as 3.5 L/min (previously 4.8 L/min). She was asymptomatic at that time. Her serum lactate dehydrogenase was mildly elevated at 300 U/L (reference range: 116-250 U/L). Plasma free hemoglobin and total bilirubin were within normal limits. Her international normalized ratio (INR) was found to be 2.8 (target: 1.8-2.2). The INR levels prior to her hospitalization were within the target range. She underwent a gated CT angiography (CTA) chest (arterial phase) examination, which showed low density material at the junction of the bend relief and the rigid portion of the outflow cannula. There was also significant flow obstruction, with imaging characteristics of thrombosis (Fig.1A-C). Of note, no thrombus within the remainder of the outflow cannula was evident.

Figure 1. *Multiplanar reformatted CTA images show the LVAD outflow graft. At the junction of the relief bend and the rigid portion of the outflow limb, an eccentric low attenuation density material (arrows) is present, with severe narrowing of the flow stream.*

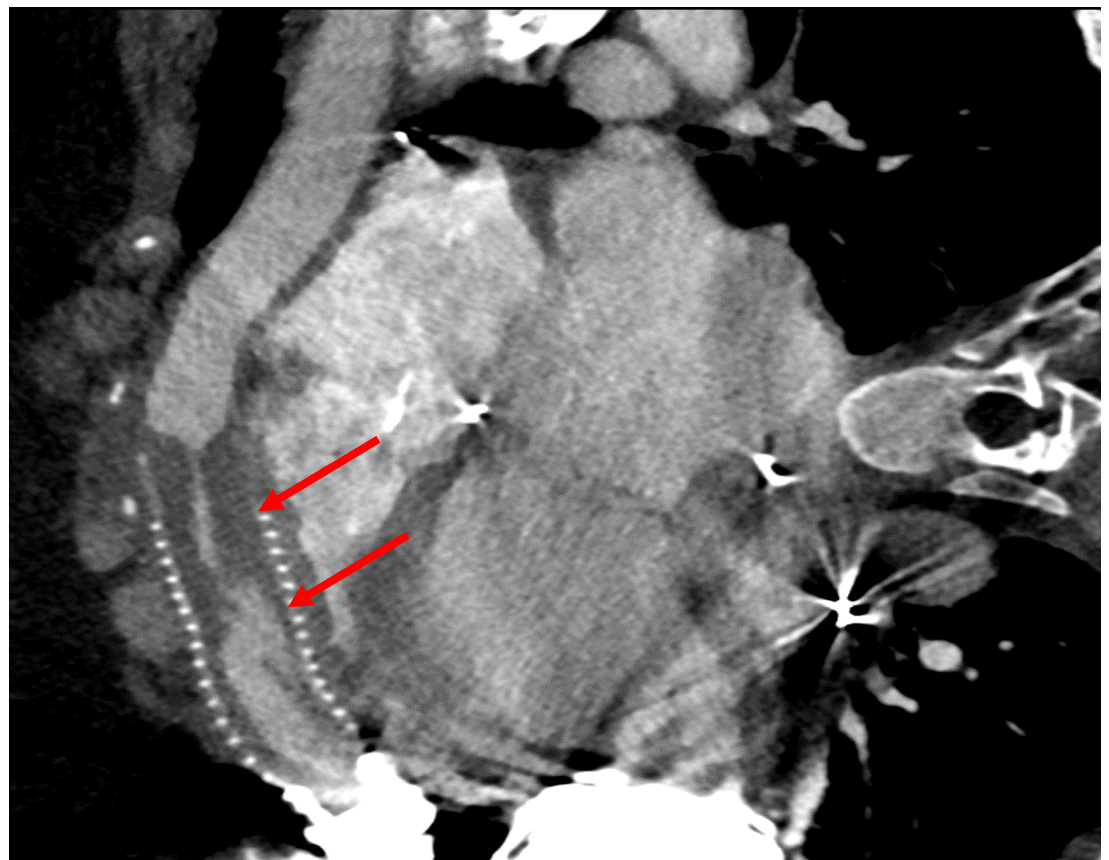


Figure 1A

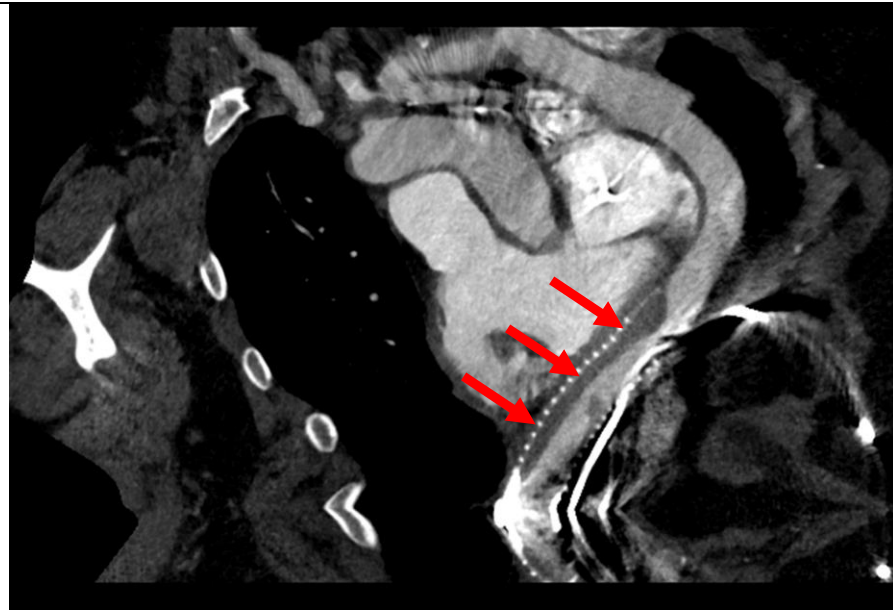


Figure 1B

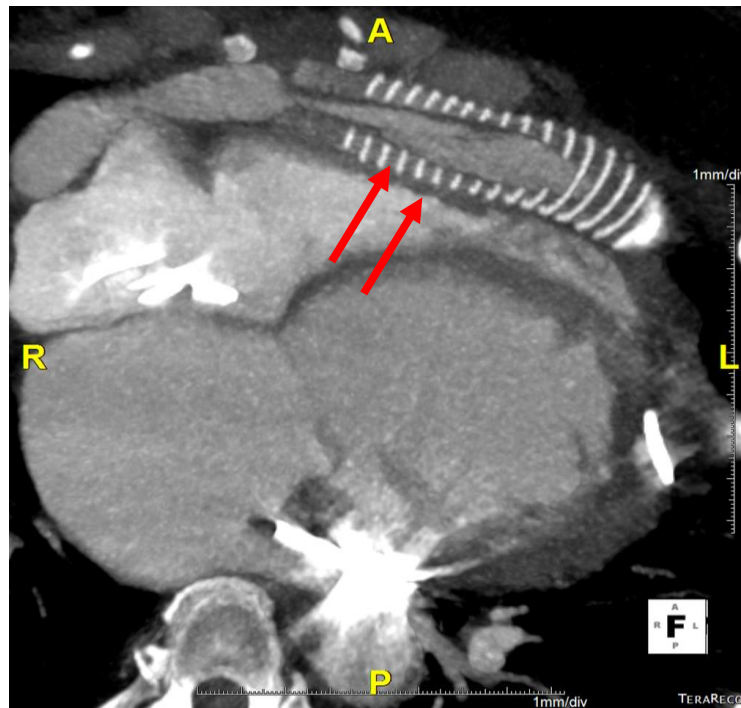


Figure 1C

The patient was taken for surgical exploration of her LVAD system via a subxiphoid approach. Intraoperatively, an epiaortic echo probe was placed on the bend relief, and this showed twisting and external compression of the outflow graft without evidence of an intraluminal thrombus. During dissection, there appeared to be a band of scar tissue causing external kinking of the outflow graft as well. After



release of the scar tissue, it was noted that the LVAD flows improved dramatically. Subsequent exploration of the bend relief showed a visible white thrombus compressing the outflow graft surface, which was removed. With exchange of the bend relief and 180-degree rotation of the outflow graft, the LVAD flows recovered to baseline.

Discussion

Gated CTA chest plays a significant role in evaluation of LVAD malfunction, evaluating the patency of outflow limb, surgical anastomosis, and the position of the inflow cannula within left ventricle (1-5). Outflow cannula obstruction can be intrinsic (thrombus, infectious material, etc.) or extrinsic (due to kinking, compression by hematoma or hematoma/sternal closure or tight suturing) (1-5). Twists in the outflow graft of the HeartMate 3 device have also recently been described as a sporadic, late complication. A recent analysis from Momentum 3 trial reported an 8% incidence of the twist at the outflow graft (6). The analysis speculated that the underlying mechanism might be related to the relatively longer graft and the metallic swivel connecting the outflow graft to the pump housing present in the HeartMate 3, when compared to the prior generations of LVAD (6).

Our case describes a unique combination of external compression by a surgical scar compounded by thrombus formation in the space between the bend relief and the outflow graft, with associated twist of the outflow graft and severe flow limitation. On imaging, the pathologic findings were consistent with a thrombus, given its classic low attenuation appearance. CTA had limited accuracy in picturing the outflow apart from thrombotic obstruction and kinking. Using 3D post-processing might assist in identifying the culprit, as demonstrated in a similar case by Aghayev et al. (7).

Distinguishing internal and external causes of outflow graft obstruction is critical in guiding clinical decision making. Thus, a differential of mechanical failure due to twisting of the outflow graft, with or without associated thrombosis, should be considered in HeartMate 3 devices when a thrombosis-like attenuation is identified at the level of the bend relief on CTA.



References:

1. Acharya D, Singh S, Tallaj JA et al. Use of gated cardiac computed tomography angiography in the assessment of left ventricular assist device dysfunction. *ASAIO J* 2011;57(1):32-37.
2. Estep JD, Stainback RF, Little SH, Torre G, Zoghbi WA. The role of echocardiography and other imaging modalities in patients with left ventricular assist devices. *JACC Cardiovasc Imaging* 2010;3(10):1049-1064.
3. Raman SV, Sahu A, Merchant AZ, Louis LB, Firstenberg MS, Sun B. Noninvasive assessment of left ventricular assist devices with cardiovascular computed tomography and impact on management. *J Heart Lung Transplant* 2010;29(1):79-85.
4. Shroff GS, Ocazonez D, Akkanti B et al. CT imaging of complications associated with continuous-flow left ventricular assist devices (LVADs). *Semin Ultrasound CT MR* 2017;38(6):616-628.
5. Tchantchaleishvili V, Sagebin F, Ross RE, Hallinan W, Schwarz KQ, Massey HT. Evaluation and treatment of pump thrombosis and hemolysis. *Ann Cardiothorac Surg* 2014;3(5):490-495.
6. Mehra MR, Salerno C, Naka Y et al. A tale of the twist in the outflow graft: An analysis from the MOMENTUM 3 trial. *J Heart Lung Transplant* 2018;37(11):1281-1284.
7. Aghayev A, Mehra MR. Cardiac CT to diagnose left ventricular assist device outflow graft twist. *Radiology* 2019;292(3):537.