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Aortic Pseudoaneurysm of a Bentall Composite Valve Graft Associated with Acute Cocaine Ingestion

Ernest Matthew Quin, M.D.,* Edmund Kenneth Kerut, M.D.,† Andy Paul Brown, M.D.,‡ and Ervin R. Fox, M.D.*

*Division of Cardiology, Department of Medicine, University of Mississippi, School of Medicine, Jackson, Mississippi, †Heart Clinic of Louisiana, Marrero, Louisiana, Departments of Physiology and Pharmacology, LSU Health Sciences Center, New Orleans, Louisiana, and ‡Department of Radiology, University of Mississippi, School of Medicine, Jackson, Mississippi

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Bentall, *pseudoaneurysm*, *cocaine*, *TEE*, *CT*, *MRI*

A 41-year-old male underwent a modified Bentall procedure with aortic root and valve replacement using a 25-mm St. Jude composite valve graft (CVG) for a dilated aortic root (5.5 cm) and severe aortic regurgitation (AR). He had an uneventful postoperative course. Subsequently, he returned to the hospital 4 months later with severe acute dyspnea and chest pain. The patient admitted to smoking "crack" cocaine prior to presentation. Physical exam revealed an apprehensive male with a blood pressure of 100/60 mmHg and a systolic flow murmur in the aortic area. Computed tomography (CT) of the chest with intravenous contrast revealed findings consistent with an anterior mediastinal hematoma (Fig. 1). Transthoracic echocardiography (TTE) showed a bileaflet prosthetic valve in the aortic position with a peak gradient of 44 mmHg (mean 35 mmHg) and moderately reduced left ventricular function with an estimated ejection fraction of 0.35. By transesophageal echocardiogram (TEE), there was a well-seated prosthetic valve and ascending root graft. However, a space was noted outside the graft conduit wall consistent with hematoma. It extended from the level of the aortic prosthesis superiorly for several centimeters along the edge of the graft. Echolucent areas were noted within the space that changed in size with the cardiac cycle (Fig. 2). These echolucencies demonstrated flow by color Doppler (Fig. 3). In addition, flow was noted from the proximal anastomotic suture line into the left ventricular outflow tract (LVOT) consistent with CVG pseudoaneurysm formation (Fig. 4). Cardiac magnetic resonance imaging (MRI) was performed and revealed a

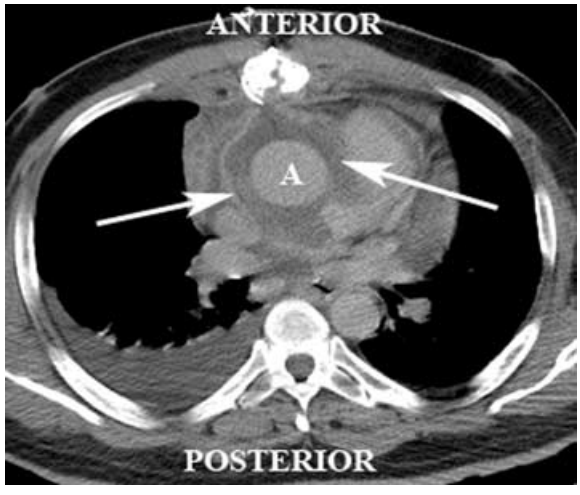

Figure 1. *Cardiac CT image of the chest in the axial plane (without contrast enhancement) reveals a fluid collection (arrows) surrounding the aortic root. A = ascending aorta.*

Address for Correspondence and reprint requests: Edmund Kenneth Kerut, M.D., 1111 Medical Center Blvd, Suite N613, Marrero, Louisiana 70072. Fax: 504-349-6621; E-mail: kenkerut@pol.net

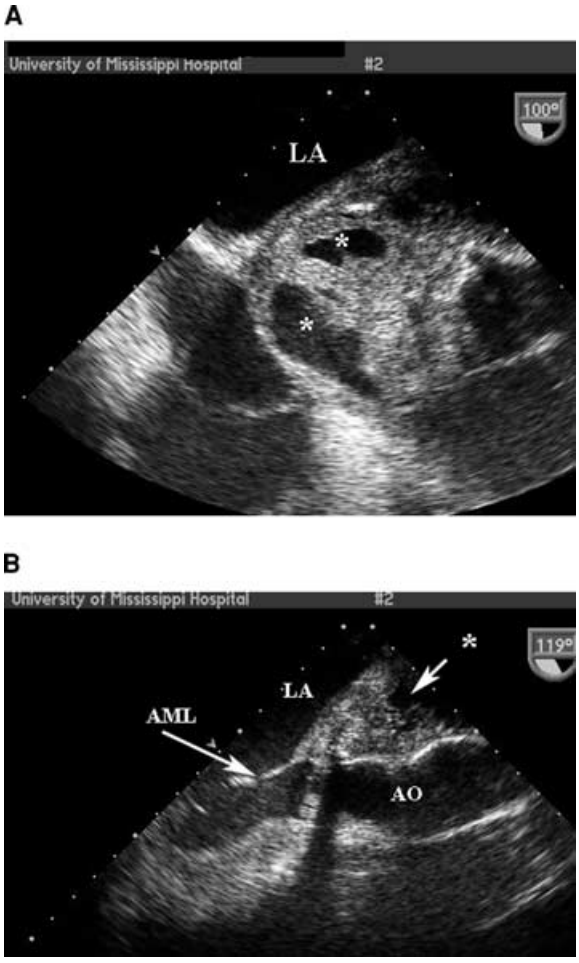

Figure 2. *TEE at* ***(A)*** *100° and* ***(B)*** *190° demonstrates echolucent (*) areas within the increased space around the aortic root. AML = anterior mitral leaflet; AO = ascending aorta; LA = left atrium.*

complex fluid collection around the aortic root with significant thickening of the proximal ascending aortic root and/or graft material (Figs. 5 and 6). On the basis of these findings, the patient was taken for repeat CVG placement. Pathology from the resected graft showed focal hemorrhage and fibrin deposition without evidence of infection.

Simultaneous replacement of the aortic root and valve is a complicated procedure. Early attempts at separate repair of the aortic valve and root individually were complicated by bleeding at suture lines.[1] An improvement in the technique, proposed by Bentall and De Bono,[2] involves simultaneous CVG placement with end-to-side anastomosis of the coronary arteries to the composite aortic graft (Fig. 7). Later modifications altered the method of coronary anastomosis to include a "button" of aortic tissue that was anastomosed to the composite graft (modified Bentall procedure). Cabrol's variation drained the space between the composite graft and the aortic wall into the right atrium.[3] The modified Bentall procedure is generally considered the procedure of choice when both the aortic valve and root require replacement,[4,5] and was the procedure performed for both of this patient's operations. Problems specific to the

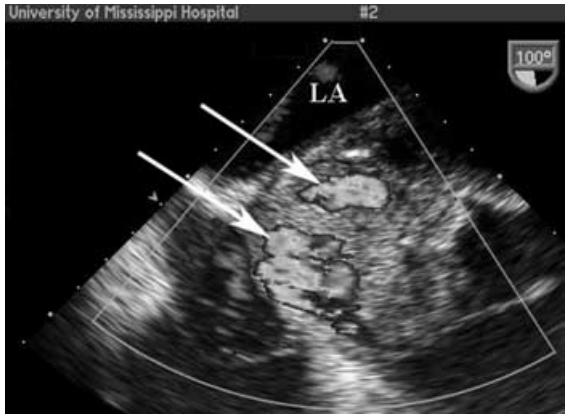

Figure 3. *In this view (as in Figure 2A) color Doppler demonstrates flow within the surrounding hematoma (arrows). LA = left atrium.*

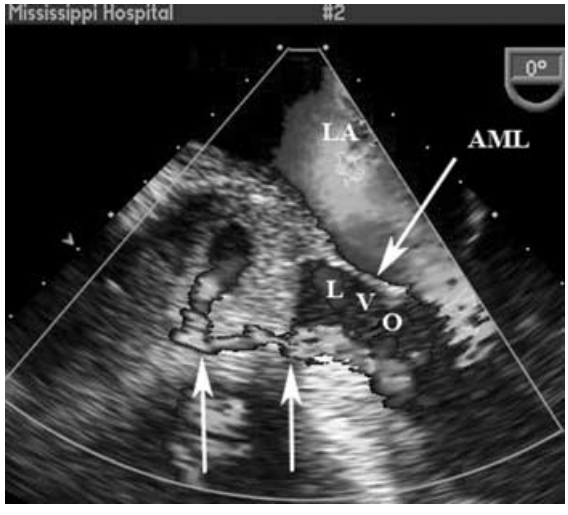

Figure 4. *TEE (diastolic frame) in the mid-upper esophagus in the horizontal plane (0°). By color Doppler, diastolic flow is noted from within the pseudoaneurysm into the left ventricular outflow tract (vertical arrows). AML = anterior mitral valve leaflet; LA = left atrium; LVO = left ventricular outflow tract.*

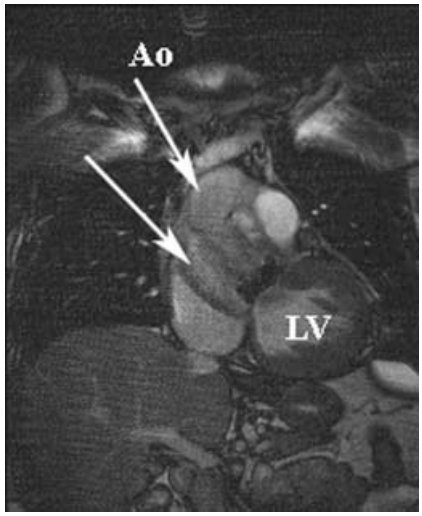

Figure 5. *Two-dimensional MRI steady-state free precession imaging of the heart in coronal section showing the aortic valve and graft with surrounding fluid collection (arrow). AO = upper ascending aorta; LV = left ventricle.*

CVG and the Bentall technique are graft dehiscence,[6] graft tearing,[7] graft infection, aortic aneurysms distal to the graft,[8] and pseudoaneurysm formation along the suture line of the sinus of Valsalva[9] or the anastomotic sites at the aortic annulus (as in this patient) and the distal aorta.[10]

An aortic pseudoaneurysm represents a rupture of the ascending or descending aortic wall where the adventitia remains intact. Bleeding into the adventitia is contained by the pleura and mediastinal tissues, and a false aneurysm develops limiting the rupture.[11] Pseudoaneurysm (also termed "false aneurysm") of the aorta has been described in cases involving trauma, penetration, ulcerative atherosclerotic plaques, infection, and in cases following ductal ligation.[11]

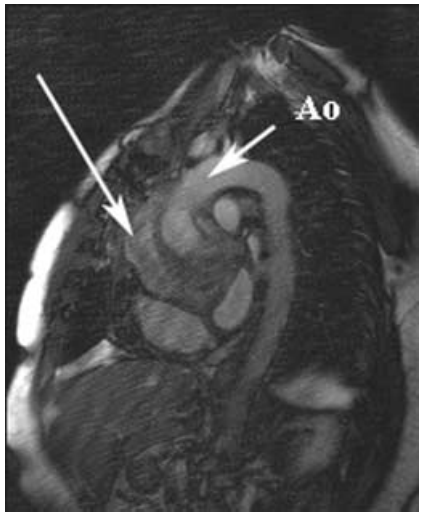

Figure 6. *Two-dimensional MRI steady-state free precession imaging in the sagittal plane showing a fluid collection (arrow) surrounding the CVG. AO = upper ascending aorta.*

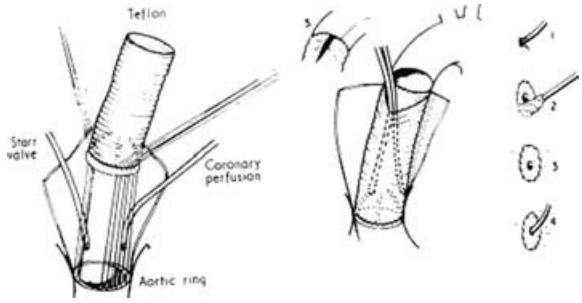

Figure 7. *Diagram of the Bentall procedure showing suture of a CVG into the aortic root and the method of attachment of the coronary arteries to the graft. (Reprinted from Reference [2] with permission).*

Recently, aortic pseudoaneurysm has been described as a postoperative complication after aortic valve replacement, specifically post-Bentall procedure.[1,8,10,12,13] Specific to this case, a pseudoaneurysm typically forms a rupture at the level of the aortic sinuses near the suture line anastomosing the coronaries to the graft or the graft to the aortic annulus. Blood extends out of the lumen of the aorta and is contained in the periaortic space by adjacent tissue.

The incidence of pseudoaneurysm following CVG replacement varies among series from 0% to 39%.[5–8] The wide variance in reports is likely influenced by selection bias and also the method used to evaluate the graft. Several modalities have been described in the literature, including CT,[1,6] MRI,[10,14] and both TTE[5,15] and TEE.[6,15] For diagnosis of aortic graft dehiscence, TTE and CT have poor sensitivity, with aortography performing somewhat better. TEE appears to be most sensitive for diagnosis.[6,11]

Echocardiographically the false aneurysm typically shows an area of flow extending a variable distance beyond the lumen of the aorta into the perigraft space. It is not uncommon for a large mass to be identified posterior to the aorta, with extravascular thrombus found at the time of surgery.[11]

The development of pseudoaneurysm following aortic dissection repair is related to

operative strategy and anastomotic technique; risk factors associated with pseudoaneurysm after CVG surgery are not well described in the literature, although factors that have been cited include suture line tension, persistent bleeding into the perigraft space, and graft infection.[8,13]

A possible complicating factor in this patient was the use of cocaine. It is reasonable to presume that increased wall stress contributes to dehiscence of suture lines and increased risk for pseudoaneurysm formation. To our knowledge this is the first reported case of pseudoaneurysm formation following the Bentall procedure associated with acute cocaine ingestion.

Pseudoaneurysm formation following CVG placement is a relatively unusual and possibly fatal complication. TEE appears to be the modality of choice for diagnosis of pseudoaneurysm with its ability to define perigraft architecture and identify blood flow within the pseudoaneurysm itself.

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Supplementary Material

The following supplementary material is available for this article on-line at the Website: Movie clips: Figures 4–6.

Figure 4 Video Clip—TEE with color Doppler in the mid-upper esophagus in the horizontal plane demonstrates systolic turbulent flow from the left ventricular outflow tract into the pseudoaneurysm. During diastole, flow occurs from the pseudoaneurysm back into the left ventricular outflow tract.

Figure 5 Video Clip—Time sequence in the plane of Figure 5 without evidence of flow in the hematoma surrounding the CVG. There appears to be aortic regurgitation present, but TEE showed this to be diastolic flow entering the left ventricular outflow tract from the pseudoaneurysm.

Figure 6 Video Clip—Time sequence in the plane of Figure 6.