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IMAGING VIGNETTE

Applications of Cardiac CT in the Tetralogy of Fallot Patient

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IN VARIOUS SUBSETS OF TETRALOGY OF FALLOT (TOF) PATIENTS, THE ANATOMIC HETEROGENEITY, myriad of potential surgical palliations, and the potentially associated intracardiac and extracardiac anomalies encountered must be taken into consideration when imaging a patient with TOF. Multidetector cardiac computed tomography (MDCT), with its superior spatial and temporal resolution, has become a valuable modality in evaluating the complex anatomic findings associated with both unrepaired (Figure 1) and repaired TOF patients that traditional echocardiography may have difficulty visualizing or if there are contraindications (i.e., rhythm devices) to magnetic resonance imaging (1-3). MDCT can be used to evaluate the patency of surgical palliative shunt placement (Figure 2) and for long-term sequelae and complications (Figure 3) including pulmonary regurgitation, right ventricular outflow obstruction, conduit stenosis, aortic root dilation

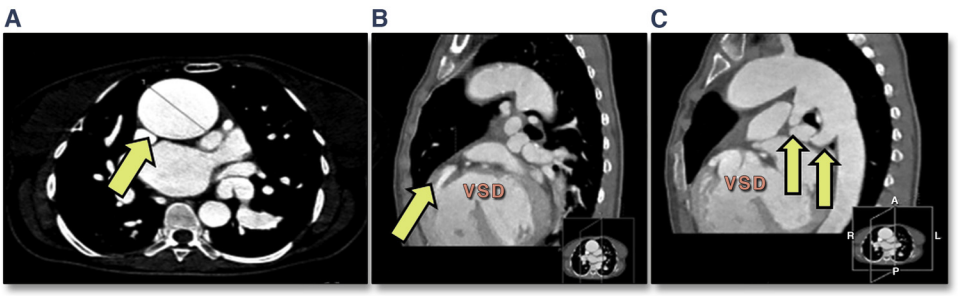

FIGURE 1 Sixty-Four Slice Multidetector Cardiac Computed Tomography of a Woman With Newly Diagnosed TOF at the Age of 33 Years

(A) Axial view showing a dilated overriding aorta **(arrow)** with a diameter of 57 mm. **(B)** Sagittal view demonstrating an area of pulmonary atresia. A large 49-mm ventricular septal defect (VSD) is also seen. **(C)** Sagittal view showing 2 large aortopulmonary collaterals connecting to the descending aorta **(arrows)**.

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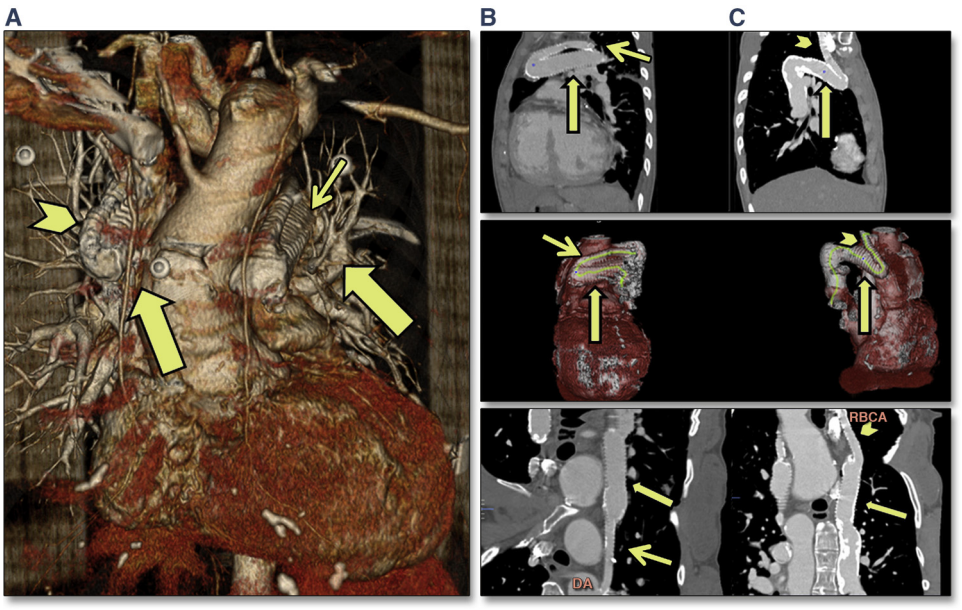

FIGURE 2 Sixteen-Slice Multidetector Cardiac Computed Tomography Anteroposterior Volume Rendering of a 25-Year-Old Woman With a History of Repaired TOF

(A) Anteroposterior volume rendering showing pulmonary atresia, major aortopulmonary collaterals, status post bilateral unifocalization **(large arrows)**, and a right Blalock-Taussig shunt **(arrowhead)** connected to the right unifocalization conduit and a central shunt **(thin arrow)** connecting the left unifocalization conduit to the descending aorta. **(B)** Left anterior oblique view showing the left central shunt **(thin arrow)** arising from the descending aorta (DA) connecting to the left unifocalization **(thick arrow)**. **(Top)** Curved multiplanar reformatting (MPR) of the Blalock-Taussig shunt connecting to the left unifocalization conduit. **(Middle)** Volume rendering of the shunt and unifocalization conduit. **(Bottom)** MPR with straightening of the shunt and unifocalization conduit showing no evidence of stenosis. **(C)** Right anterior oblique view showing the right central shunt **(arrowhead)** arising from the descending aorta (DA) connecting to the left unifocalization **(thick arrow)**. **(Top)** Curved MPR of the Blalock-Taussig shunt originating from the right brachiocephalic artery (RBCA) connecting to the right unifocalization conduit. **(Middle)** Volume rendering of the right shunt and unifocalization conduit. **(Bottom)** MPR of the right shunt and unifocalization conduit showing no evidence of stenosis.

with aortic regurgitation, left-sided failure, and right ventricular hypertrophy and failure. Finally, intra-procedural 3-dimensional computed tomography combined with fluoroscopic overlay has shown encouraging early results and may play an important future role in complex congenital and structural interventions (**Figure 4**, Online Video 1). In conclusion, due to the increasing prevalence and improved overall survival of TOF patients, there is a growing need for safe, reliable, and low-cost diagnostic imaging modalities, with MDCT offering accurate anatomic assessment for the complex spectrum of these patients.

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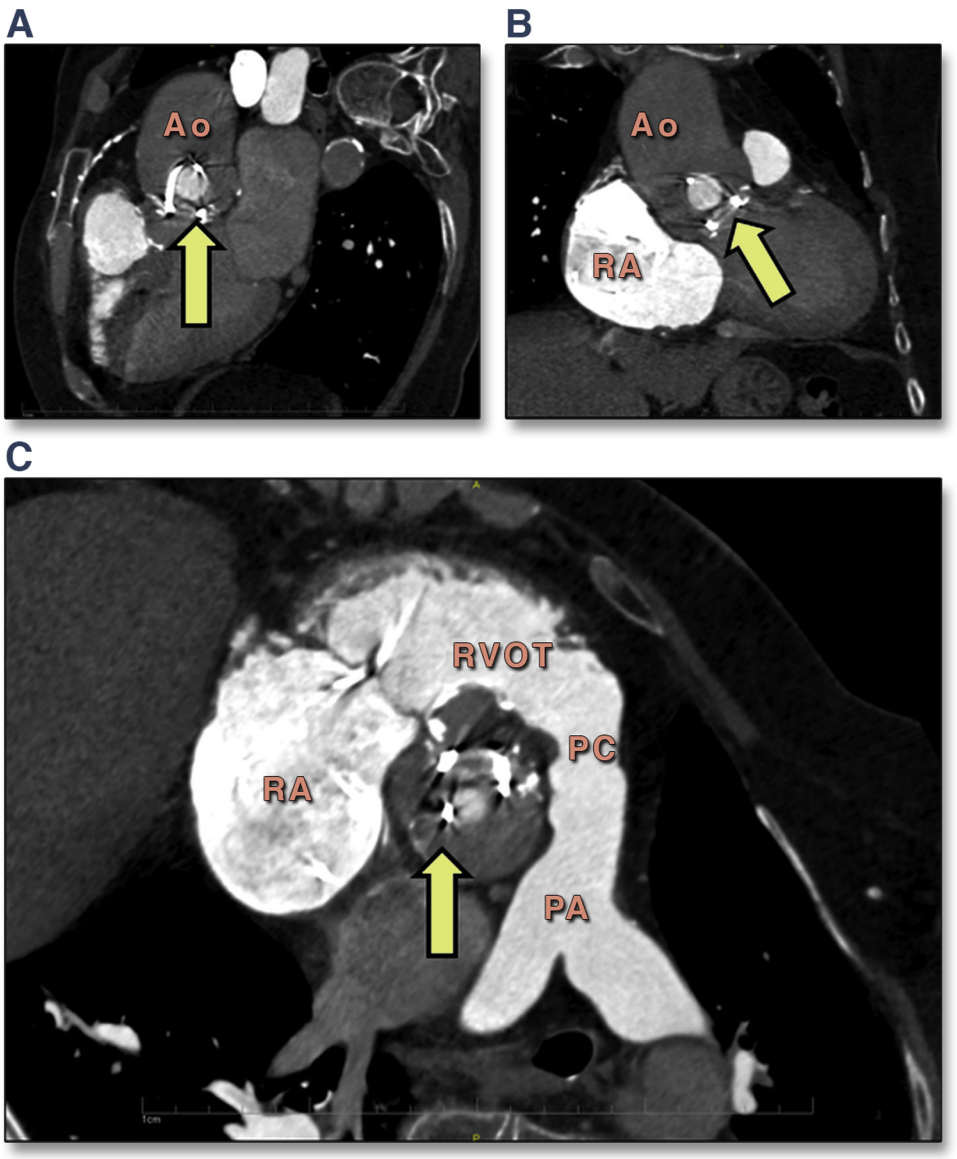

FIGURE 3 128-Slice Dual-Source Multidetector Cardiac Computed Tomography of a 64-Year-Old Tetralogy of Fallot Patient Being Evaluated for Melody Valve Replacement

Imaging obtained during transit of contrast in the right-sided system to evaluate pulmonary conduit patency. Contrast bolus was optimized for right heart visualization with administration of 110 ml of low osmolar contrast medium at 4 ml/s followed by a saline solution flush of 50 ml at 3 ml/s. Scan initiation was triggered by region-of-interest analysis of the right pulmonary artery with a threshold of 110 Hounsfield units. The patient also has a history of mechanical aortic valve replacement with a Starr-Edwards ball-and-cage valve (Edwards Lifesciences, Irvine, California) **(arrow)**, pacemaker placement, ventricular septal defect repair, and a 57-mm ascending aortic aneurysm. Severe right atrial enlargement is present. **(A)** Left anterior oblique cranial view. **(B)** Right anterior oblique view. **(C)** Axial short-axis view through the aortic valve with visualization of the pulmonary conduit and right ventricular outflow tract. Ao = aorta; PA = pulmonary artery; PC = pulmonary conduit; RA = right atrium; RVOT = right ventricular outflow tract.

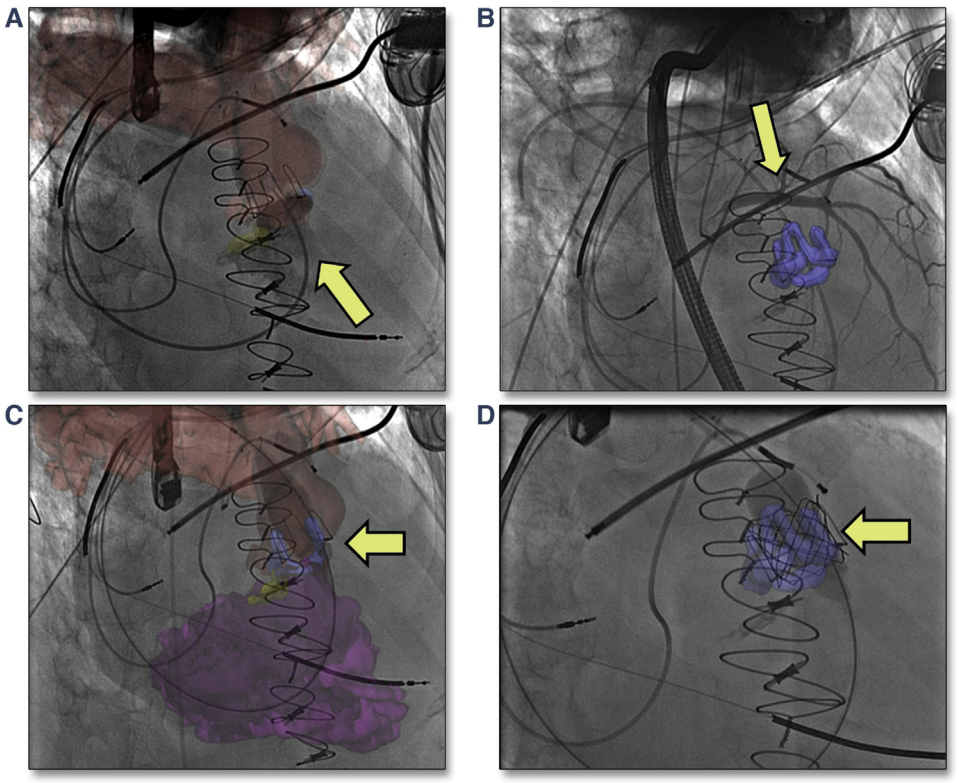

FIGURE 4 Utility of CT Overlay During Pulmonary Valvuloplasty and Subsequent Melody Valve Deployment in an Incompetent Bioprosthetic Pulmonic Valve in a Patient With Repaired TOF and Implantable Cardioverter Defibrillator

(A) Pulmonary angiography is performed with the tip of the catheter across the bioprosthetic valve, which delineates the pulmonary arterial anatomy on CT **(red area)** and significant pulmonary regurgitation is seen **(arrow)**. Ventricular septal defect repair is also seen **(yellow area)**. **(B)** Coronary angiography of the left coronary artery is performed showing the left main coronary artery **(arrow)** and its course in relation to the pulmonic valve **(blue area)**. Coronary angiography is typically simultaneously performed during valvuloplasty balloon inflation to evaluate for left main coronary artery compression to determine the safety of Melody valve (Medtronic, Minneapolis, Minnesota) implantation. **(C)** Inflation of a percutaneous transluminal valvuloplasty balloon **(arrow)** across the bioprosthetic valve **(blue area)**. The main pulmonary artery and its branches **(red area)**, the ventricular septal repair **(yellow area)**, and the right ventricle **(blue area)** are also displayed on CT overlay. **(D)** Deployment of a Melody valve **(arrow)** across the bioprosthetic valve **(blue area)**. The outline of the stents are seen aligning with the borders of the bioprosthetic valve at maximal inflation. Please see Online Video 1. CT = computed tomography.

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APPENDIX For a supplemental video, please see the online version of this paper.