Images in Cardiovascular Medicine

Ventricular Tachycardia and Right Ventricular Fibrosis After Tetralogy of Fallot Surgical Repair

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Ventricular tachyarrhythmias are known sequelae among adults with repaired tetralogy of Fallot. The incidence of sustained ventricular tachycardia and sudden cardiac death in patients 35 years after corrective surgery is estimated at 11.9% and 8.3%, respectively.1 Studies have shown that right ventricular enlargement resulting from chronic pulmonary regurgitation is the most common hemodynamic substrate.2 QRS prolongation (>180 milliseconds) is one of the most sensitive ECG predictors and in turn correlates with right ventricular (RV) dilation.3 The exact mechanism is not as well studied as that of left ventricular arrhythmias, but it is purported that volume overload leads to RV myocardial stretching and RV fibrosis and hence serves as an arrhythmogenic focus.

The anatomic location of the RV pathology leading to ventricular tachyarrhythmias after tetralogy of Fallot surgical repair is not well defined. The basal portions of the RV and the subpulmonary regions of the RV are difficult to visualize on transthoracic echocardiography. Furthermore, 2-dimensional echocardiography is not capable of myocardial scar imaging. Cardiac magnetic resonance imaging (MRI) is capable of not only visualizing all anatomic segments of the RV but also delineating areas of myocardial fibrosis with late-gadolinium-enhancement imaging.

The value of cardiac MRI is demonstrated in this case of a 50-year-old man with a history of tetralogy of Fallot surgical repair as an infant. While playing recreational hockey, he suddenly developed presyncope with severe lightheadedness, dizziness, diaphoresis, and palpitations. On evaluation by emergency medical services personnel, he was found to have a wide-complex tachycardia at a rate of 300 bpm, suspicious for ventricular tachycardia (Figure 1). Normal sinus rhythm was restored after administration of amiodarone 150 mg IV. A postconversion ECG revealed normal sinus rhythm with a right bundle-branch block and a QRS duration of 175 milliseconds (Figure 2). The estimated total duration of the wide-complex tachycardia was 5 minutes. A transthoracic echocardiogram revealed evidence of both RV pressure and volume overload, with RV hypertrophy and abnormal septal motion.

A cardiac MRI study showed moderate RV dilation with severe RV systolic dysfunction, noting a global RV ejection fraction of 20%. Left ventricular function was normal with a global LV ejection fraction of 62%. The basal portions of the RV and RV outflow tract were aneurysmal (Figures 3 and 4 and Movie I in the online-only Data Supplement). This was not as well appreciated on the transthoracic echocardiogram (Movie II in the online-only Data Supplement). The RV aneurysmal area was found to have discrete subendocardial fibrosis on late-gadolinium delayed-hyperenhancement imaging (Figure 5). Late-gadolinium-enhanced imaging also illustrated fibrosis at the LV–RV hinge point (Figure 6) but not in the left ventricle itself. Hence, the arrhythmogenic focus was thought to be the RV outflow tract. The patient subsequently underwent automatic implantable cardioverter-defibrillator placement.

Cardiac MRI is capable of acquiring true short-axis views of the ventricles from base to apex, allowing detection of segmental RV wall motion abnormalities that are not evident with 2-dimensional echocardiography because of its thoracic window limitations. In addition, 2-dimensional echocardiography is usually not capable of visualizing the RV outflow tract in the coronal view, which is easily accomplished with cardiac MRI. This case demonstrates the value of cardiac MRI in the assessment of patients with surgically repaired tetralogy of Fallot.

Disclosures

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References


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Figure 1. Rhythm strip illustrating wide-complex tachycardia suspicious for monomorphic ventricular tachycardia and its transition to normal sinus rhythm (red arrow) within 5 minutes of administration of 150 mg IV amiodarone.

Figure 2. Baseline ECG demonstrates normal sinus rhythm with a right bundle-branch block pattern and prolonged QRS of 175 milliseconds.

Figure 3. Magnetic resonance imaging short-axis view of the right ventricular outflow tract aneurysm.

Figure 4. Magnetic resonance imaging 4-chamber view of the right ventricular outflow tract aneurysm.

Figure 5. Late gadolinium enhancement illustrating endocardial fibrosis of the aneurysmal right ventricular outflow tract.
Figure 6. Late gadolinium enhancement illustrating fibrosis at the left ventricle–right ventricle hinge point.
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