Images in Cardiovascular Medicine

Catastrophic Right Ventricular Rupture Prevented by Coincident Coronary Artery Bypass Grafting

The Pivotal Role of Cardiac Magnetic Resonance Imaging

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An 85-year-old man was taken to a local hospital after a motor vehicle accident. He had undergone coronary artery bypass grafting (CABG) many years previously and was in good health before the accident. A computed tomographic scan revealed leakage of contrast dye into the pericardium. On transfer to our hospital, the patient had hemodynamic signs of possible cardiac tamponade. A transthoracic echocardiogram showed echogenic material in the pericardial space adjacent to the anteroapex of the right ventricle (RV) (Fig. 1). Immediately after cardiac magnetic resonance imaging (CMR) was requested, the patient went into cardiac arrest due to ventricular tachycardia. After precordial thump, synchronized DC shock, and restoration of sinus rhythm, he regained consciousness. We examined the patient and considered the possibility that his condition might deteriorate while he was in the scanner. We determined that early CMR would be advantageous to his safety, because it would expedite the diagnosis and enable us to evaluate the need for surgical repair. The procedure was performed that afternoon.

Real-time cine images obtained by CMR showed a collection of abnormal fluid and fibrosis located outside the RV epicardium, yet retained within the RV pericardium—the 1st definitive and objective evidence of cardiac sequelae after the accident (Fig. 2). To confirm the diagnosis, a CMR perfusion scan was performed. The gadolinium contrast produced an initial bright contrast signal into the right atrium and RV, which then uncharacteristically extended beyond the apical free wall of the RV, suggesting a contained RV free-wall (apical) rupture. (Fig. 3). Within 2 minutes of perfusion imaging, a post-contrast enhancement (delayed-hyperenhancement [DHE]) sequence was performed in the same plane as the perfusion sequence. It showed a 3.6 × 2.1-cm mushroom-shaped object traversing the RV apical wall, with fluid or material from the object distributing into a moderate apical extracardiac space (Fig. 4). Of note, this space was maintained by extensive pericardial scarring and fibrosis and by epicardial fat and sternal adhesions, presumably due to the prior CABG. There was

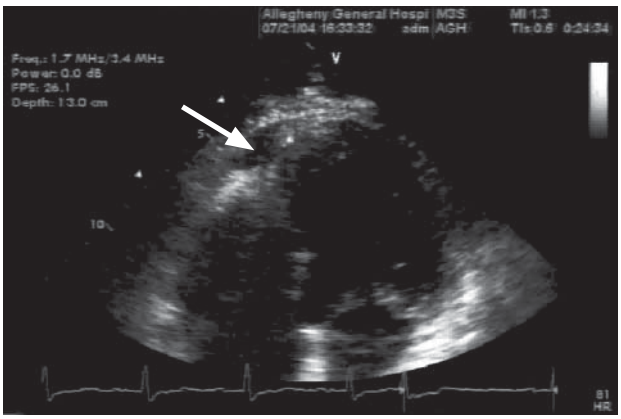

Fig. 1 *Two-dimensional echocardiogram (modified 4-chamber view) shows an ill-defined hypoechogenic zone (arrow).*

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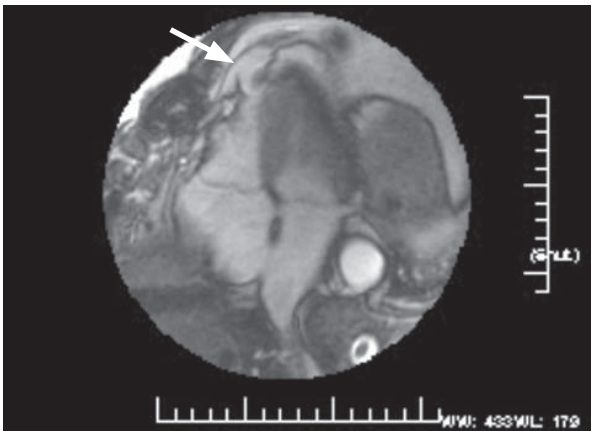

Fig. 2 *Steady-state free precession CMR image (4-chamber view) shows loss of right ventricular apical continuity, with an apparent continuation of the blood signal into the intrapericardial space (arrow).*

CMR = cardiac magnetic resonance

Click here for real-time motion image: Fig. 2.

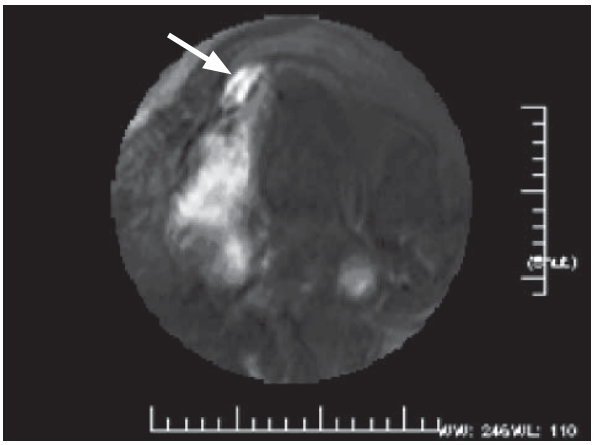

Fig. 3 *Cardiac magnetic resonance perfusion image (4-chamber view) shows an early, rapid influx of gadolinium into the extrapericardial space (arrow). Note that Figure 4 (the delayed-hyperenhancement image) punctuates this finding.*

Click here for real-time motion image: Fig. 3.

no evidence that myocardial infarction had occurred either before or after the motor vehicle accident.

The patient's condition stabilized, and we discharged him without RV repair. His age made the risk of sternotomy and RV repair too great,[1,2] and the residual pericardial adhesions and fibrosis afforded natural protection.

Comment

What makes this case highly unusual is that, despite the rupture of the ventricular free wall due to a deceleration injury and subsequent pericardial effusion, cardiac tamponade did not occur. High-resolution CMR

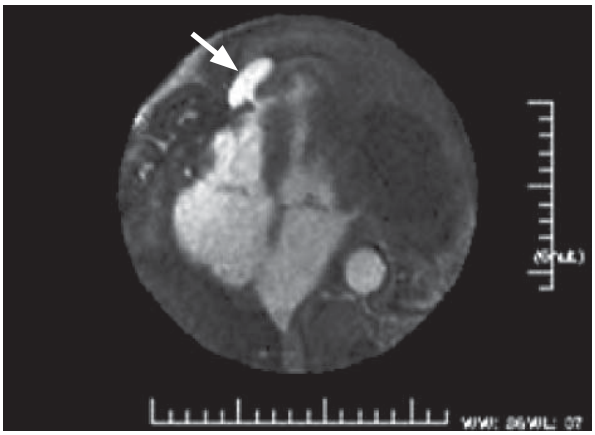

Fig. 4 *Delayed-hyperenhancement CMR image, obtained 2 minutes after the perfusion sequence, confirms the presence of a contained right ventricular rupture. The mushroom-shaped extrapericardial signal is diagnostic of the fortuitous pericardial and mediastinal scarring from coronary artery bypass grafting that prevented exsanguination after the motor vehicle accident.*

CMR = cardiac magnetic resonance

made it possible for us to see the contained rupture of the RV free wall in the setting of extensive pericardial and sternal adhesions.

This case underscores the importance of several features of CMR. First, CMR can be routinely used to characterize and diagnose complicated pericardial conditions, including ventricular rupture. The CMR scan, which provides freedom from acoustic interference, makes it particularly suited for characterizing material that is equivocal on echocardiograms. Second, CMR can *indeed* be performed in controlled circumstances in acute life-threatening conditions. This is not the typical clinical approach; nevertheless, it offers substantial potential benefit in certain acute cases. Third, the advantages of high-resolution imaging in our patient's case are apparent: perfusion and DHE sequences enabled us to clearly delineate the extracardiac condition. Finally, our creative use of CMR is a testament to its versatility. In particular, the DHE sequence was valuable beyond its typical use as a tool for indicating myocardial infarction.

References

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