Percutaneous Closure of a Traumatic Right Ventricular Pseudoaneurysm: A Novel Interventional Approach

Matthew Lippmann, DO, Mark Wiley, MD, Jon Freeman, MD, Travis Abicht, MD, and Jayant Nath, MD, *Kansas City, Kansas*

INTRODUCTION

Right ventricular (RV) pseudoaneurysm is a rare and potentially fatal condition that may occur because of infection, trauma, cardiac surgery, or myocardial ischemia. The initial diagnosis may be very difficult, as RV pseudoaneurysm does not have any identifiable features on clinical examination. Optimal management remains unclear; however, the primary goal is to reduce the incidence of rupture. We describe a case of an unexpected finding of a RV pseudoaneurysm that developed following previous traumatic rib fractures, in which percutaneous closure was attempted.

CASE PRESENTATION

An 80-year-old man with coronary artery disease and prior coronary artery bypass graft was transferred to our institution after a motor vehicle collision complicated by a small right parietal subarachnoid hemorrhage, bilateral rib fractures, and blunt cardiac injury. On arrival, there was concern for tamponade. Two-dimensional with Doppler echocardiography demonstrated normal left ventricular systolic function (Video 1), a large pseudoaneurysm sac size of 6.0 × 3.4 cm apical to the right ventricle, and a narrow neck measuring 1.2 cm in length. Color Doppler (Figure 1, Video 2) and ultrasound contrast agent (Figure 2, Video 3) demonstrated communication between the right ventricle and pseudoaneurysm. The patient was diagnosed with blunt injury to the chest and rupture of the RV apex with subsequent pseudoaneurysm formation. Given his age, subarachnoid hemorrhage, and prior sternotomy, he was at excessive risk for open repair and was referred for a percutaneous closure of the pseudoaneurysm.

The patient was transported to the hybrid operating room. Transesophageal echocardiography was used in complementing the procedure. A 22-mm Amplatzer Vascular Plug (AVP) II closure device (St. Jude Medical, St. Paul, MN) was situated into the RV apex with reduction in flow out to the RV apical segment. A 12-mm AVP II closure device was then deployed, which further improved the flow out into the RV apex. There was persistent residual flow in the inferior segment at the base of the RV apex, so a 14-mm AVP II closure device was deployed. After the third AVP II closure device was deployed, there was no significant residual flow noted out into the RV apex. RV angiography demonstrated no significant residual flow out into the RV apex (Figure 3, Video 4). Although there was a good result with angiography, color Doppler echocardiography did show residual communication with the RV pseudoaneurysm measuring 0.6 cm in length (Figure 4, Video 5). The RV pseudoaneurysm persisted and measured 4.9 × 2.8 cm with subsequent cardiac rupture. The patient clinically deteriorated, requiring increased hemodynamic support for cardiogenic shock and was taken for emergent surgery. The left ventricle was severely impaired, and surgery was quickly aborted. The patient was transferred to the intensive care unit, and the family decided to withdraw care.

DISCUSSION

Pseudoaneurysms of the heart are rare conditions that form as a result of ventricular rupture contained by adherent pericardium and fibrotic tissue and are characterized by absence of myocardial tissue in its wall with a narrow neck between the ventricle and paraventricular chamber.[1] Left ventricular pseudoaneurysm is an uncommon entity, but RV pseudoaneurysm is an even more uncommon entity. A literature review demonstrates multiple causes of RV pseudoaneurysm, including infection, remote history of myocardial infarction, after cardiac surgery, as a complication of endomyocardial biopsy, penetrating chest wall trauma, lipoma, and following lead device extraction.[2-8]

Most patients present with chest pain and dyspnea; however, up to 10% can be asymptomatic.[9] Transthoracic echocardiography with ultrasound contrast agent remains the first-line test to accurately diagnose RV pseudoaneurysm, but it is heavily reliant on visualization of the pseudoaneurysm neck and paraventricular chamber. Pulsed-wave and continuous-wave Doppler are potential alternatives but have demonstrated limited sensitivity.[6,10] Left ventricular and coronary angiography is the imaging modality of choice for the diagnosis of ventricular pseudoaneurysm. Angiographic findings seen with a pseudoaneurysm may demonstrate a narrow orifice leading into a saccular aneurysm with the lack of surrounding coronary arteries.[11] Computed tomography and magnetic resonance imaging are adjunctive alternatives to aid in improving visualization of the heart otherwise unseen on echocardiography, but these imaging modalities may not be feasible in unstable patients.[10]

Optimal management strategies for pseudoaneurysms remain highly variable, but the primary goal is to reduce the incidence of cardiac rupture. Pseudoaneurysms are more prone to rupture than true aneurysms because of the lack of myocardial tissue, and the treatment strategy for left ventricular pseudoaneurysm is surgical resection because of the high propensity to rupture.[12] Unfortunately, given the rarity of RV pseudoaneurysm occurrence, there is a paucity of large-scale trials on the management. Spontaneous obliteration of the pseudoaneurysm neck can occur in the low-pressure system of the right ventricle, so surgery may be individualized.[13] In a literature review of 253 patients with left ventricular pseudoaneurysm, Frances *et al.*[9] demonstrated a high mortality rate in patients who underwent surgery

From the Department of Cardiovascular Medicine (M.L., M.W., J.H., J.N.), and Division of Cardiothoracic Surgery, University of Kansas Medical Center, Kansas City, Kansas (T.A.).

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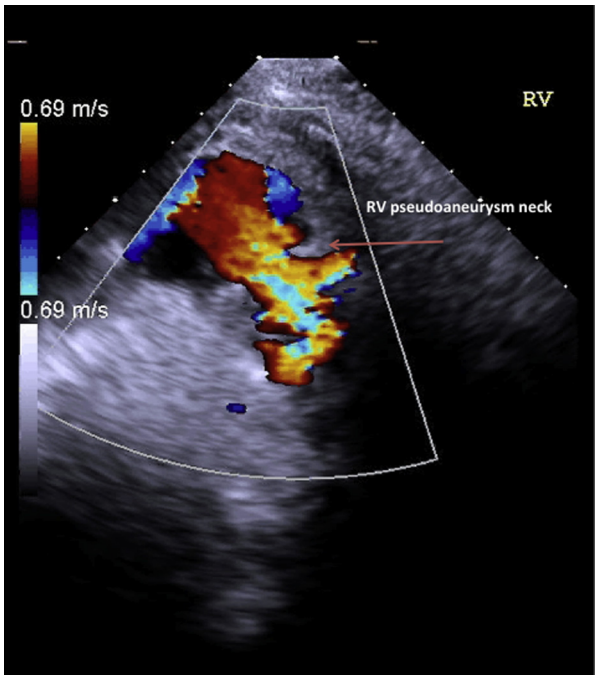

Figure 1 Transthoracic echocardiography with color Doppler; *arrows* point to the pseudoaneurysm neck.

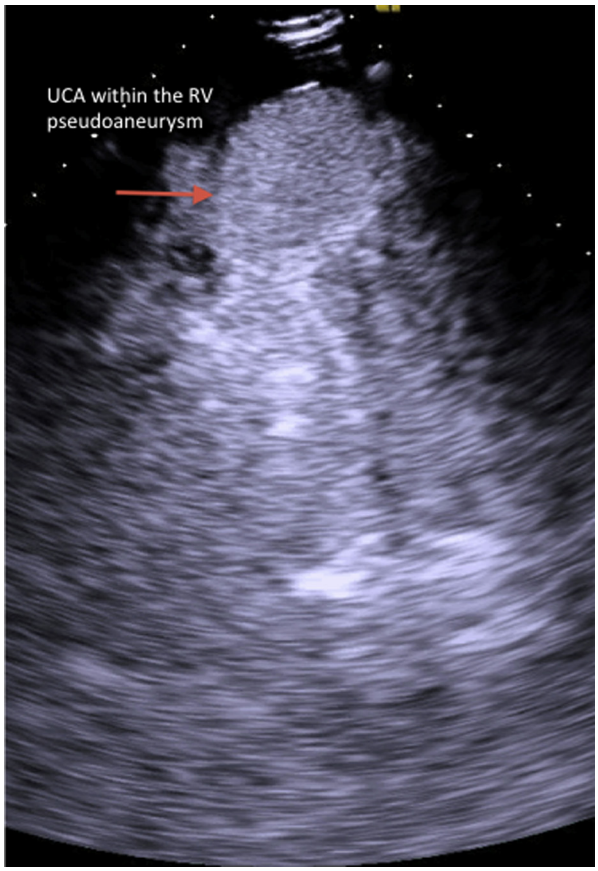

Figure 2 Ultrasound contrast agent (UCA) opacified a structure adjacent to the RV apex that was considered most likely to be a contained RV rupture.

Figure 3 Selective angiography of the pseudoaneurysm was performed; the *arrow* demonstrates no significant flow out into the RV apex.

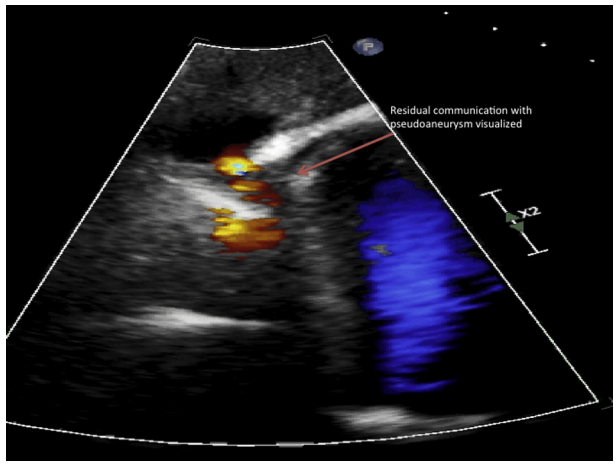

Figure 4 Color Doppler image; the *arrow* points toward the residual communication with the pseudoaneurysm measuring 0.6 cm in length from a midesophageal view.

(23%) but a higher rate in those patients treated medically (48%). Percutaneous treatment for left ventricular pseudoaneurysm in high-risk surgical candidates is a novel approach and has been limited to a few case series.[14,15] Innovative techniques such as percutaneous closure of an RV pseudoaneurysm are rare but have been described.[16]

CONCLUSION

We add to the literature a presentation of trauma-induced RV pseudoaneurysm formation, an extremely rare diagnosis. Even though we had excellent angiographic results, postprocedural echocardiography did demonstrate a residual communication, so the procedure was

partially successful. An innovative technique, such as percutaneous closure of RV pseudoaneurysm, is a possibility, but more cases are needed to better understand the role of percutaneous closure of this life-threatening condition.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2018.11.005.

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