

MINI-FOCUS ISSUE: CARDIOMYOPATHIES AND MYOCARDITIS

INTERMEDIATE

CASE REPORT: CLINICAL CASE

Ventriculoseptal Rupture Caused by Takotsubo Syndrome



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ABSTRACT

Ventriculoseptal rupture (VSR) is a rare complication of takotsubo syndrome that often requires immediate treatment. Patients with VSR experience a range of outcomes and should be managed at centers with cardiac and surgical expertise. We present 2 cases of VSR complicating takotsubo syndrome that highlight potential outcomes. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2020;2:2072-7) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Takotsubo syndrome is a form of acute myocardial injury characterized by left ventricular dysfunction that is typically localized to the apex, often termed “apical ballooning” (1). Diagnosis and management of Takotsubo syndrome can be both challenging and delayed, in part because of similarities in its presentation to that of acute coronary syndrome. Takotsubo syndrome was initially assumed to be a benign condition, with the expectation of left ventricular functional recovery within weeks. However, more recent data show a 20% risk of serious adverse cardiac-related events (2) and an in-hospital mortality of 5% (2,3), comparable to outcomes for patients with

acute coronary syndrome (1). The incidence of this syndrome is increasing, and awareness of possible complications is important (4). Potential life-threatening complications of takotsubo syndrome include acute heart failure, ventricular arrhythmias, left ventricular outflow tract obstruction, cardiogenic shock, and rupture of the ventricular free wall or interventricular septum (1). This case series describes 2 patients with ventriculoseptal rupture (VSR) as a result of takotsubo syndrome.

PATIENT 1

HISTORY OF PRESENTATION. An 80-year-old woman with hypertension, obesity, rheumatoid arthritis, hypothyroidism, and seizure disorder presented to the emergency department (ED) at an outside hospital with sudden onset dyspnea and light-headedness. She was treated for hypertensive urgency and discharged home. The following day she returned with new substernal chest pain radiating to the left arm. Vital signs were within normal limits,

LEARNING OBJECTIVES

- To recognize VSR as a potential consequence of takotsubo syndrome.
- To discuss the presentation, clinical management considerations, and potential outcomes of VSR secondary to takotsubo syndrome.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Case Reports* [author instructions page](#).

Manuscript received July 23, 2020; revised manuscript received September 5, 2020, accepted September 17, 2020.

and physical examination was without pertinent findings.

INVESTIGATIONS. The electrocardiogram showed anterolateral ST-segment elevation, with cardiac troponin I (TnI) elevated to 8.51 ng/ml (normal range <0.04 ng/ml). The patient was taken to the cardiac catheterization laboratory, and coronary angiography revealed no obstructive disease. The left ventriculogram and transthoracic echocardiogram (TTE) revealed a left ventricular ejection fraction (LVEF) of 40% to 45% with distal left ventricular hypokinesis and apical ballooning, consistent with takotsubo syndrome (Figures 1A to 1F, Video 1). The patient was started on lisinopril and furosemide for the treatment of acute heart failure secondary to takotsubo syndrome before she was discharged home.

Two weeks later, the patient presented to the outside ED with progressive dyspnea on exertion, dry cough, and orthopnea. The electrocardiogram showed nonspecific ST-segment changes, and TnI measured 0.03 ng/ml (normal range <0.04 ng/ml). Repeat TTE revealed an increase in LVEF to 60% and a new VSR measuring 0.77 cm in diameter in the midanterior septum. The patient was transferred to our institution (Pauley Heart Center, Virginia Commonwealth University, Richmond, Virginia) for treatment of the VSR. On arrival, her heart rate was 92 beats/min, blood pressure was 127/66 mm Hg, and oxygen saturation was 93% on room air. Physical examination was notable for an IV/VI holosystolic murmur throughout the precordium, diminished breath sounds in the left lung base, and trace lower extremity edema. The electrocardiogram illustrated anterolateral T-wave inversions (Figure 2), and TnI was newly elevated to 0.86 ng/ml (normal range <0.2 ng/ml). Five hours after arrival, the patient developed a new oxygen requirement of 2 l/min. Repeat TTE illustrated enlargement of the VSR in the anterior apical septum, 1.4 cm in diameter, resulting in a significant left-to-right shunt and subsequent right ventricular dilation and systolic dysfunction. These findings were confirmed by cardiac magnetic resonance (Figures 1E and 1F, Video 1). Right-sided heart catheterization revealed a “step-up” in oxygen saturation among the right atrium (63.5%), right ventricle (69.5%), and pulmonary artery (80.5%). The pulmonary-systemic flow ratio (Q_p/Q_s ratio) was 2.07, consistent with a significant left-to-right shunt.

MANAGEMENT. The VSR was not amenable to percutaneous closure because of an inadequate rim. The patient underwent surgical VSR correction. Intraoperatively, the surrounding myocardial tissue

appeared viable, and the rupture was closed with CorMatrix patches (CorMatrix Cardiovascular Inc., Sunnyvale, California) on both sides of the septum in addition to the epicardial surface.

OUTCOME. The operation was well tolerated, and a post-operative transesophageal echocardiogram did not show any evidence of residual shunt. Repeat TTE before discharge showed a residual apical 3-mm ventricular septal defect with trivial left-to-right shunting, apical akinesis, and a small apical thrombus. The patient received anticoagulation therapy with heparin as a bridge to warfarin and was discharged home in good condition on post-operative day 15. She remained out of the hospital for 2 months until a brief admission for a heart failure exacerbation, and she was lost to follow-up 2 months thereafter.

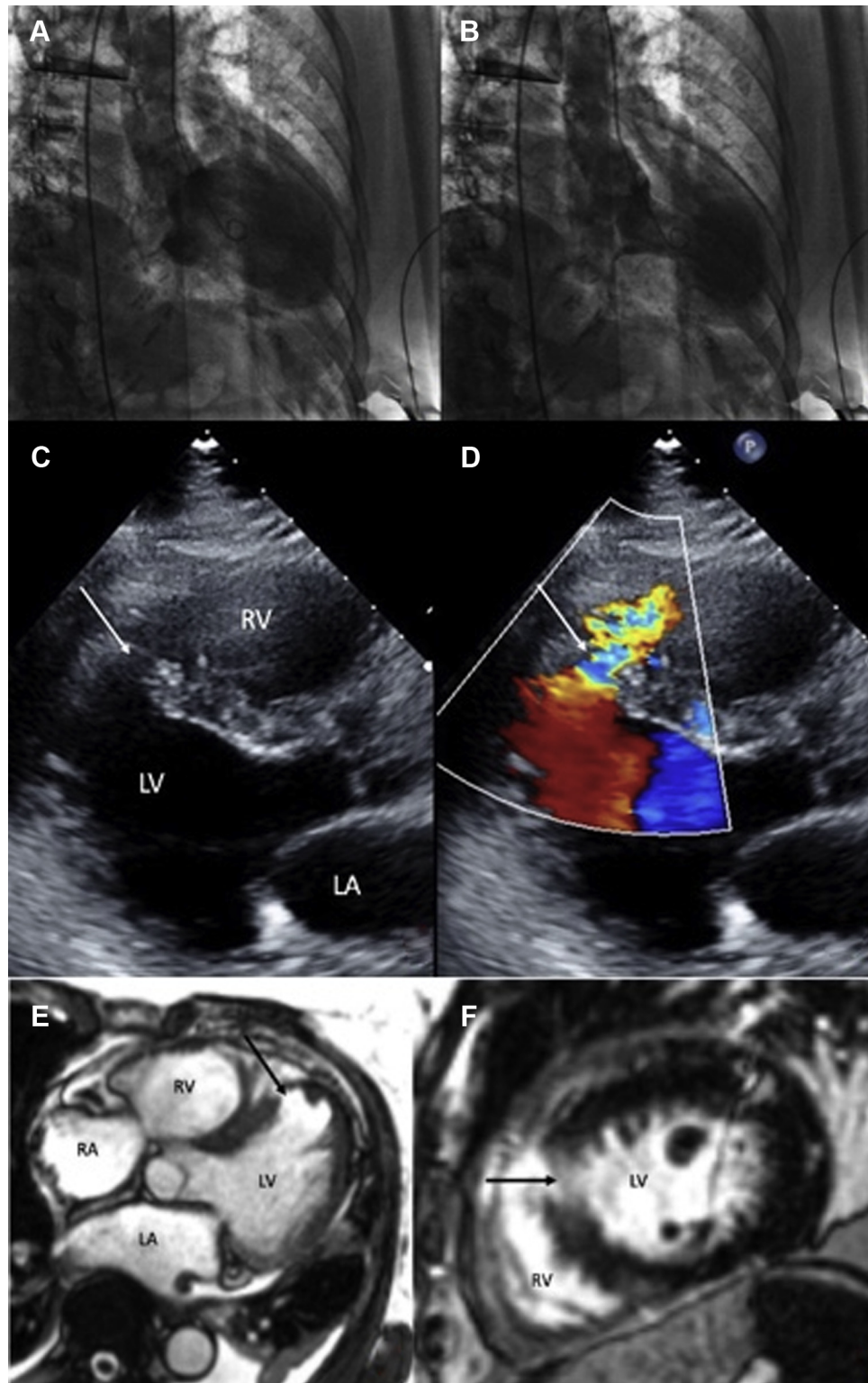
PATIENT 2

HISTORY OF PRESENTATION. A 63-year-old woman with hypertension, hyperlipidemia, and anxiety presented to an outside hospital ED with dyspnea, palpitations, and light-headedness while playing golf after having recently recovered from an upper respiratory tract infection. The patient’s blood pressure was 105/54 mm Hg, heart rate was 105 beats/min, respiratory rate was 24 breaths/min, and oxygen saturation was 97% on room air. Physical examination was notable for a grade II/VI systolic murmur at the lower sternal borders.

INVESTIGATIONS. An electrocardiogram revealed ST-segment elevation in the inferior and anterolateral leads (Figure 3). TnI was elevated to 5.4 ng/ml (normal range <0.3 ng/ml). The patient was loaded with aspirin and ticagrelor and started on a heparin drip before coronary angiography, which demonstrated nonobstructive coronary artery disease. A left ventriculogram revealed distal left ventricular hypokinesis with apical ballooning (Figures 4A and 4B), consistent with takotsubo syndrome. TTE demonstrated an LVEF of 55% and moderate septal hypokinesis. A pericardial friction rub was appreciated, and the patient was empirically treated for myopericarditis with colchicine and indomethacin. On day 3, symptoms of dyspnea and chest discomfort abruptly worsened, and physical examination revealed a new S_4 gallop with a grade IV/VI holosystolic apical murmur radiating to the base. Emergency TTE revealed an increased LVEF to 65% to 70%, an enlarged right ventricle, and a new

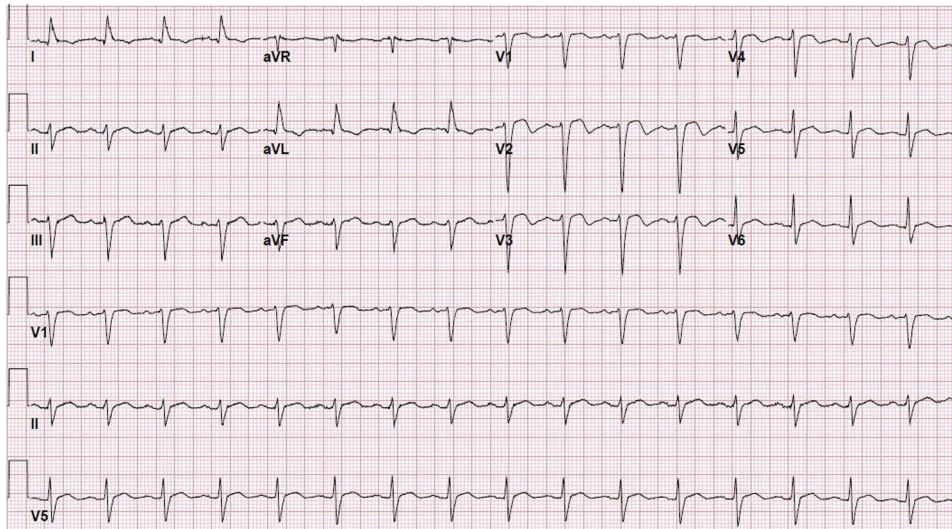
ABBREVIATIONS AND ACRONYMS

- ED** = emergency department
- LVEF** = left ventricular ejection fraction
- TnI** = troponin I
- TTE** = transthoracic echocardiogram
- VSR** = ventriculoseptal rupture

FIGURE 1 Imaging of Ventriculoseptal Rupture From Takotsubo Syndrome

Left ventriculogram in **(A)** diastole and **(B)** ballooning of the apex during systole. **(C and D)** Transthoracic echocardiogram with parasternal long-axis view illustrating ventriculoseptal rupture (**arrows**). Cardiac magnetic resonance **(E)** 5-chamber view and **(F)** short-axis view showing ventriculoseptal rupture between the left ventricle (LV) and the right ventricle (RV). LA = left atrium; RA = right atrium.

FIGURE 2 Electrocardiogram of Patient 1 Showing Anterolateral T-Wave Inversions and Interventricular Conduction Delay



left-to-right shunt at the basal inferior septum, consistent with VSR (Figures 4C and 4D).

MANAGEMENT. The patient was transferred to a tertiary care center for emergency cardiothoracic surgery evaluation. She developed cardiogenic shock within hours of transfer and was promptly taken to the operating room to repair the rupture with a bovine patch. The left ventricular cavity was small, and there was extensive friability of the myocardial tissue surrounding the defect. The anterior mitral papillary muscle was necrotic, and progressive mitral regurgitation intraoperatively mandated valvular

replacement. At the conclusion of the surgical procedure, the left ventricle had severe global hypokinesis and required an assist device. An Impella 5.0 device (Abiomed, Danvers, Massachusetts) was placed through the right femoral artery approach for post-operative support.

OUTCOME. The patient was transferred to the surgical intensive care unit in critical condition. She remained in cardiogenic shock and was unable to be weaned from the Impella device. The patient developed multisystem organ failure, including acute renal failure requiring continuous renal replacement

FIGURE 3 Electrocardiogram of Patient 2 Showing ST-Segment Elevation in the Inferior and Anterolateral Leads

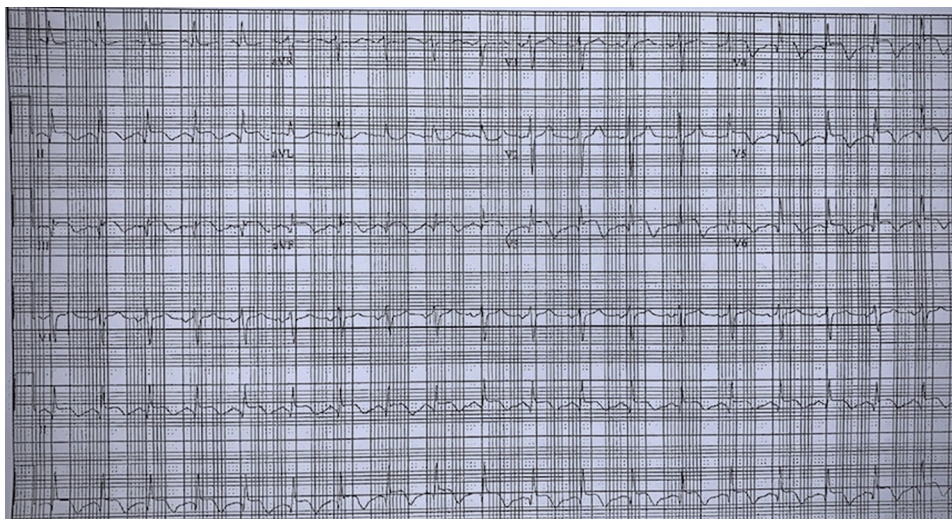
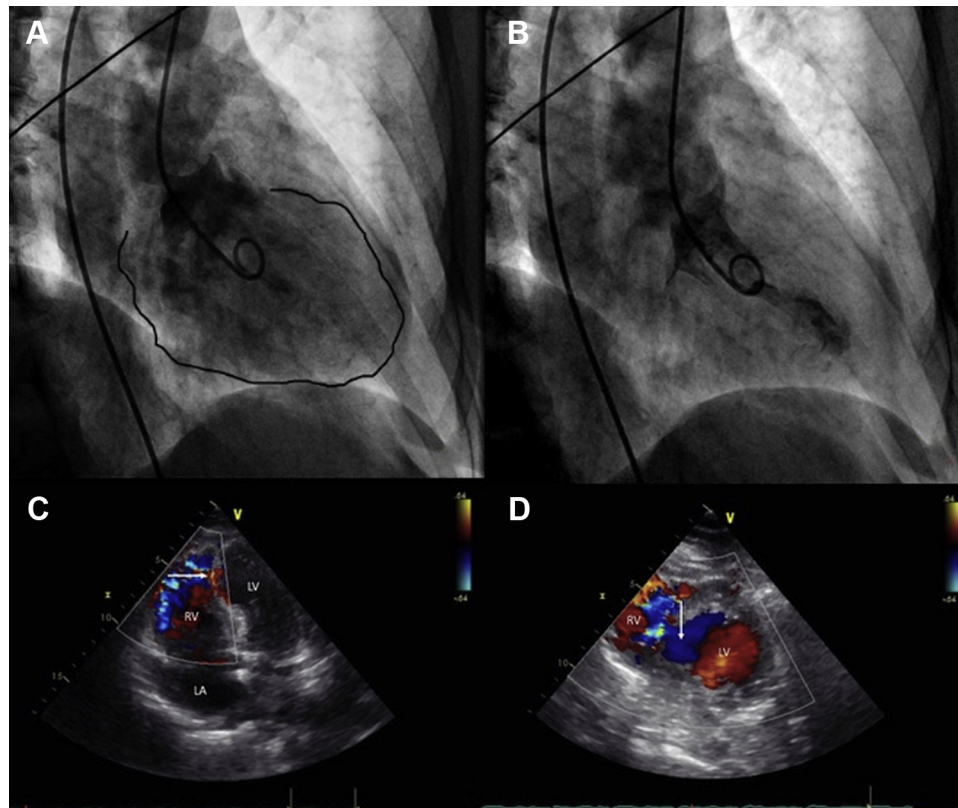


FIGURE 4 Imaging of Ventriculoseptal Rupture From Takotsubo Syndrome

Left-sided heart catheterization with left ventriculogram in (A) diastole (line to demarcate left ventricular cavity) and (B) systole. Trans-thoracic echocardiogram with (C) apical 4-chamber view and (D) parasternal short-axis view illustrating ventriculoseptal rupture (arrows). Abbreviations as in Figure 1.

therapy, metabolic acidosis, acute liver injury, ventilator-associated pneumonia, coagulopathy, and continued blood loss necessitating a massive transfusion protocol. She had seizures on post-operative day 2 and subsequent loss of brainstem reflexes. The family elected to withdraw care, and the patient died on post-operative day 7.

DISCUSSION

Takotsubo syndrome is a form of acute myocardial injury defined by apical left ventricular dysfunction that can manifest with an electrocardiographic pattern and cardiac biomarker elevation that mimic acute coronary syndrome. The diagnosis is made in 1% to 2% of patients presenting with suspected acute coronary syndrome (3,5). Takotsubo syndrome was previously thought to be a benign and transient entity, but increased recognition has revealed a multitude of severe complications (1). Patients with VSR secondary to takotsubo syndrome are at extremely high risk, as

evidenced by a review of 8 published cases with 3 mortalities (4). Our experience supports this view, as demonstrated by 1 death in our 2 cases. This case series illustrates the spectrum of possible outcomes associated with VSR from takotsubo syndrome. The incidence of takotsubo syndrome is increasing (6), and awareness of potential life-threatening complications and transfer to a center equipped to handle them are of the utmost importance.

AUTHOR DISCLOSURES


The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS cardiomyopathy, complication, ventricular septal defect

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