

CASE REPORT

INTERMEDIATE

CLINICAL CASE

# Unusual Cause of Severe Tricuspid Regurgitation



## Tricuspid Leaflet Annular Tear Following Remote Motor Vehicle Accident

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### ABSTRACT

Tricuspid regurgitation (TR) is an uncommon and underdiagnosed complication of blunt chest trauma. Typical mechanisms include torn chordae, papillary muscle rupture, and radial leaflet tear. We describe an unusual case of traumatic TR due to circumferential avulsion of the anterior tricuspid leaflet from the tricuspid annulus and the crucial role of multimodality imaging in its diagnosis and treatment. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2020;2:2156-61) © 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/>).

### PRESENTATION

A 48-year-old man presented with lightheadedness, exertional dyspnea, and near syncope in the setting of new-onset tachycardia.

### MEDICAL HISTORY

He reported a history of type 2 diabetes mellitus, hyperlipidemia, and a motor vehicle accident at age 20 years, when he sustained impact from the steering wheel into his chest but no known cardiac injury.

### DIFFERENTIAL DIAGNOSES

Coronary artery disease, heart failure, arrhythmia, occult infection, and vasovagal disturbance.

### LEARNING OBJECTIVES

- To recognize often underdiagnosed TV disease following blunt wall trauma.
- To appreciate that significant TV disease may become clinically apparent decades later.
- To highlight the benefits of multimodal imaging in characterizing the mechanism and extent of post-traumatic TV disease.

### INVESTIGATIONS

On physical examination, the patient was normotensive and tachycardic with a regular rate of 130 beats/min, corresponding to atrial tachycardia on electrocardiography tracing. No cardiac murmurs, jugular

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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 June 18, 2020; revised manuscript received July 17, 2020, accepted July 28, 2020.

venous distension, abnormal lung sounds, or edema were noted. Laboratory findings were unremarkable. Transthoracic echocardiography revealed preserved left ventricular ejection fraction, a severely dilated right atrium (RA), dilated and hypokinetic right ventricle (RV), and severe tricuspid regurgitation (TR). Pulmonary embolism was ruled out with a computed tomography (CT) scan.

### MANAGEMENT

After transesophageal echocardiography (TEE) results demonstrated no intracardiac thrombus, the patient underwent successful electrical cardioversion. TEE imaging also revealed severe TR with an unusual jet origin along the base of the anterior tricuspid leaflet (Figure 1, Video 1). This low-velocity and rapidly decelerating TR jet extended to the posterior RA wall, giving rise to the so-called anchor sign (Figure 2, Video 2). There was only a small amount of central TR at the level of leaflet coaptation (Figure 3, Video 3). 3-Dimensional (3D) TEE imaging revealed circumferential avulsion of the anterior tricuspid leaflet from the tricuspid annulus as the mechanism of TR with a regurgitant orifice area of 1.66 cm × 1.24 cm (Figure 4,

Video 4) and intact subvalvular apparatus (Figure 5, Video 5).

Chest CT scanning revealed a markedly dilated right heart with contrast reflux into the hepatic veins (Figure 6). Cardiac magnetic resonance (CMR) imaging revealed severe TR originating along the base of the anterior leaflet near the TV annular hinge point and distinct from the milder transvalvular TR (Figure 7, Video 6). RA and RV were severely dilated (indexed RV end-diastolic volume, 156 ml/m<sup>2</sup>) without primary RV myopathy.

### FOLLOW-UP

The patient successfully underwent surgical repair (Figure 8, Video 7) using a bovine pericardial patch and an annuloplasty band.

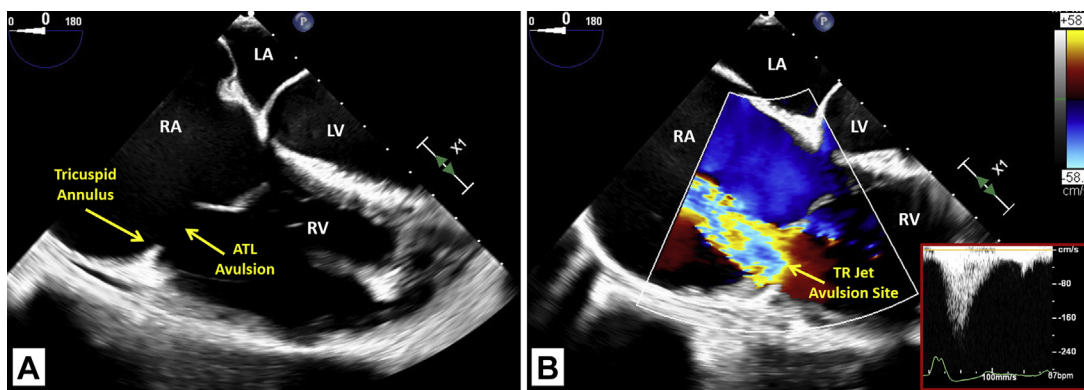
### DISCUSSION

Tricuspid valve (TV) disease is a rare complication of nonpenetrating chest wall trauma, often following motor vehicle accidents or falls from great heights.

### ABBREVIATIONS AND ACRONYMS

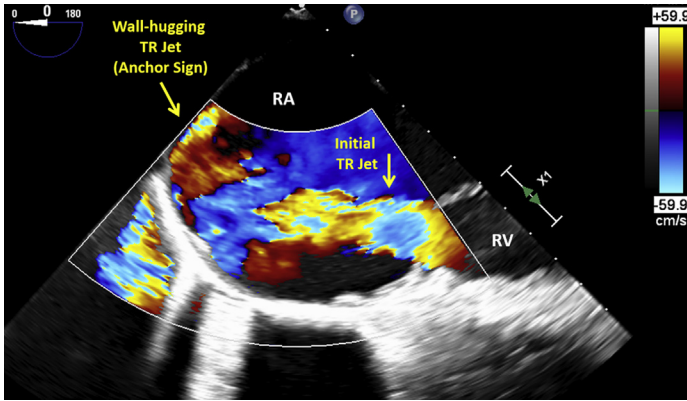
- 3D = 3-dimensional
- CT = computed tomography
- RA = right atrium
- RV = right ventricle
- TR = tricuspid regurgitation
- TV = tricuspid valve

**FIGURE 1** 2-Dimensional Transesophageal Echocardiogram Focused on Right Heart Demonstrates Avulsion of Anterior Leaflet of the Tricuspid Valve on Gray-Scale Imaging Resulting in Severe Eccentric TR



2-dimensional transesophageal echocardiogram focused on the right heart demonstrates avulsion of anterior leaflet of the tricuspid valve on gray-scale imaging (A), resulting in severe eccentric tricuspid regurgitation (TR) (B). (Inset) Spectral Doppler of the TR demonstrates dense, triangular shaped, low-velocity jet, consistent with severe TR. ATL = anterior tricuspid leaflet; LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle.

**FIGURE 2** 2-Dimensional Transesophageal Echocardiogram Focused on Right Heart Shows the TR Jet Extending to the Posterior RA Wall Giving Rise to the So-Called Anchor Sign



Abbreviations as in Figure 1.

Immediately after motor vehicle accidents, the primary focus is commonly on noncardiac trauma, and the cardiac injury may be missed (1-3). Due to the anterior location of the right heart, the TV is at particular risk for blunt injury. Further complicating the initial diagnosis is the possibility of subacute

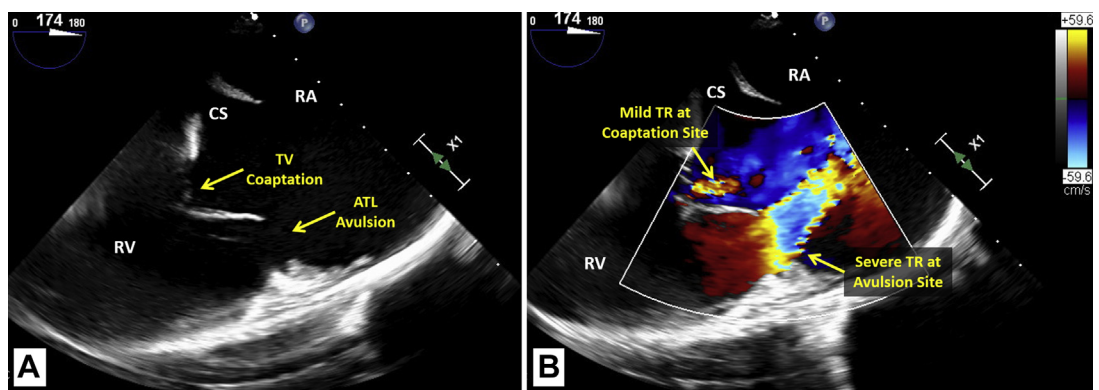
traumatic valvular disease which may not be present on initial cardiac imaging (4).

In 1829, the British physician Allen Williams published what appears to be the first confirmed case of traumatic TV injury on postmortem examination (5). Damage to the subvalvular apparatus appears more commonly than leaflet injury, with a reported prevalence of chordal rupture (55.4%), papillary muscle rupture (27.0%), and leaflet rupture (14.8%) (6).

The proposed mechanisms of tricuspid injury include severe chest wall compression, deceleration force, and sudden increase in right ventricular pressure (1,7-10). A study using an in vitro lamb model suggested that the severity of cardiac injury related to the timing of maximum wall stress. The injuries are more likely to occur during end-diastole when the ventricular radius is increased, the wall thickness is decreased, and the wall stress is highest, according to the Laplace law (11).

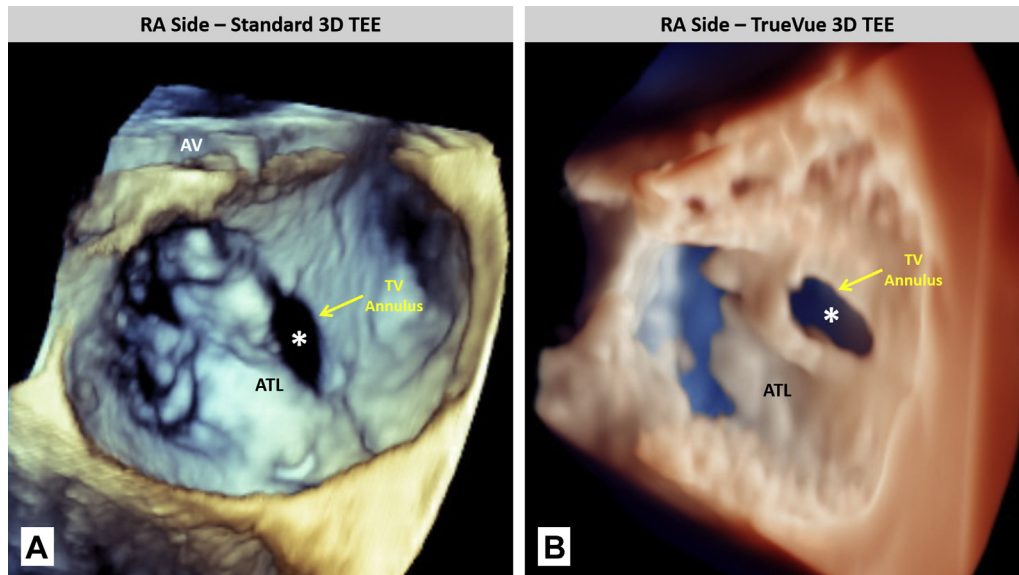
Two aspects of this patient's case are unusual, first, the uncommon mechanism of post-traumatic TR and, second, the nearly 30-year delay in diagnosis. Traumatic TR due to circumferential avulsion of the anterior tricuspid leaflet from the tricuspid annulus seen in this patient is exceedingly rare, and only a few cases have been reported (7,10,12,13). No previously published cases have included detailed multimodality imaging with 3D TEE, chest CT, and CMR

**FIGURE 3** 2-Dimensional Transesophageal Echocardiogram Delineating the Tricuspid Leaflet Coaptation Point Versus the Site of Avulsion



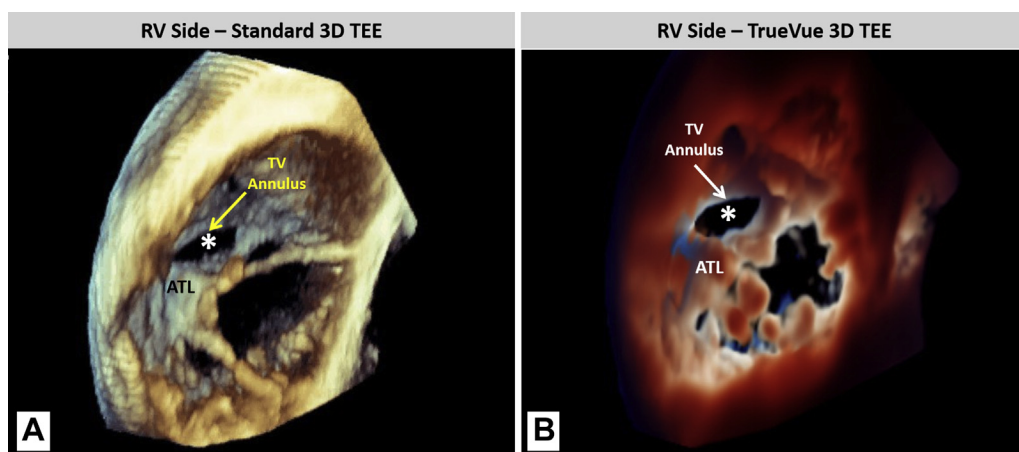
2-dimensional transesophageal echocardiogram delineating the tricuspid leaflet coaptation point versus the site of avulsion (A) with severe TR at the site of valve avulsion versus mild central TR (B). ATL = anterior tricuspid leaflet; CS = coronary sinus; other abbreviations as in Figure 1.

**FIGURE 4** 3-Dimensional Transesophageal Echocardiogram Imaging Shows Circumferential Avulsion of the ATL From the Tricuspid Annulus

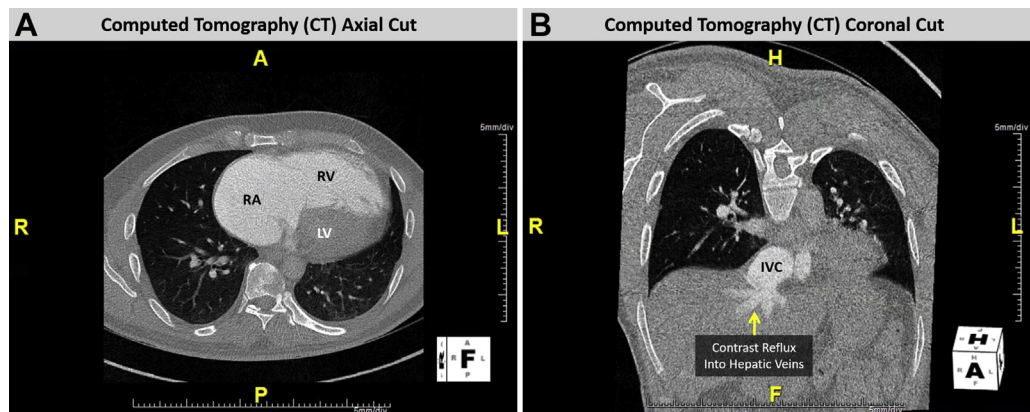


3-dimensional transesophageal echocardiogram (3D TEE) imaging demonstrating circumferential avulsion of the anterior tricuspid leaflet from the tricuspid annulus as visualized from the RA on standard (A) and photorealistic TrueVUE rendering (TrueVUE, Sewell, New Jersey) (B). Asterisk and arrow indicate the orifice resulting from avulsion. AV = aortic valve; other abbreviations as in Figures 1 and 3.

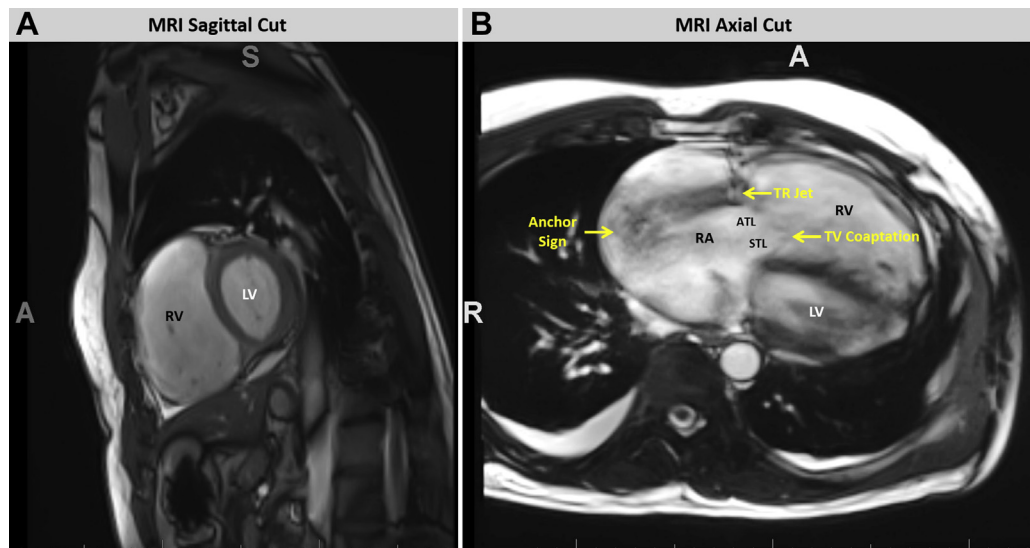
**FIGURE 5** 3-Dimensional Transesophageal Echocardiogram Imaging Demonstrating Circumferential Avulsion of the ATL



3-dimensional transesophageal echocardiogram imaging shows circumferential avulsion of the anterior tricuspid leaflet from the tricuspid annulus as visualized from the RV on standard (A) and photorealistic TrueVue rendering (B). Asterisk and arrow point to the orifice resulting from the avulsion. Abbreviations as in Figures 1, 3, and 4.

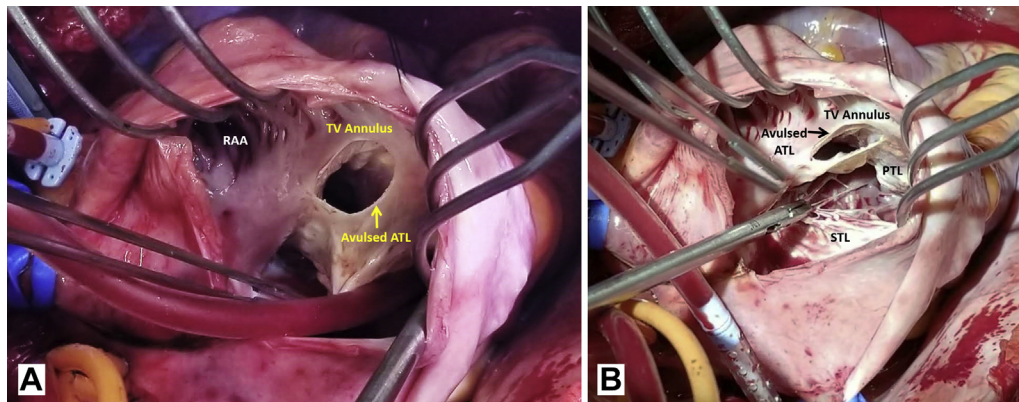
**FIGURE 6** Chest CT Reveals Markedly Dilated Right Heart With Contrast Reflux

Chest computed tomography (CT) reveals markedly dilated right heart (A, axial cut) with contrast reflux into a dilated inferior vena cava and hepatic veins (B, coronal cut), consistent with chronic severe TR. IVC = inferior vena cava; other abbreviations as in [Figure 1](#).

**FIGURE 7** Cardiac Magnetic Resonance Shows a Dilated RV and TR

Cardiac magnetic resonance shows a dilated RV (A) and TR originating along the base of the anterior leaflet adjacent to the TV annular hinge point and distinct from the milder transvalvular TR (B). ATL = anterior tricuspid leaflet; STL = septal tricuspid leaflet; other abbreviations as in [Figure 1](#).

**FIGURE 8** Intraoperative Views of the Opened Right Atrium Showing the Avulsion of the ATL



Intraoperative views of the opened right atrium showing the avulsion of the ATL from the TV annulus (A) and the relationship between the ATL and other tricuspid leaflets. (B) PTL = posterior tricuspid leaflet; RAA = right atrial appendage; STL = septal tricuspid leaflet; other abbreviations as in Figure 1.

imaging, which was crucial for defining the exact mechanism of post-traumatic TR and surgical planning in this patient.

## CONCLUSIONS

Traumatic TV disease is a rare complication of blunt chest trauma and may become apparent decades later. Thorough medical history and multimodality imaging are essential for detecting post-traumatic TR and characterizing its exact mechanism.

## 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** avulsion, cardiac magnetic resonance imaging, leaflet tear, motor vehicle accident, transesophageal echocardiography, tricuspid valve

**APPENDIX** For supplemental videos, please see the online version of this paper.