FELLOWS CORNER

A zebra masquerading as a horse: A case of bundle-branch reentrant ventricular tachycardia

Anas Jawaid, MD, Michael Riordan, MD, David Huang, MD, FHRS, Mehmet Aktas, MD, FHRS

From the University of Rochester Medical Center, Rochester, New York.

An 80-year-old woman presented with sudden-onset palpitations with dyspnea, as well as chest tightness. The patient had a pertinent medical history of severe aortic stenosis for which she had a 23 mm Edwards bioprosthethic valve implanted a year prior. Post transcatheter aortic valve replacement (TAVR) she developed PR prolongation (247 ms) and a left bundle branch block (LBBB) (Figure 1A). Short-term outpatient monitoring did not reveal progression to high-grade atrioventricular (AV) block. She had no history of coronary artery disease, significant structural heart disease, or extensive cardiomyopathy. No cardiac implantable electronic devices were present.

On assessment, the patient had a heart rate between 150 and 160 beats per minute. Her blood pressure range was 90–110/60–70 mm Hg. At rest, she was asymptomatic. Electrocardiography revealed a wide complex tachycardia with LBBB morphology at 161 beats per minute without atrial activity (Figure 1B). Biochemical investigation did not yield metabolic or endocrine abnormalities. NT-proBNP was elevated at 1937. High-sensitivity troponins were mildly elevated.

At bedside, the modified Valsalva maneuver transiently terminated the tachycardia, ending with a QRS complex into sinus rhythm. No underlying atrial fibrillation or flutter was observed. However, the patient had recurrent, minimally symptomatic tachycardia. She was admitted to the cardiology unit for additional evaluation and started on a diltiazem infusion. The differential for her presentation included supraventricular tachycardia with aberrancy, junctional tachycardia with VA block, atriofascicular ("Mahaim") tachycardia (either antidromic reentry or preexcited AV nodal reentry with bystander Mahaim), bundle-branch reentrant ventricular tachycardia (VT), and myocardial reentrant VT.

An echocardiogram showed concentric left ventricular (LV) hypertrophy with LV ejection fraction of 49% and a normally functioning prosthesis. With recurrent paroxysms and baseline sinus bradycardia limiting uptitration of AV-nodal blocking agents, the patient was referred for an electrophysiological study.

The femoral vein was accessed. A decapolar catheter was placed in the coronary sinus, quadripolar Josephson catheter was placed in the right ventricle (RV), and quadripolar Cournand catheter was placed in the His location. LV access was not obtained. The His signal could not consistently be recorded, likely owing to His-Purkinje conduction disease. Using a multipolar catheter, an HV interval of 79 ms and a right bundle (RB) potential–to–surface QRS interval of 28 ms was recorded. Retrograde conduction was absent during RV pacing. Dual AV nodal physiology was not observed. Atrial burst pacing initiated wide complex tachycardia with a cycle length of 370 ms, with presence of AV dissociation, with a rate and QRS morphology similar to the baseline conduction pattern. The RB signal preceded each QRS complex. During VT, variations in the RB-RB interval preceded the subsequent V-V intervals (Figure 1C). VT terminated spontaneously but was easily inducible with programmed ventricular extrastimuli using "short-long-short" pacing sequences from the RV apex. Attempts to entrain VT from the RV apex resulted in termination. The findings of the study

WHAT WE LEARNED FROM THIS CASE:

- Bundle-branch reentrant ventricular tachycardia (BBRVT) may mimic the QRS morphology during underlying rhythm.
- BBRVT should remain in the differential for wide-complex tachycardia in patients with structural heart disease and baseline His-Purkinje conduction disease.
- Patients undergoing transcatheter aortic valve replacement may develop His-Purkinje conduction disease that can facilitate BBRVT.
- Focal ablation of the right bundle can be curative in patients with BBRVT.

KEYWORDS Wide-complex tachycardia; BBRVT; Structural heart disease; RF ablation; TAVR (Heart Rhythm O^2 2022;3:441–443)

Address reprint requests and correspondence: Dr Anas Jawaid, Cardiovascular Disease, Interventional Cardiology, Electrophysiology & Heart Failure/Transplant Programs, University of Rochester Medical Center, 601 Elmwood Ave, Box 679A, Rochester, NY 14642. E-mail address: anas_jawaid@urmc.rochester.edu.

https://doi.org/10.1016/j.hroo.2022.07.002

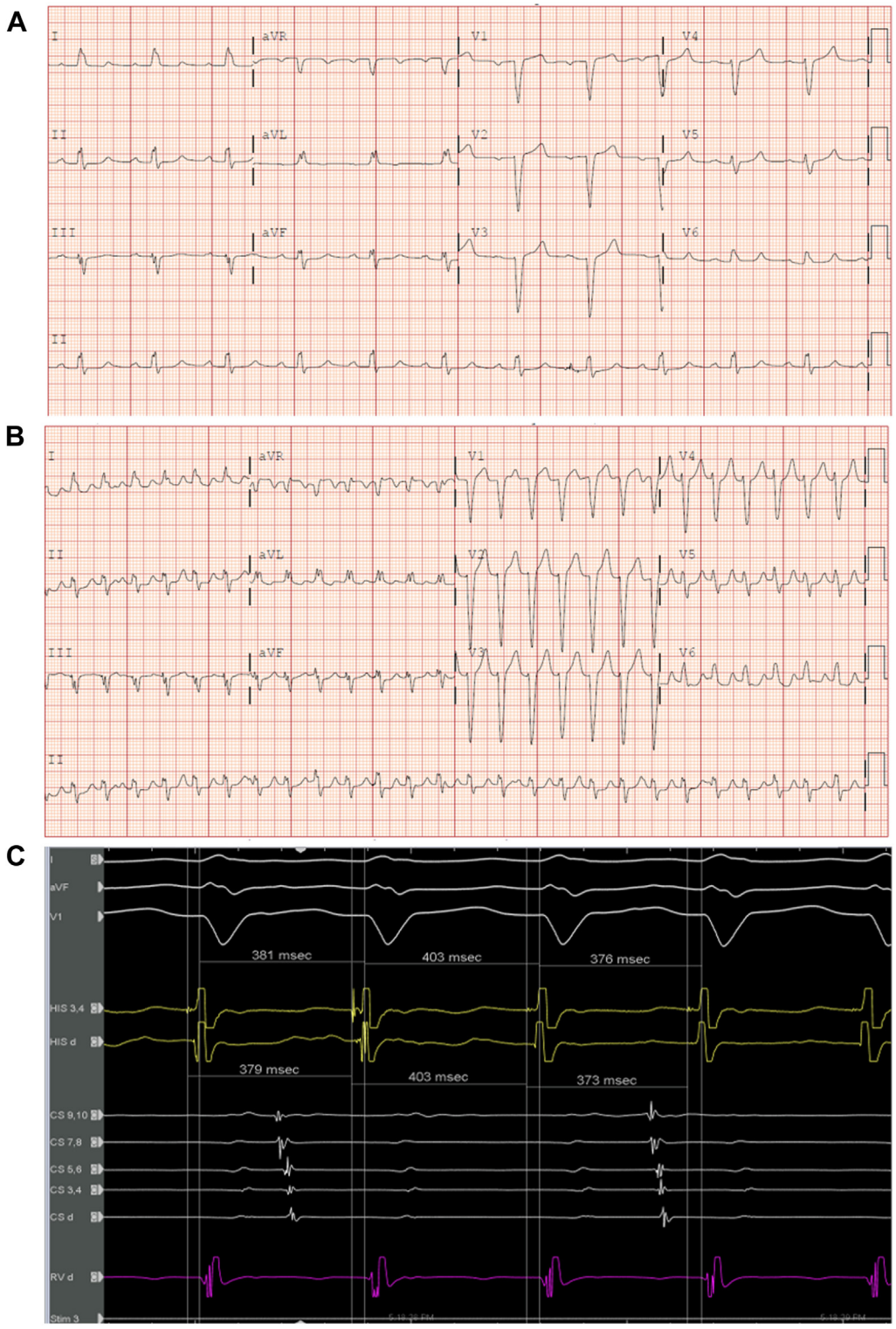

Figure 1 **A:** Baseline EKG following TAVR. **B:** Presenting EKG at admission showing a WCT with LBBB morphology. **C:** Intracardiac recordings during VT.

were suggestive of bundle-branch reentrant VT. LV access with assessment of the sequence of activation in the left bundle branch would have helped definitively rule out junctional tachycardia with VA block.

Based on these findings, a decision was made to ablate the RB branch. Using an irrigated-tip radiofrequency ablation catheter, the location of the RB potential was mapped while in sinus rhythm. Successful radiofrequency ablation was

performed but intermittent complete heart block followed by 2:1 AV block was observed. Following ablation, tachycardia was rendered noninducible with repeated programmed ventricular stimulation. Given the complete heart block, a dual-chamber permanent pacemaker was implanted. The patient was discharged home 4 days after admission. At 1 year of follow-up, she has had no recurrence of any further tachycardia.

Bundle-branch reentrant ventricular tachycardia (BBRVT) is an uncommon clinical entity in which both the right and left bundle branches are used as part of the reentrant circuit. Most commonly, it is observed in patients with significant structural heart disease, such as idiopathic dilated cardiomyopathy, coronary artery disease, and significant valvular heart disease.[1] BBRVT can be observed in patients with relatively structurally normal hearts, but the incidence in this population is significantly lower, with plausible mechanisms involving significant disease of the His-Purkinje system. Our patient developed post-TAVR conduction disease, which likely facilitated the subsequent development of BBRVT. This is an infrequent complication post TAVR, with only isolated reports in the available literature.[2]

The hallmark of BBRVT is anterograde conduction along the RB branch followed by conduction across the septum and then retrograde conduction along the left bundle branch, resulting in a typical LBBB pattern on the electrocardiogram. The opposite pattern may be observed (antegrade conduction down the left bundle and retrograde conduction up the RB), although this is less frequent. BBRVT is diagnosed during an electrophysiology study by showing that the presence of a His bundle (or RB) signal precedes ventricular activation, with changes in the H-H interval driving changes in the V-V interval, and usually the HV interval is longer during VT than in sinus rhythm.[3,4] Radiofrequency ablation of the RB branch is often curative, with long-term prognosis dependent on the underlying cardiac substrate.

Funding Sources: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosures: The authors have no conflict to disclose.

Authorship: All authors attest they meet the current ICMJE criteria for authorship.

Patient Consent: Consent for this publication was obtained directly from the patient.

References

1. Blanck Z, Dhala A, Deshpande S, Sra J, Jazayeri M, Akhtar M. Bundle branch reentrant ventricular tachycardia: cumulative experience in 48 patients. J Cardiovasc Electrophysiol 1993;4:253–262.
2. Workman V, Freeman J, Forrest J, Upadhyaya K, Carney K, Enriquez A. Bundle branch reentrant ventricular tachycardia after transcatheter aortic valve replacement. J Am Coll Cardiol 2019;73:2934–2934.
3. Akhtar M, Gilbert C, Wolf FG, Schmidt DH. Reentry within the His-Purkinje system. Elucidation of reentrant circuit using right bundle branch and His bundle recordings. Circulation 1978;58:295–304.
4. Roberts JD, Gollob MH, Young C, et al. Bundle branch re-entrant ventricular tachycardia. JACC Clin Electrophysiol 2017;3:276–288.