10-1-2022

The Frog Sign Revisited

Christopher J. Ho
James Madison University

Reginald T. Ho
Thomas Jefferson University Hospital

J Innov Cardiac Rhythm Manage. 2022;13(10):5184–5187

The Journal of Innovations in Cardiac Rhythm Management™

DOI: 10.19102/icrm.2022.13101

ATRIOVENTRICULAR NODAL RE-ENTRANT TACHYCARDIA

INTERESTING ELECTROCARDIOGRAMS

CASE REPORT

The Frog Sign Revisited

CHRISTOPHER J. HO, BS[1] and REGINALD T. HO, MD, FHRS[2]

[1]*Department of Biology, James Madison University, Harrisonburg, VA, USA*
[2]*Department of Medicine, Division of Cardiology, Thomas Jefferson University Hospital, Philadelphia, PA, USA*

ABSTRACT. *The frog sign is a classic physical examination finding of typical atrioventricular nodal re-entrant tachycardia. We present the case of a 78-year-old man with recurrent, symptomatic supraventricular tachycardia referred for ablation in whom the frog sign was observed during physical examination.*

KEYWORDS. *Frog sign, right atrial pressure, typical atrioventricular nodal re-entrant tachycardia.*

ISSN 2156-3977 (print)
ISSN 2156-3993 (online)

The frog sign is a classic physical examination finding of typical atrioventricular (AV) nodal re-entrant tachycardia (AVNRT) due to right atrial contraction against a closed tricuspid valve resulting in a reflux of blood into the superior vena cava and jugular veins.[1] Because of transmitted ventricular waveforms during right atrial pressure (RAP) recordings, RAP measurements during ventricular pacing maneuvers might further facilitate the diagnosis of AVNRT.

A 78-year-old man with recurrent, symptomatic supraventricular tachycardia (SVT) was referred for SVT ablation **(Figure 1)**. Upon presentation, he was in tachycardia, and

Figure 1: Twelve-lead electrocardiogram of supraventricular tachycardia.

the frog sign was observed on physical examination. An electrophysiologic study with RAP recordings was performed. Frequent non-sustained atrial tachycardia repeatedly induced an "A-on-V" tachycardia that was terminated by late-coupled His-refractory atrial premature depolarizations (*), excluding junctional tachycardia **(Figure 2)**.[2]

The authors report no conflicts of interest for the published content.
No funding information was provided.
Manuscript received February 14, 2022. Final version accepted April 15, 2022.
Address correspondence to: Reginald T. Ho, MD, 925 Chestnut Street, Mezzanine Level, Philadelphia, PA 19107, USA.
Email: reginald.ho@jefferson.edu.

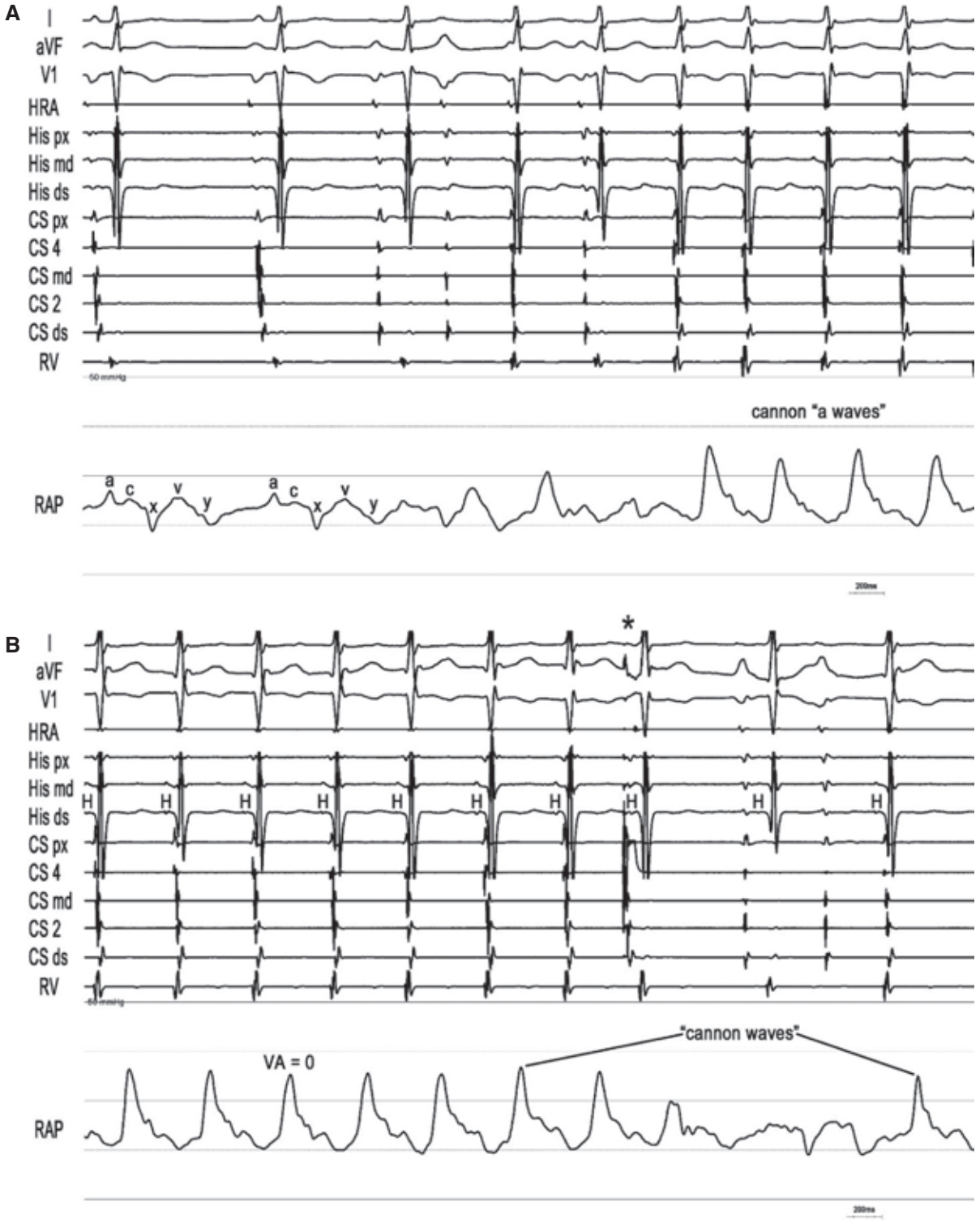

Figure 2: Onset **(A)** and termination **(B)** of typical atrioventricular nodal re-entrant tachycardia with right atrial pressure (RAP) recordings. The positive a-wave represents atrial contraction that actively fills the right ventricle in end-diastole.[7] The positive c-wave results from the closure and bulging of the tricuspid valve into the right atrium during early systole. The positive v-wave reflects a passive increase in RAP as the right atrium fills in late systole and early diastole. The x descent reflects atrial relaxation in the final phase of ventricular systole. The y descent results from the opening of the tricuspid valve and passive ventricular filling in early diastole. *Abbreviations:* CS, coronary sinus; HRA, high right atrium; RAP, right atrial pressure; RV, right ventricle; VA, ventriculoatrial. *His-refractory atrial premature depolarization.

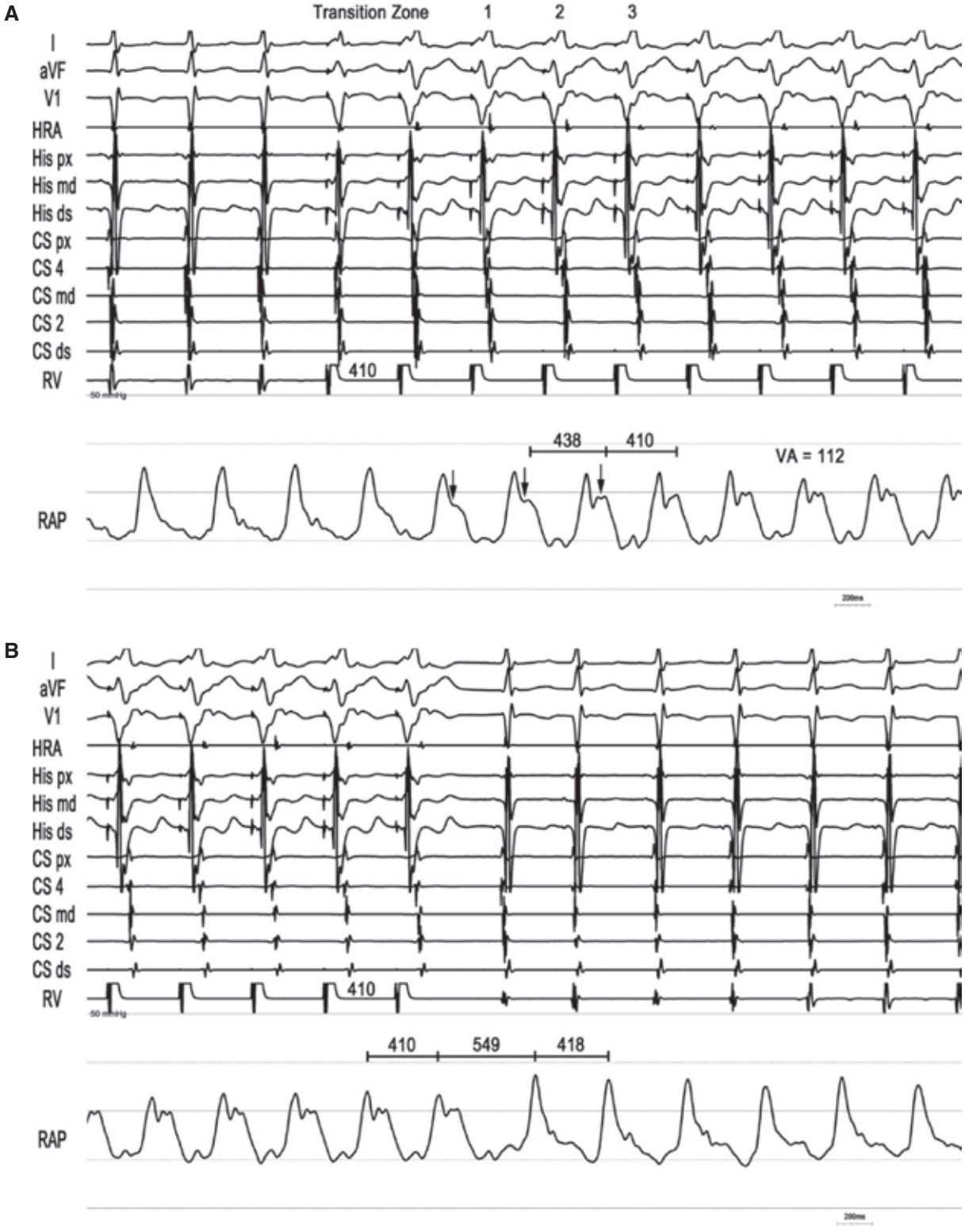

Figure 3: Onset **(A)** and termination **(B)** of entrainment of typical atrioventricular nodal re-entrant tachycardia from the ventricle with right atrial pressure recordings. *Abbreviations:* ↓, atrial pressure waveforms dissociated from ventricular waveforms; CS, coronary sinus; HRA, high right atrium; RAP, right atrial pressure; RV, right ventricle; VA, ventriculoatrial.

Characteristic low-pressure sinus waveforms transitioned to higher-pressure (peak, 25 mmHg) fused ventriculoatrial "cannon waves" (VA = 0 ms) during tachycardia. During onset of entrainment from the ventricle, atrial waveforms (↓) were dissociated from the ventricle within the transition zone, causing a drop in RAP, but then became fixed with the ventricle (VA = 112 ms) following acceleration of the atrial rate to the pacing cycle length (410 ms) after the third fully paced ventricular complex (hemodynamic ΔVA [$VA_{(V\ entrainment)} - VA_{(SVT)}$] = 112 ms [>85 ms]) **(Figure 3)**.[3,4] Termination of entrainment revealed an "AV" response with a long hemodynamic post-pacing interval (549 ms) that exceeded the tachycardia cycle length by 131 ms (>115 ms), followed by resumption of cannon waves.[5,6] Slow pathway ablation rendered the AVNRT non-inducible.

Besides cannon waves, hemodynamic post-pacing interval and ΔVA intervals derived from RAP waveforms can be useful for the diagnosis of typical AVNRT.

References

1. Gursoy S, Steurer G, Brugada J, Andries E, Brugada P. Brief report: The hemodynamic mechanism of pounding in the neck in atrioventricular nodal reentrant tachycardia. *N Engl J Med*. 1992;327(11):772–774.
2. Padanilam BJ, Manfredi JA, Steinberg LA, Olson JA, Fogel RI, Prystowsky EN. Differentiating junctional tachycardia and atrioventricular node re-entry tachycardia based on response to atrial extrastimulus pacing. *J Am Coll Cardiol*. 2008;52(21):1711–1717.
3. Al Mahammeed ST, Buxton AE, Michaud GF. New criteria during right ventricular pacing to determine the mechanism of supraventricular tachycardia. *Circ Arrhythm Electrophysiol*. 2010;3(6):578–584.
4. Dandamudi G, Mokabberi R, Assal C, et al. A novel approach to differentiating orthodromic reciprocating tachycardia from atrioventricular nodal reentrant tachycardia. *Heart Rhythm*. 2010:7(9):1326–1329.
5. Knight B, Zivin A, Souza J, et al. A technique for the rapid diagnosis of atrial tachycardia in the electrophysiology laboratory. *J Am Coll Cardiol*. 1999;33(3):775–781.
6. Michaud GF, Tada H, Chough S, et al. Differentiation of atypical atrioventricular node re-entrant tachycardia from orthodromic reciprocating tachycardia using a septal accessory pathway by the response to ventricular pacing. *J Am Coll Cardiol*. 2001;38(4):1163–1167.
7. Applefeld MM. The jugular venous pressure and pulse contour. In: Walker HK, Hall WD, Hurst JW, eds. *Clinical Methods: The History, Physical, and Laboratory Examinations*. 3rd ed. Boston, MA: Butterworths; 1990.