Pinos and Piedra
International Journal of Arrhythmia (2024) 25:7
https://doi.org/10.1186/s42444-024-00114-9

International Journal of Arrhythmia

CASE REPORT Open Access

Atrioventricular nodal re-entrant tachycardia with a 2:1 atrioventricular block in a young man: What is the mechanism?

Javier Pinos[1,2*] and Diego Serrano Piedra[1]

Abstract

A 16-year-old man presented with short VA supraventricular tachycardia and 2:1 atrioventricular ratio. The correct maneuvers allowed us to guide not only the mechanism but also the probable location of the atrioventricular block.

Keywords Atrioventricular nodal re-entrant tachycardia, Atrioventricular block, Functional block, Intrahisian, Case report

Background

Atrioventricular nodal re-entrant tachycardia (AVNRT) has different forms of presentation, where the slow-fast type, with a 1:1 atrioventricular (AV) ratio, is the most common. In this case report, we present a case of a young man and an AVNRT with 2:1 AV ratio, where specific maneuvers allowed a correct diagnosis and suggested the level of the AV block.

Case presentation

A 16-year-old man with no cardiovascular diseases presented with episodes of rapid palpitations in the previous two years, on some occasions accompanied by pre-syncope. A resting electrocardiogram (ECG), 24-h Holter recording, and a transthoracic echocardiogram were normal. An electrophysiological study (EPS) was indicated.

With the use of conventional fluoroscopy, one multipolar catheter (12-polar) was introduced and positioned from the right atrium to the right ventricle, passing through the His region.

The baseline conduction intervals were normal (PA = 38 ms, AH = 76 ms and HV = 46 ms). The atrial stimulation protocol with programmed extra-stimulation demonstrated a decremental and discontinuous AV conduction with the presence of AH jump and nodal echoes. A continuous atrial pacing protocol induced a supraventricular tachycardia with 2:1 AV ratio and fixed VA intervals of 36 ms and concentric atrial activation. This ruled out the possibility of an atrioventricular re-entrant tachycardia by an accessory pathway. The fusion between the blocked P wave and the previous T wave on surface ECG, configured an electrocardiographic sign described as "*the kiss of the girl from Ipanema*" [1] (Fig. 1).

Rapid and continuous programmed ventricular stimulation was performed, showing a change in the AV ratio from 2:1 to 1:1 and showing an His electrogram preceding all the VA electrograms, and maintaining a VA linking. A change in the QRS morphology was evidenced, compatible with right bundle branch block (RBBB), probably secondary to a phase III block (Fig. 2).

Faster ventricular stimulation was performed to entrainment the tachycardia to assess the VAV response and post pacing interval—tachycardia cycle length (PPI-TCL). After adequate entrainment of the tachycardia, a

*Correspondence:
Javier Pinos
japopv89@hotmail.com
[1] Centro Integral de Marcapasos y Arritmias, Hospital Monte Sinaí, Miguel Cordero Dávila Aveneu 6-140, Cuenca, Ecuador
[2] Universidad de Cuenca, Cuenca, Ecuador

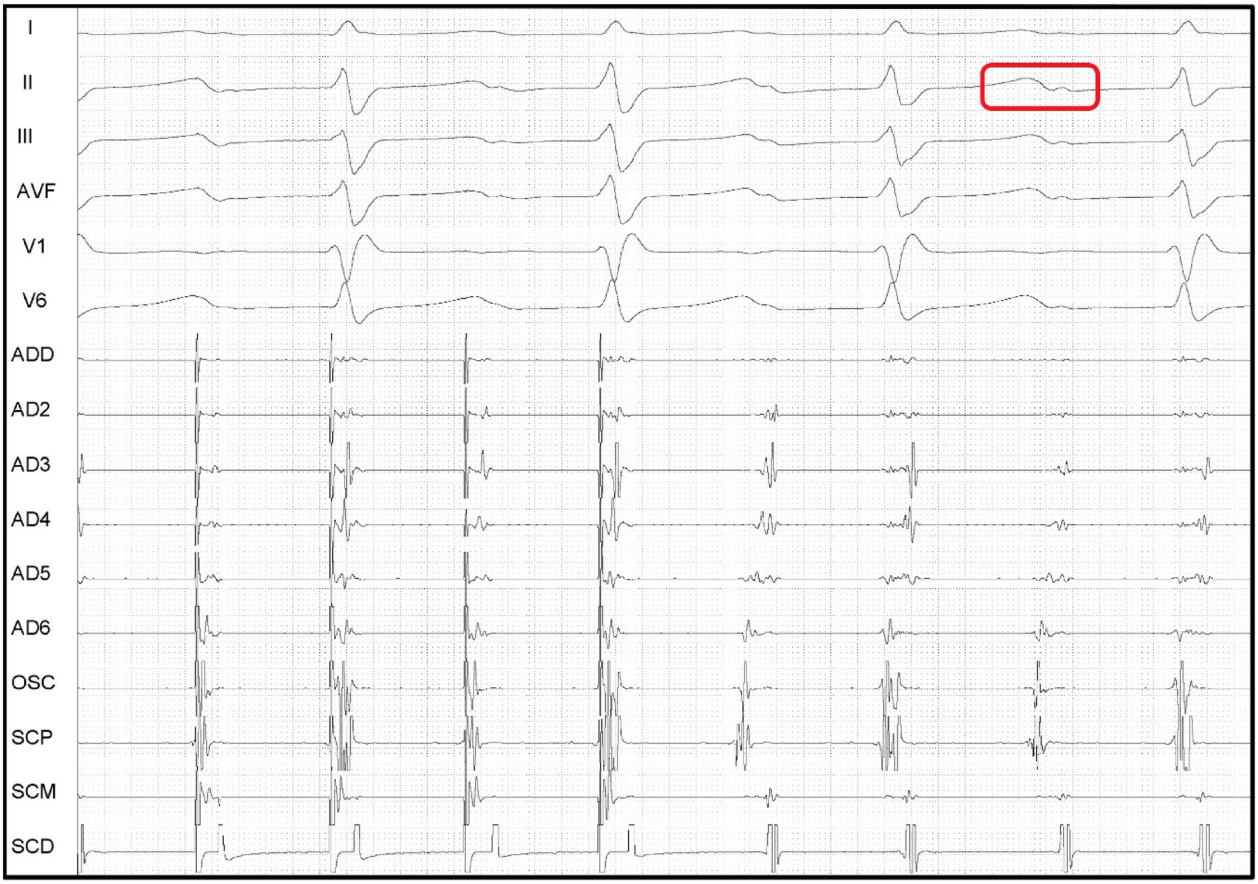

Fig. 1 SVT induction with 2:1 AV ratio. In red the sign of *the kiss of the girl from Ipanema*. SVT, supraventricular tachycardia; AV, atrioventricular

VAV response with a PPI-TCL of 228 ms was observed, ruling out the possibility of an atrial tachycardia, in addition to ruling out the participation of the right ventricle in the tachycardia circuit, confirming a slow-fast AVNRT (Fig. 3).

Radiofrequency ablation in the slow pathway region, between coronary sinus ostium and tricuspid annulus, was performed. Accelerated junctional beats were induced during the delivery of the RF current. After ablation, a new protocol of atrial stimulation was performed, without induction of supraventricular tachycardias. The patient has remained asymptomatic 9 months later.

Discussion

The case described is compatible with a typical slow-fast AVNRT with 2:1 AV block. Current evidence suggests the presence of a functional block; however, two questions arise: at what level and why does the block occur?

Some clues and evidence exposed in other cases help us try to explain these questions.

First, in the past, because his bundle (HB) potential was not observed in beats with AV block, the existence of a lower common pathway was proposed, as a lower part of the arrhythmia circuit and as part of the distal AV node. However, some researchers later showed that in cases of blockage at HB (proximal intrahisian level), his potential can be a very low amplitude and no apparent signal [1, 2].

Although the proposal of a lower common pathway is still valid, current evidence is in favor of an intrahisian blockade. The absence of his potential in blocked beats can be explained because the initial portion of activated HB is so small that it produces an unrecognizable low voltage potential in the intracavitary registry [3].

A fact in favor of a functional phase 3 block at the HB is due to the phenomenon known as the *long–short*

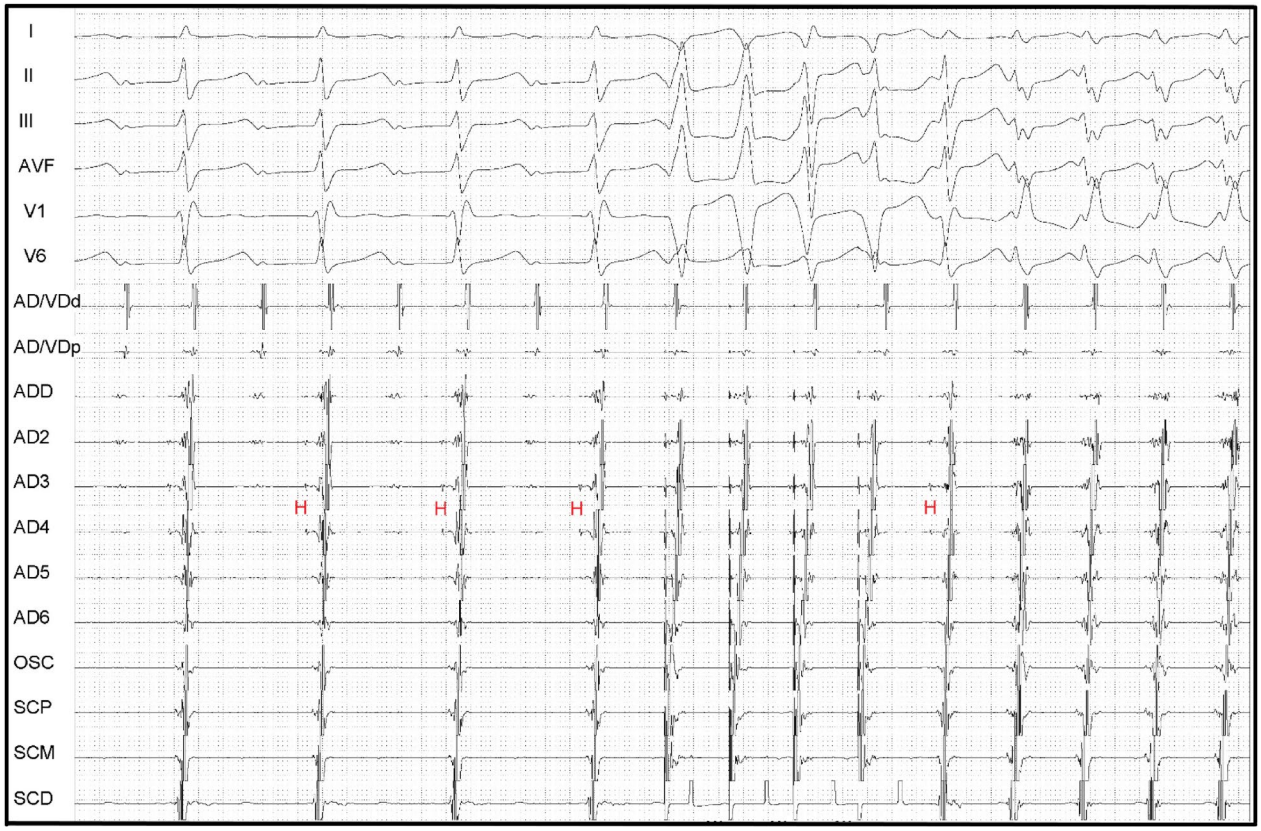

Fig. 2 Change in the AV ratio from 2:1 to 1:1 with continuous programmed ventricular stimulation. AV, atrioventricular; AD-ADD, right atrium; AD2-AD3-AD4, His bundle region; AD5 to SCD, right ventricle proximal to distal

activation sequence, typical of the HB, especially in very fast AVNRT, which may expose the HB tissue to long–short periods and can lead to functional block [4].

The change in AV ratio from 2:1 to 1:1 with continuous programmed ventricular stimulation probably occurs because retrograde depolarization of the HB by the ventricular stimulus eliminates the long–short activation sequence in the HB by peeling back and shortens the effective refractory period, with the consequent recovery of antegrade conduction to 1:1 [5, 6].

From everything described above, it seems that the region where the blockage occurs is at the intrahisian level and whose mechanism is a functional phase 3 block at the same level.

Conclusion

The mechanism of AVNRT with 2:1 AV block may be due to the presence of a lower common pathway or an intrahisian block. The *long–short activation sequence* phenomenon and the change in AV ratio from 2:1 to 1:1 with continuous programmed ventricular stimulation, suggest a functional phase 3 block at the HB (intrahisian). The absence of HB potential in blocked beats is probably because a small initial HB portion depolarized

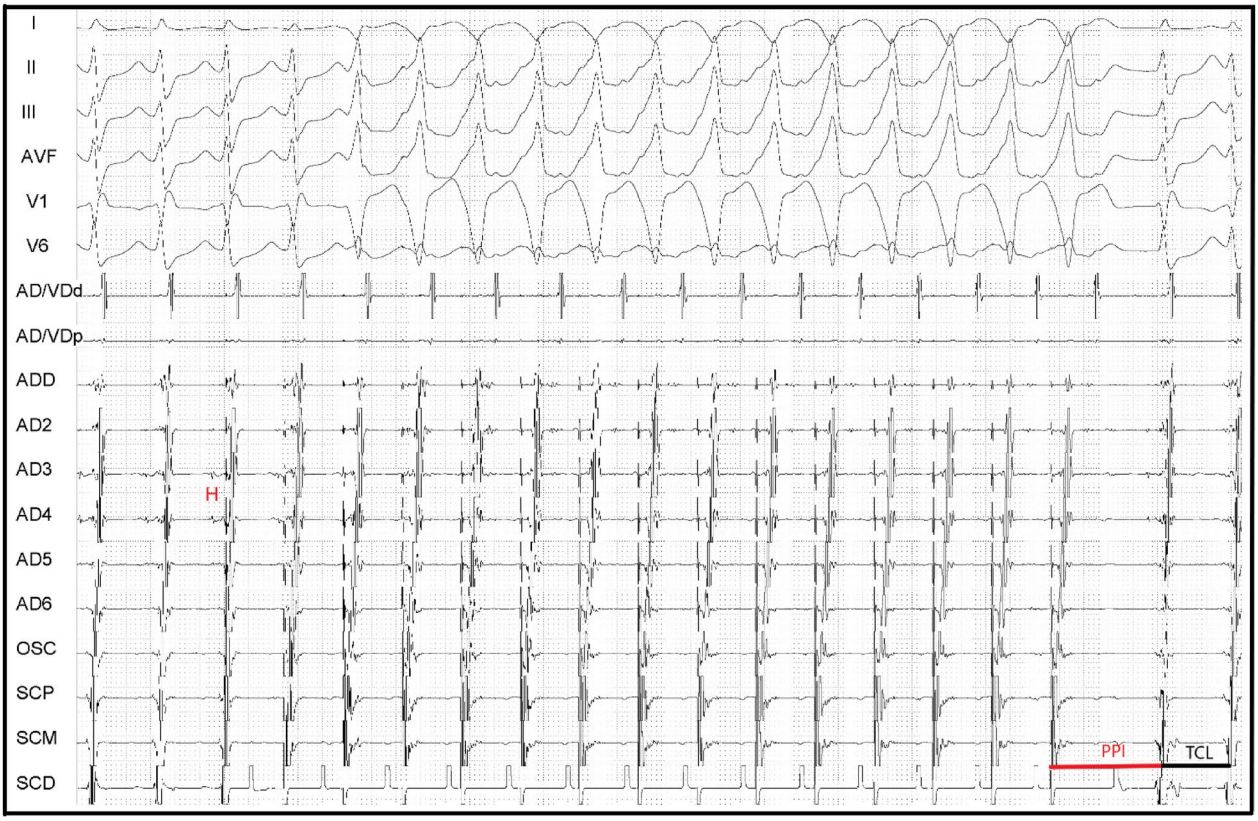

Fig. 3 Entrainment of the tachycardia with a VAV response and a PPI-TCL of 228 ms. VAV = ventricle-atrium-ventricle. PPI-TCL, post pacing interval-tachycardia cycle length; AD-ADD, right atrium; AD2-AD3-AD4, His bundle region; AD5 to SCD, right ventricle proximal to distal

that produces an unrecognizable low voltage potential in the intracavitary registry.

Acknowledgements
None.

Author contributions
Both authors contributed to the interpretation of the data and drafted the manuscript. Both authors have reviewed and approved the submission of the paper to the journal.

Funding
This research received no specific grant from any funding agency.

Availability of data and materials
Data generated or analyzed during this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
Written informed consent was obtained.

Consent for publication
We agree.

Competing interests
The authors declare that they have no competing interests.

Received: 19 December 2023 Accepted: 2 April 2024
Published online: 08 May 2024

References

1. Ching Man K, Brinkman K, Bogun F, Knight B, Bahu M. 2:1 Atrioventricular block during atrioventricular node reentrant tachycardia. J Am Coll Cardiol. 1996;28:1770–4.
2. Philibert S, Laurent G. A rare case report of variable degrees of atrioventricular block during atrioventricular nodal reentrant tachycardia. HeartRhythm Case Rep. 2020;6(7):441–4. https://doi.org/10.1016/j.hrcr.2020.04.008.
3. Issa ZF, Miller JM, Zipes DP. Clinical arrhythmology and electrophysiology: a companion to Braunwald's heart disease. 3rd ed. Philadelphia: Elsevier; 2019.
4. Katritsis DG, Josephson ME. Classification of electrophysiological types of atrioventricular nodal re-entrant tachycardia: a reappraisal. Europace. 2013;15(9):1231–40. https://doi.org/10.1093/europace/eut100.
5. Sorgente A, Chierchia GB, De Asmundis C, et al. Stepwise transition of 2:1 atrio-ventricular block to 1:1 conduction induced by ventricular premature beats in a patient with atypical AVNRT. Pacing Clin Electrophysiol. 2010;33(2):e20–3.
6. Kaneko Y, Nakajima T, Tamura S, et al. Superior-type fast slow atrioventricular nodal reentrant tachycardia with a 2:1 atrioventricular block. J Cardiovasc Electrophysiol. 2019;30(9):1696–8.

Publisher's Note