CASE REPORT

Premature ventricular contraction-induced concealed retrograde penetration: Electrocardiographic manifestations on anterograde ventricular preexcitation

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Abstract

In patients with manifest anterograde ventricular preexcitation, the electrocardiographic manifestation of the anomalous conduction through the simultaneous conduction over the atrioventricular (AV) node and the accessory pathway ("delta wave"); depends on several factors, the most representative being the conduction velocity over one or another connection. Occasionally, ventricular ectopic beats may present with retrograde penetration over one or both conduction pathways (AV node and/or accessory pathway), impacting on the morphology of the next immediate anterogradely conducted QRS. We present a case of a young patient with WPW syndrome and ectopic ventricular beats with different manifestations on the postectopic QRS due to concealed penetration of different conduction pathways.

KEYWORDS

concealed penetration, ECG, premature ventricular contractions, WPW syndrome

1 | CASE PRESENTATION

A 21-year-old male patient presented to the cardiology consult due to palpitations. He did not experience syncope and had no family history of cardiovascular disease nor sudden death. Patient denied use of recreational drugs. Physical exam was unremarkable. Minimal ventricular preexcitation was observed in the surface ECG and a 24-hr Holter monitoring was performed to try to establish symptom-rhythm correlation. The recording showed repetitive isolated and monomorphic premature ventricular contractions (PVC), with a specific postectopic QRS complex behavior. The patient was referred to the electrophysiology service who performed a successful ablation of the pathway.

2 | ECG INTERPRETATION AND CASE DISCUSSION

In our patient with manifest minimal ventricular preexcitation, a PVC with a coupling interval (CI) of 507 ms produced concealed

retrograde penetration of the AV node inducing a greater preexcitation of the following QRS complex indicating preferential anterograde conduction over the accessory pathway (Figure 1). The baseline QRS duration was 120 ms and the QRS after the ectopic beat increased to 150 ms. Note that at a shorter CI (lower panel, 500 ms), the degree of preexcitation of the following QRS complex was even greater. A variation in the PP interval induced by the PVC with shorter CI, may have induced complete anterograde block in the AV node, facilitating maximum preexcitation of the following beat.

On the contrary, when the structure that is retrogradely invaded is the accessory pathway (Figure 2), the following QRS complex is narrower (80 ms) (absence of delta wave) indicating preferential anterograde conduction over the AV node and His-Purkinje, without signs of ventricular preexcitation. This has occurred after a PVC with a CI of 523 ms. Finally, when the PVC CI reaches a critical point (in this case 625 ms), a retrograde penetration of both structures (AV node and accessory pathway) occurs simultaneously, leading to a block of the next beat indicated by a complete compensatory pause. Alternatively, it is also conceivable that this critical PVC CI also turns the sinus

FIGURE 1 (a) A premature ventricular contractions with retrograde penetration of the atrioventricular (AV) node produces maximum preexcitation of the following QRS complex. In the lower ECG panel, note that at a shorter coupling interval, the degree of preexcitation is even greater (see text for details). (b) Diagram showing retrograde penetration of the AV node and subsequent facilitation of anterograde conduction over the accessory pathway

FIGURE 2 (a) A premature ventricular contractions with retrograde penetration of the accessory pathway produces disappearance of preexcitation of the following QRS complex (see text for details). (b) Diagram showing retrograde penetration of the accessory pathway and subsequent facilitation of anterograde conduction over the atrioventricular node showing a completely narrow QRS complex

node refractory, as the P wave is not clearly seen following the PVC (Figure 3, Panels a,b).

Several factors can influence retrograde penetration of different structures following a PVC (Caldwell et al., 2013; Enriquez et al., 2014; Lehmann et al., 1984): the anatomical location of the ectopic beat and its vicinity to other structures of the conduction system, different coupling intervals and timing (refractory periods) to reach those structures, and the autonomic nervous system balance. In this specific case, a single recording on the same patient allowed visualizing three different responses in response to retrograde concealed penetration:

(i) retrograde penetration of the AV node, manifested as maximum preexcitation in the following beat; (ii) retrograde penetration of the accessory pathway, manifested as disappearance of preexcitation in the following beat and (iii) retrograde penetration of both structures (and possibly the sinus node), manifested as a full compensatory pause after the ectopic beat.

The exact mechanism of concealed retrograde penetration of different structures of the conduction system could be inferred through careful examination of different responses of the postectopic beat in the same Holter recording (Lehmann et al., 1987).

FIGURE 3 (a) A premature ventricular contractions with retrograde penetration of the atrioventricular (AV) node and the accessory pathway (and/or the sinus node) produces a complete block on the anterograde conduction inducing a full compensatory pause (see text for details). (b) Diagram showing retrograde penetration of the AV node and the accessory pathway (and/or the sinus node) inducing full block of the anterograde conduction

3 | CONCLUSIONS

Correct identification of the mechanisms of concealed retrograde penetration on the conduction system and accessory pathways can be done by a detailed analysis of surface recordings.

CONFLICT OF INTEREST

None.

REFERENCES

- Caldwell, J. C., Chiale, P. A., Gonzalez, M. D., & Baranchuk, A. (2013). The link in Linking. *Indian Pacing and Electrophysiology Journal*, 13(3), 118–121.
- Enriquez, A., Bittner, A., Alamehairi, M., & Baranchuk, A. (2014). Electrophysiology study without intracardiac catheters. The value of

proper Holter interpretation: A case report. *Journal of Electrocardiology*, 47(3), 329–332.

- Lehmann, M. H., Mahmud, R., Denker, S., Soni, J., & Akhtar, M. (1984). Retrograde concealed conduction in the atrioventricular node: Differential manifestations related to level of intranodal penetration. *Circulation*, 70(3), 392–401.
- Lehmann, M. H., Mahmud, R., Denker, S. T., Tchou, P. J., Dongas, J., & Akhtar, M. (1987). Effect of concealed anterograde impulse penetration on retrograde atrioventricular nodal conduction in man. *American Heart Journal*, 114(6), 1374–1383.

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