Atypical Pre-excitation Pattern in Asymptomatic Wolff-Parkinson-White—A Hallmark for High Risk?

Alexandru-Paul Burcin[1], Elena Ene[2], Radu-Gabriel Vătășescu[3]*

Abstract

Introduction: Delta wave morphology during sinus rhythm on 12 lead ECG usually allows for a relatively precise prediction of the anatomic location of an accessory pathway (AP) provided that the rhythm is fully pre-excited. However, the pre-excitation pattern during sinus rhythm usually offers little information about sudden cardiac death (SCD) risk in adult patients with asymptomatic Wolf-Parkinson-White (WPW).

Case Presentation: A 42-year-old policeman was referred for an asymptomatic WPW pattern with an unusual delta wave. Initial mapping showed that atrio-ventricular (A-V) fusion on the lateral mitral annulus and radiofrequency (RF) ablation induced a shift in the pre-excitation pattern. Re-mapping identified A-V fusion on the left postero-septal area. Another RF application eliminated pre-excitation. Re-mapping identified A-V fusion on the postero-septal aspect of the mitral annulus and another RF application almost instantaneously induced an A-V split and loss of pre-excitation. Post-ablation testing proved normal anterograde A-V conduction without pre-excitation and no ventriculo-atrial conduction. Serial ECGs proved the persistent loss of pre-excitation at one-month of follow-up.

Conclusion: This case highlights the diagnostic challenges associated with atypical pre-excitation patterns and the importance of a thorough evaluation in asymptomatic individuals. Patients with atypical pre-excitation may harbor multiple accessory pathways (MAPs) and should be carefully assessed to mitigate the risk of SCD.

Keywords

asymptomatic Wolf-Parkinson-White, multiple accessory pathways, sudden cardiac death risk

Introduction

Delta wave morphology during sinus rhythm on 12 lead ECG in the presence of multiple accessory pathways (MAP) may be less useful in the prediction of anatomic position but may add valuable information for sudden cardiac death (SCD) risk stratification in asymptomatic Wolf-Parkinson-White (WPW) [1]. To the best of our knowledge, this is one of the extremely rare reports on multiple left accessory pathways (APs) [2] and the only case report in which a pre-excitation pattern on standard ECG in an asymptomatic WPW case was highly suggestive for an association of two distinct left APs—an association that was confirmed during an invasive study. Moreover, this association was proven to be a high risk for SCD.

Case Presentation

A 42 year-old asymptomatic policeman with a Wolf-Parkinson-White (WPW) pattern and structurally normal heart was referred for sudden cardiac death (SCD) risk assessment. Patient had no history of syncope/presyncope or sustained palpitations, only occasionally perceiving brief episodes of palpitations (one to two seconds) during exercise. Echocardiography was normal. Baseline 12 lead ECG showed a short PR interval and an unusual pattern of pre-excitation, with delta wave positive across all precordial leads as well as positive in inferior leads and biphasic in leads I and aVL, with only a small initial negative deflection and a final prominent positive deflection (usually left lateral APs have definite negative delta wave in I and/or aVL) (Figure A). After the patient-informed consent was obtained, an electrophysiological study (EPS) was performed. Catheter manipulation mechanically induced short-coupled atrial extrasystoles, unmasking another two distinct patterns of pre-excitation, both with a positive delta wave in all precordial leads. The first one had a negative delta wave in inferior leads and a positive one in leads I and aVL (Figure B, first three beats), and the second one had an intensely positive delta wave in inferior leads and negative in leads I and aVL (Figure C, beats four to seven), suggesting that delta wave morphology during sinus rhythm may be due to fusion between two pre-excitation fronts produced by two distinct left-sided APs. During sinus rhythm, initial mapping showed atrio-ventricular (A-V) fusion at the antero-lateral area of the mitral annulus. Radiofrequency (RF) application induced an A-V split and a sudden change of the pre-excitation pattern (Figure C, last two QRS complexes), with a persistent positive delta wave across all precordial leads, a positive one in lead I and aVL, and a completely negative one in inferior leads. Re-mapping identified A-V fusion at the postero-septal aspect of the mitral annulus (Figure D, first two QRS complexes) and another RF application almost instantaneously induced an A-V split and loss of pre-excitation (figure D, last two QRS complexes). Post-ablation testing proved normal anterograde A-V conduction without pre-excitation and no ventriculo-atrial conduction. Serial ECGs proved a persistent loss of pre-excitation at one month of follow-up.

*Corresponding author: Radu-Gabriel Vătășescu, Clinic Emergency Hospital Bucharest, Bucharest, Romania; E-mail address: radu_vatasescu@yahoo.com

[1]Clinic Emergency Hospital Bucharest, Bucharest, Romania
[2]M.D., Emergency Institute for Cardiovascular Diseases Prof C C Iliescu: Institutul de Urgenta pentru Boli Cardiovasculare Prof Dr C C Iliescu
[3]MD, Cardiovascular Center Bad Neustadt

https://doi.org/10.2478/rjc-2023-0030
sciendo

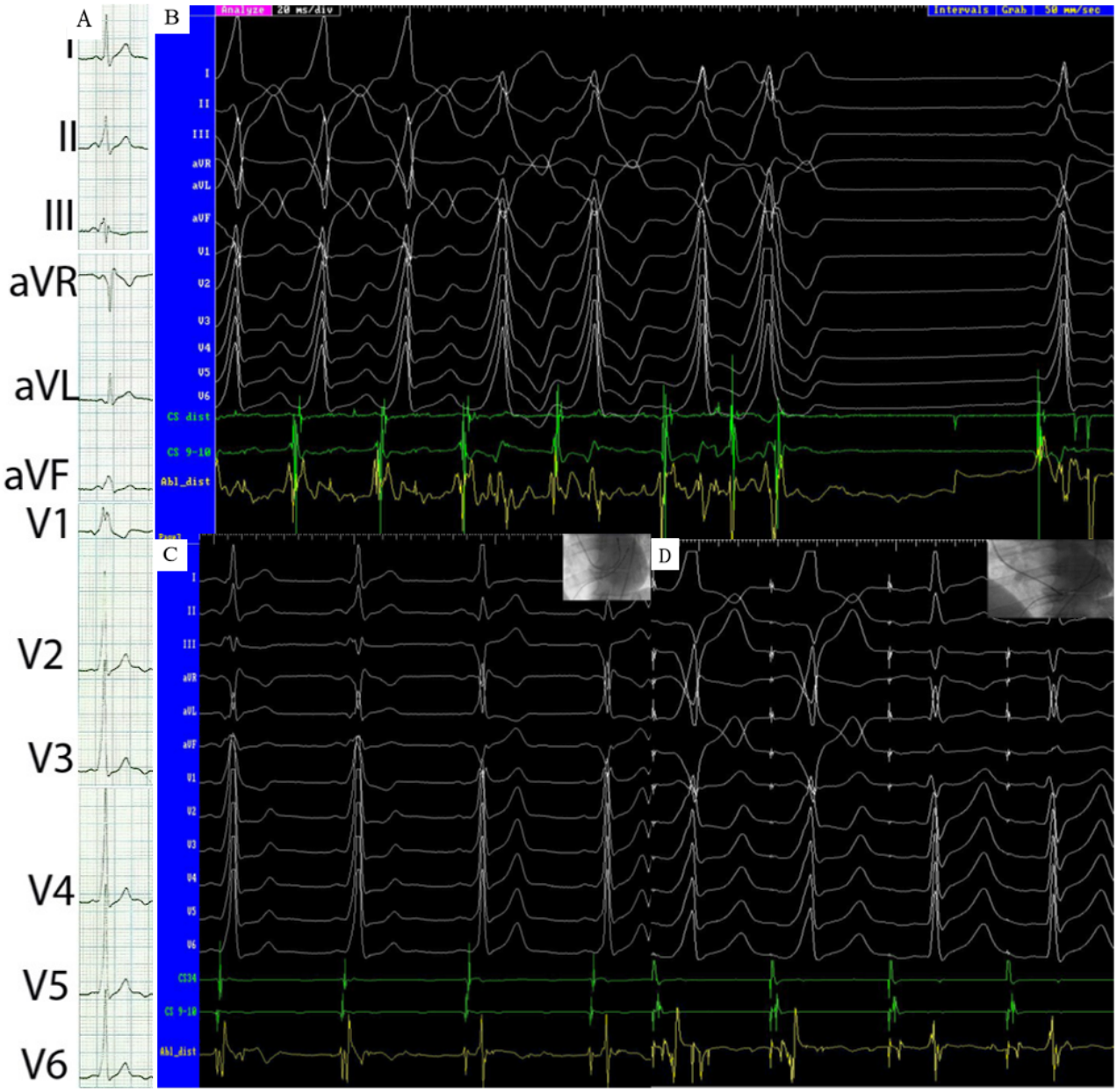


Figure 1 - **A** – 12-lead ECG; **B** – During catheter manipulation mechanically induced short-coupled atrial extrasystoles unmask two distinct patterns of pre-excitation; **C** – Initial mapping during SR revealed A-V fusion (first two QRS complexes) on the antero-lateral aspect of mitral annulus (X-Ray LAO projection on top-right corner) and RF application immediately induced A-V split and a sudden change in the pre-excitation pattern (last two QRS complexes); **D** – Remapping during atrial pacing identified an A-V fusion (first two QRS complexes) on the postero-septal aspect of the mitral annulus (X-Ray LAO projection on top-right corner) and RF application immediately induced an A-V split and sudden loss of pre-excitation (last two QRS complexes); CS, coronary sinus catheter, (9–10 proximal, 3–4 distal); Abl-dist, distal pole of map/ablation catheter.

Discussion

Among patients with the Wolf-Parkinson-White (WPW) pattern, the presence of multiple accessory pathways (MAP) is an infrequent occurrence [2], adding complexity to the management of this condition. Furthermore, in some cases, the surface ECG displays a distinctive pattern, potentially signaling the existence of MAP. This prompts the question of whether individuals manifesting these ECG patterns are at a heightened risk of SCD compared to those with a single AP.

MAP can be suspected from the surface ECG if the patterns do not align with the classic pre-excitation profiles. In cases of concomitant structural heart disease such as myocardial infarction, ventricular hypertrophy, or congenital heart defects, the ECG analysis is extremely difficult and predicting A-V conduction over MAP is even more challenging [3].

In our case, there was a distinctive ECG pattern of pre-excitation characterized by a short PR interval, with a positive delta wave across all precordial leads, a slightly negative wave in avL, a biphasic configuration in lead I, and only mild positivity in the inferior leads, which proved to be a fusion pattern between two APs.

The ECG analysis in orthodromic and antidromic circus movement tachycardia can provide a strong argument for the existence of MAP. The proximity of the atrial and ventricular connections of the AP ensures a consistent matching of the QRS site of origin during exclusive retrograde or antegrade conduction even in patients with an oblique course in the AP. Furthermore, the presence of two discernible P waves during orthodromic circus movement tachycardia may raise suspicion of MAP. One must keep in mind that this argument holds true when significant distance exists between the atrial insertion sites of the APs [3].

Although our patient has a structurally normal heart, it is worth mentioning that patients with structural heart disease (SHD) are three times more likely to have MAP according to a retrospective review conducted by Zachariah et al [4], with tricuspid valve annulus locations found predominantly in anatomic congenital malformations such as Ebstein's anomaly and mitral valve annulus locations identified in patients with cardiomyopathy.

The mechanism of SCD in WPW syndrome is ventricular fibrillation induced by atrial fibrillation conducted to the ventricles by APs with a short anterograde effective refractory period (APERP). Short APERP is an accepted predictor of SCD in adults with asymptomatic WPW syndrome. Additionally, concomitant short APERP is frequently observed in such cases but the presence of MAP is also considered an independent marker of SCD [1]. In some studies, its predictive value for SCD was not deemed independent from an APERP [5]. This could be attributed to the relatively low number of patients with multiple APs, alongside the frequent occurrence of concomitant short APERP in these scenarios [6]. Another controversial risk factor is the anatomical location, with the septal and left lateral areas as the most frequently incriminated (both are present in our patient). Although relatively scarce, the data from a single-center randomized trial in high risk asymptomatic WPW suggest that prophylactic catheter ablation is beneficial [7]. Another important issue is that, currently, there is no non-invasive marker for SCD in WPW except for a shorter than 250 ms pre-excited RR interval during atrial fibrillation [1]. Since the presence of MAP is accepted as a risk factor for SCD even in asymptomatic WPW patients, this condition could be seen as an alternating ECG pattern during a short burst of supraventricular arrhythmia (for instance during Holter monitoring) or as an ECG pattern on a standard ECG that cannot be explained by a single AP. Based on this useful information, the patients could be referred for earlier EPS and ablation.

To the best of our knowledge, this is one of the few case reports in which baseline ECG is highly suggestive of two distinct left APs, and therefore, of increased SCD risk in an asymptomatic WPW.

Conclusion

This case is a rare scenario that underscores the significance of an ECG analysis that subtly hinted at the presence of two distinct APs, warranting consideration for prophylactic catheter ablation due to an elevated risk of SCD in an otherwise young, asymptomatic patient.

Conflict of interest

The authors declare no conflict of interest.

REFERENCES

1. Blomström-Lundqvist C, Katritsis D, Arbelo E, Arribas F, Bax J, Brugada J, et al. 2019 ESC guidelines for the management of patients with supraventricular tachycardia The Task Force for the management of patients with supraventricular tachycardia of the European Society of Cardiology (ESC). Eur. Heart J. 2020 Feb;41(5):655–720. doi: 10.1093/eurheartj/ehz467.

2. Wallace AG, Gallagher JJ, Kasell J, Sealy WC. Multiple accessory pathways in patients with the pre-excitation syndrome. Circulation. 1976 Oct;54(4):571-59. doi: 10.1161/01.cir.54.4.571.

3. Gorgels AP, Cruz FE, Wellens HJ, Atié J, Smeets JL, Brugada P. The electrocardiogram in patients with multiple accessory atrioventricular pathways. J. Am. Coll. Cardiol. 1990 Sep;16(3):745–751. doi: 10.1016/0735-1097(90)90369-z.

4. Berul CI, Walsh EP, Cecchin F, Triedman JK, Zachariah JP, Bevilacqua LM, et al. Multiple accessory pathways in the young: the impact of structural heart disease. Am. Heart J. 2013 Jan;165(1):87–92. doi: 10.1016/j.ahj.2012.10.025.

5. Radinovic A, Ciaccio C, Pappone C, Manguso F, Ciconte G, Vicedomini G, et al. Asymptomatic ventricular preexcitation: a long-term prospective follow-up study of 293 adult patients. Circ. Arrhythm. Electrophysiol. 2009 Apr;2(2):102–107. doi: 10.1161/CIRCEP.108.827550.

6. Pappone A, Pappone C, Manguso F, Oreto G, Vicedomini G, Alfieri O, Mazzone P, et al. Usefulness of invasive electrophysiologic testing to stratify the risk of arrhythmic events in asymptomatic patients with Wolff-Parkinson-White pattern: results from a large prospective long-term follow-up study. J. Am. Coll. Cardiol. 2003 Jan;41(2):239–244. doi: 10.1016/S0735-1097(02)02706-7.

7. Pappone A, Dicandia C, Pappone C, Manguso F, Augello G, Vicedomini G, et al. A randomized study of prophylactic catheter ablation in asymptomatic patients with the Wolff-Parkinson-White syndrome. N. Engl. J. Med. 2003 Nov;349(19):1803–1811. doi: 10.1056/NEJMoa035345.