




The mystery of the dark tracing: a strange apparent intraventricular conduction alternance—case report

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Abstract

We present the electrocardiogram (ECG) of an elderly woman with Mobitz II atrioventricular (AV) block, left bundle branch block (LBBB), and ventricular ectopic activity. At first glance, the ECG may give the misleading impression of Wenckebach periodicity and raise the suspicion of intermittent left anterior fascicular block (LAFB) and left posterior fascicular block (LPFB), suggesting an apparent alternating conduction block in the main divisions of the LBB. This intriguing appearance prompted us to present the case.

Keywords

Mobitz II atrioventricular block, Wenckebach periodicity, alternating conduction, case report

Introduction

Sometimes, even a poorly recorded and visually unappealing electrocardiogram (ECG) trace can illuminate our understanding, as in the case described below.

Case report

An 85-year-old woman presented to our emergency room (ER) following a syncope. Upon arrival, she was alert, asymptomatic, and in good clinical condition, without any significant traumatic injuries. Laboratory tests revealed no signs of acute cardiac disease; electrolyte levels were normal, and she was not taking any medications known to impair cardiac conduction (her only medication was ramipril for arterial



hypertension). The ECG shown in [Figure 1](#) was recorded in the ER, but unfortunately became darkened after being left on the doctor's desk under a strong lamp for several hours, awaiting interpretation.

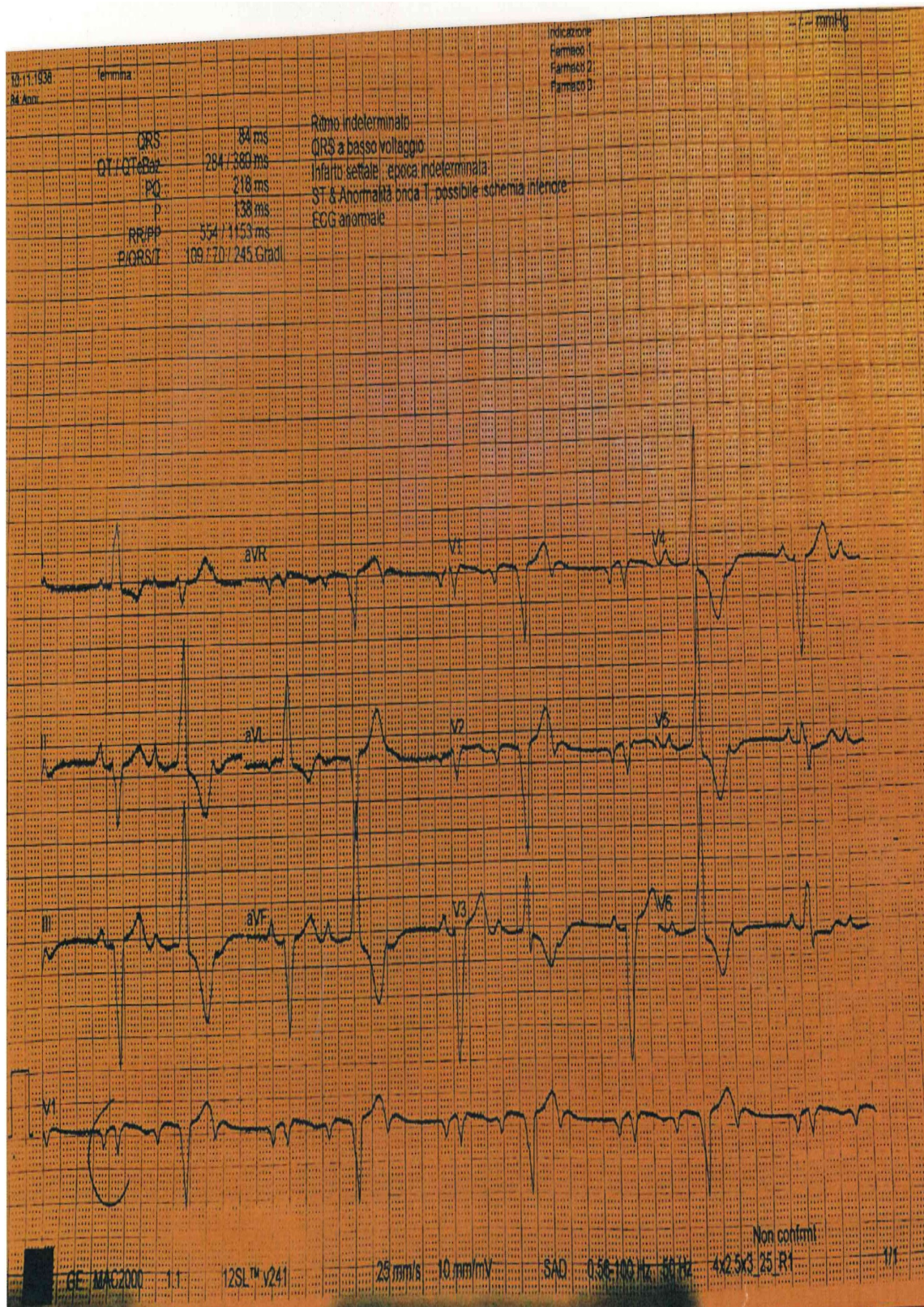


Figure 1. Darkened ECG recorded in the ER. Sinus rhythm with LBBB and left axis deviation. Mobitz II second-degree AV block with monomorphic VEBs at fixed coupling intervals. Note that each VEB is followed by a blocked sinus beat. See text for detailed interpretation. ER: emergency room; LBBB: left bundle branch block; AV: atrioventricular; VEBs: ventricular ectopic beats

Discussion

At first glance, the ECG appears to show a curious pattern suggestive of trifascicular block, with a rare form of distal Wenckebach periodicity, alternating conduction in the anterior and posterior fascicles of the left bundle branch (LBB), and an apparent 3:2 atrioventricular (AV) block. However, on closer inspection, the correct interpretation is more likely as follows:

1. Sinus rhythm with 2:1 AV block and LBB block (LBBB) with left axis deviation in the conducted sinus beats. The symptoms and the presence of LBBB in the conducted beats suggest a distal nature of the second-degree AV block present, making a diffuse pathology of the distal conduction system very likely. Therefore, the site of the P block (since the LBB is already blocked in the basal state) can be the right bundle branch or (less likely) the His bundle.
2. The regularity of the 2:1 AV block is disrupted by a bigeminal pattern of monomorphic ventricular ectopic beats (VEBs). These have a morphology consistent with LBBB, right axis deviation, and a fixed, very long coupling interval with the preceding beats.
3. By coincidence, in this short, dark ECG strip, each VEB follows a non-conducted sinus P wave with a long PR interval of identical length. Additionally, after each VEB, a sinus beat is blocked, likely due to concealed retrograde conduction within the His-AV node pathway. These findings give a false impression of Wenckebach periodicity.

What findings support this interpretation? The following observations, involving both depolarization and repolarization, are noteworthy:

1. The morphology of the beats with right axis deviation is not consistent with left posterior fascicular block (LPFB), as it lacks the typical S1Q3 pattern, the rS pattern in aVL, and the qR complex in leads II, III, and aVF [1]. Furthermore, the pseudo-delta wave morphology at the onset of the QRS complexes in leads V4 and V5 suggests an intramyocardial or epicardial origin of the ventricular depolarization [2].
2. The repolarization pattern of the beats with right axis deviation also supports their ventricular origin. Unlike depolarization, repolarization does not follow predefined pathways (e.g., bundle branches, Purkinje fibers) and is closely linked to the geometry of the depolarization wavefront [3]. This often leads to prolonged repolarization and increased QT dispersion when depolarization originates and terminates in the ventricles, as is typical with VEBs [4]. In our trace, the longer QT intervals, their dispersion across leads, and the bizarre repolarization morphology of the right axis deviation beat all support a ventricular origin.

A second ECG, recorded shortly after the one already discussed (Figure 2) shows 2:1 and 3:2 Mobitz II AV block and confirms the ventricular nature of the ectopic beats, clearly showing no temporal relationship with atrial activity.

Given the symptoms and the likely distal origin of the second-degree AV block—along with the known increased susceptibility in women to ventricular arrhythmias during AV block [5]—the patient underwent in the same day of arrival, DDD pacemaker implantation. An electrophysiological study was deemed unnecessary. After more than a year of follow-up, the patient is in good clinical condition: she is asymptomatic (no further syncopal episodes have occurred) and in good hemodynamic equilibrium. Her ECG shows (on prolonged observation) regular sinus rhythm and ventricular activity stimulated by the pacemaker operating in VDD mode. The timeline of the case is shown in Figure 3.

Thus, even an aesthetically poor-quality ECG can yield insights that extend far beyond the surface appearance of the trace. Furthermore, this case seems to tell us that an accurate analysis of a simple and inexpensive ECG can offer us a large amount of physiopathological, clinical, and prognostic information, making other expensive and invasive investigations unnecessary.

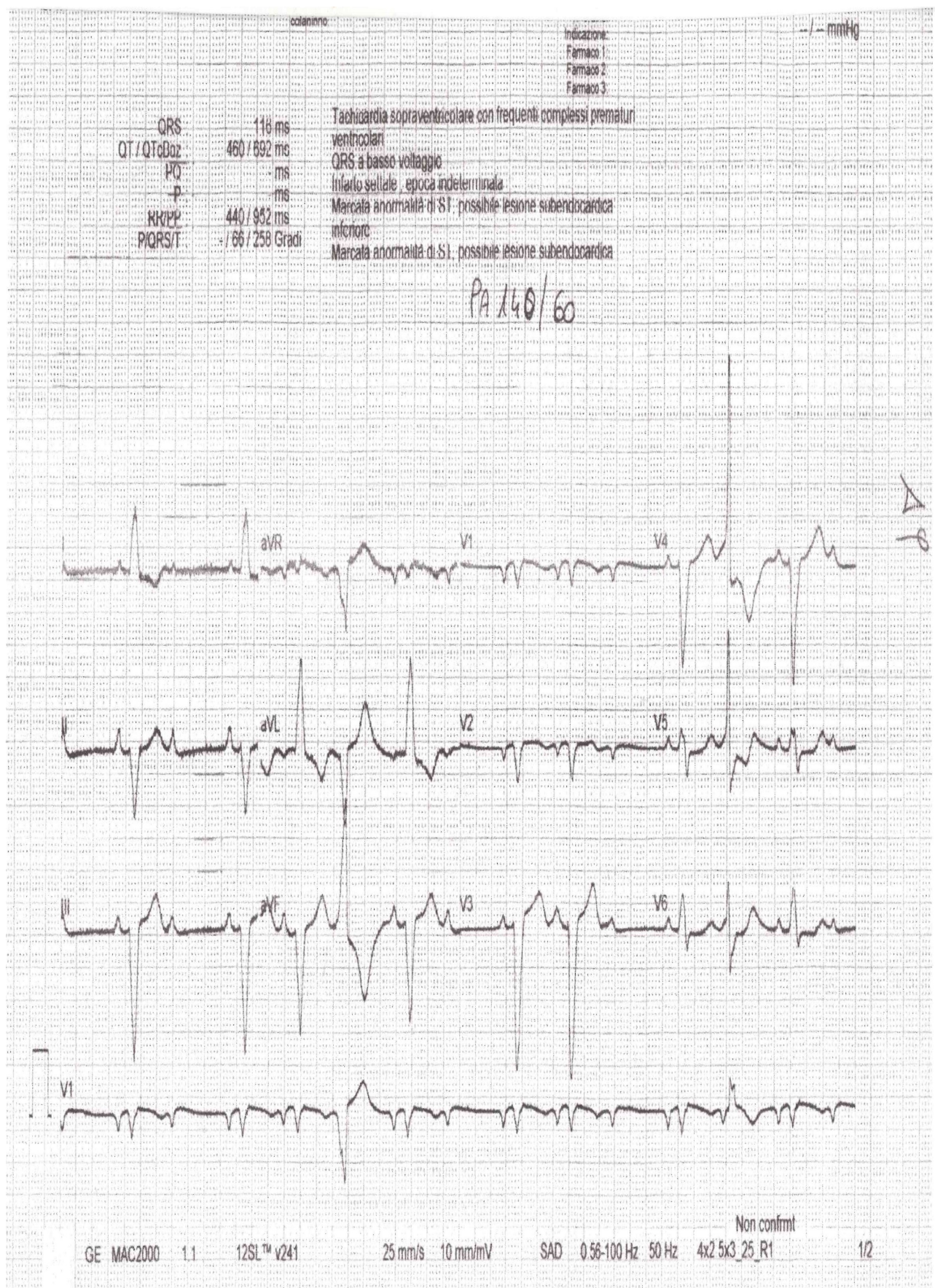


Figure 2. ECG recorded a few minutes later showed 2:1 and 3:2 Mobitz II AV block and premature ventricular beats. To be noted, the fourth QRS complex corresponds to the same VEB with right axis deviation as that described in [Figure 1](#), although with a shorter coupling interval and indubitable evidence of not being a sinus conducted beat. The penultimate beat looks like a fusion between the sinus beat and an EVB of a different origin. See text for further interpretation. ECG: electrocardiogram; AV: atrioventricular; VEB: ventricular ectopic beat

February 7, 2024, 7.15 a.m.

An 85-year-old woman arrives in the emergency room after syncope. Upon arrival, she was alert, asymptomatic, and in good clinical condition. An ECG is recorded immediately.



Although the initial interpretation of the tracing was that of a second degree Wenckebach AV block, with alternating conduction through the two fascicle of the left bundle branch, a subsequent more careful analysis reveals the presence of: (a) second-degree AV block Mobitz II and left bundle branch block in the conducted sinus beats; (b) presence of ventricular ectopic beats.



On the basis of symptoms and ECG, the patient underwent the same-day pacemaker DDD implantation.



After more than a year, the woman is well, she has not had any more syncope, her ECG shows regular sinus rhythm and ventricular activity correctly stimulated by the pacemaker in VDD mode.

Figure 3. Table of timeline. ECG: electrocardiogram; AV: atrioventricular

Abbreviations

AV: atrioventricular

ECG: electrocardiogram

ER: emergency room

LBB: left bundle branch

LBBB: left bundle branch block

LPFB: left posterior fascicular block

VEBs: ventricular ectopic beats

Declarations

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Author contributions

MC: Conceptualization, Data curation, Writing—original draft, Writing—review & editing. MP: Data curation, Formal analysis. LC: Validation, Writing—review & editing. PC: Data curation, Methodology. MVE: Supervision, Validation.

Conflicts of interest

All authors declare that they have no conflicts of interest.

Ethical approval

Ethical approval for the study is not required according to the local ethics committee as it is just a simple interpretation of a difficult ECG tracing.

Consent to participate

Informed consent to participate in the study was obtained from the patient.

Consent to publication

Not applicable.

Availability of data and materials

The data for this study could be available from the corresponding author upon reasonable request.

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