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ECG for Students and Associated Professionals

A short RP narrow QRS rhythm: What is the mechanism?



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1. Case presentation

A 75-year-old woman with syncope was hospitalized at our institute. The surface 12-lead electrocardiogram (ECG) at admission indicated a regular short RP rhythm at a rate of 95 beats per minute (bpm) with a narrow QRS complex (Fig. 1A). Echocardiography and enhanced multidetector computed tomography revealed a heart with a normal structure and without significant coronary artery disease. She developed dizziness and nausea while hospitalized. A 12-lead ECG at the time of her symptoms documented a prolongation of the RR interval up to 4 s (Fig. 1B). What is the mechanism of the short-RP narrow QRS rhythm and the prolongation of the RR interval?

2. Discussion

A short RP rhythm without tachycardia (heart rate < 100 bpm) is generally recognized as a junctional rhythm with retrograde nodal atrial conduction. In the present case, the ECG during the patient's symptoms (Fig. 1A) indicated an accelerated junctional ectopic rhythm followed by a P wave. However, there was no QRS complex preceding the first P wave at the beginning

Abbreviations: ECG, electrocardiogram; AV, atrio-ventricular

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of the RR prolongation (Fig. 1B). This absence of a QRS complex before the P wave suggests that the atrium is not passively activated by the ectopic beats originating from the atrio-ventricular (AV) node. An AV reciprocating rhythm with a concealed accessory pathway can be excluded. Thus, the mechanism of the short RP rhythm is likely either a sinus rhythm or an ectopic atrial arrhythmia with a long first-degree AV block. The positive P wave morphology in the inferior leads during the short RP rhythm also indicates that the atrium was not activated from the AV node. A positive P wave in lead V1 suggests that the origin of the ectopic rhythm is from the left atrium, with a sensitivity of 93% and a specificity of 88% [1]. In the present case, the morphology of the P wave at admission may have originated not from the sinus node but from the left atrium.

On the basis of this mechanism, the prolonged RR interval with the patient's symptoms was likely a reflection of the progression of the AV block with an underlying first-degree AV block. Despite a first-degree AV block (420 ms) during the short RP rhythm, a short PR interval (160 ms) was observed with an advanced AV block (Fig. 1B). Thus, the patient could have a dual AV node pathway. The effective refractory period of the fast pathway can exceed that of the slow pathway. The functional block in the fast pathway can be maintained by repetitive collision of retrograde invasion of impulses conducted through the slow pathway (linking phenomenon) [2]. During an advanced AV block, the antegrade conduction block of the slow pathway can allow the recovery of fast pathway conduction. However, the P wave resulting in the QRS is not the one immediately in front of the QRS but the P wave before that one, conducting with a long PR, which would explain this phenomenon.

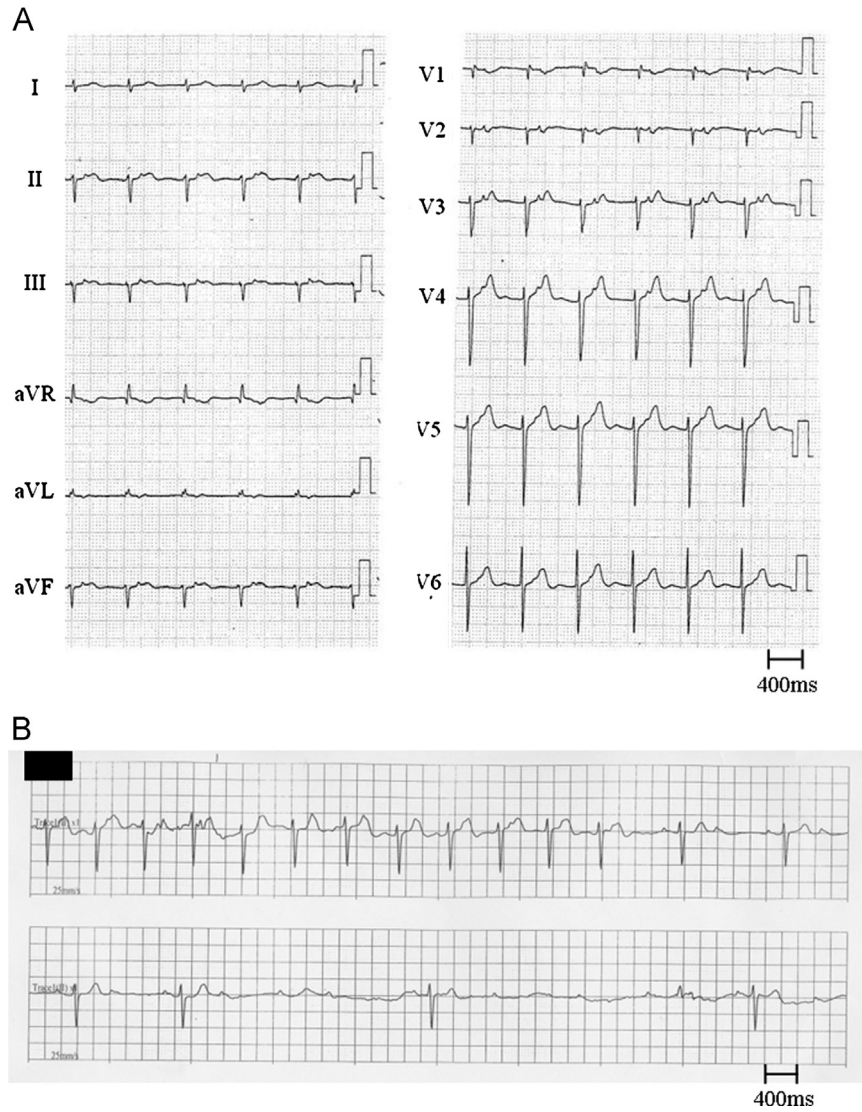


Fig. 1. (A) Surface 12-lead electrocardiogram at admission demonstrated a regular short RP rhythm at a rate of 95 beats per minute with a narrow QRS complex. (B) A continuous electrocardiogram monitoring strip at the emergency room revealed a prolongation of the RR interval.

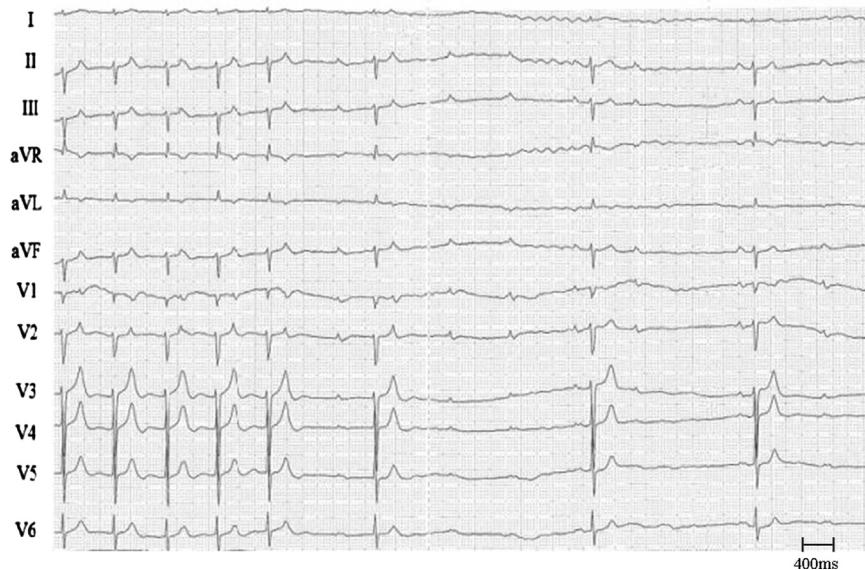


Fig. 2. Twelve-lead electrocardiogram during bolus injection of adenosine triphosphate. An advanced atrio-ventricular block with temporary prolongation of atrial cycle lengths was induced by adenosine triphosphate injection.

After temporary pacemaker insertion, adenosine triphosphate (ATP) (100 µg/kg) was rapidly administered to confirm the mechanism of the short RP rhythm (Fig. 2). Following venous administration of adenosine, an advanced AV block was observed with persistent atrial ectopic rhythm similar to that shown in Fig. 1. The prolongation of atrial cycle lengths with ATP injection may suggest that this rhythm has an automaticity mechanism. In conclusion, the present case demonstrated an ectopic rhythm with marked first-degree AV block followed by an advanced AV block resulting in the prolongation of the long RR interval.

Conflict of interest

No conflict of interest disclosed.

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