

## AV nodal reentrant tachycardia with a 2:1 right bundle branch block missed as bidirectional ventricular tachycardia in the first superficial evaluation

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A 95-year old woman was admitted to our emergency unit because of acute abdominal pain. After urgent surgery according to the acute abdomen, she was referred to intensive care unit (ICU) of the emergency unit as she was intubated. It was developed a run of new arrhythmia which was diagnosed by cardiology resident as bidirectional ventricular tachycardia due to beat to beat changing the axis of the QRS. However, a second and more precise evaluation of the abnormal ECG suggested a narrow supraventricular tachycardia, most probably AV nodal reentrant tachycardia with a 2:1 right bundle branch block.

**Keywords:** Electrocardiogram, Bidirectional ventricular tachycardia, Supraventricular tachycardia, Atrioventricular nodal reentry tachycardia, Bundle branch block.

### INTRODUCTION

Distinguishing of supraventricular tachycardia with bundle branch block from ventricular tachycardia (VT) is a crucial step of wide QRS tachyarrhythmia interpretation; an incorrect explanation may lead to inappropriate management and therapy that could be harmful and risky. This issue is so prominent in emergency units where physicians and residents are in a stressful condition and have limited time to decide and approach quickly. Moreover, in some cases, it is so difficult to discriminate these two types of arrhythmia from each other. Supraventricular tachycardia with 2:1 bundle branch block may be confused as a bidirectional VT in rare cases.

### CASE REPORT

A 95-year old woman was admitted to the emergency unit because of acute abdominal pain following enema of an external device due to chronic constipation. According to findings of the abdominal examination and air-fluid level in the abdominal x-ray, she was urgently prepared for

laparotomy which revealed rectosigmoid rupture, so rectosigmoidectomy with primary anastomosis was performed for her.

She was referred to intensive care unit as she was intubated where she developed a run of new arrhythmia. 12-lead ECG showed a non-sinus rhythm with a rate of 150 beats per minute (Figure 1, A); her blood pressure was stable (110/65). The patient was consulted urgently with cardiology service.

Due to changing the axis of the QRS beat to beat, bidirectional VT was made as initial proposed diagnosis by cardiology resident.

The patient was not on digoxin. She had no signs or symptoms of new onset ischemia. Cardiac enzymes were all in normal ranges, and previous serial ECGs showed no significant ST segment-T wave abnormalities. Serum electrolytes including potassium, sodium, calcium and magnesium were all within normal limits.

A closer look at the ECG revealed two patterns of QRS complex, a narrow complex and a wide complex with right bundle branch block (RBBB) pattern. This pattern may suggest a supraventricular tachycardia, most probably AV nodal reentrant tachycardia, with intermittent RBBB pattern.

Intravenous adenosine was administered which terminated the arrhythmia to normal sinus rhythm

in a few seconds (Figure 1, B). 25 mg of metoprolol was ordered twice daily as maintenance dose which was administered *via* nasogastric tube.

Bedside transthoracic echocardiography showed ejection fraction of 50% with mild mitral and tricuspid regurgitations and grade 1 diastolic dysfunction.

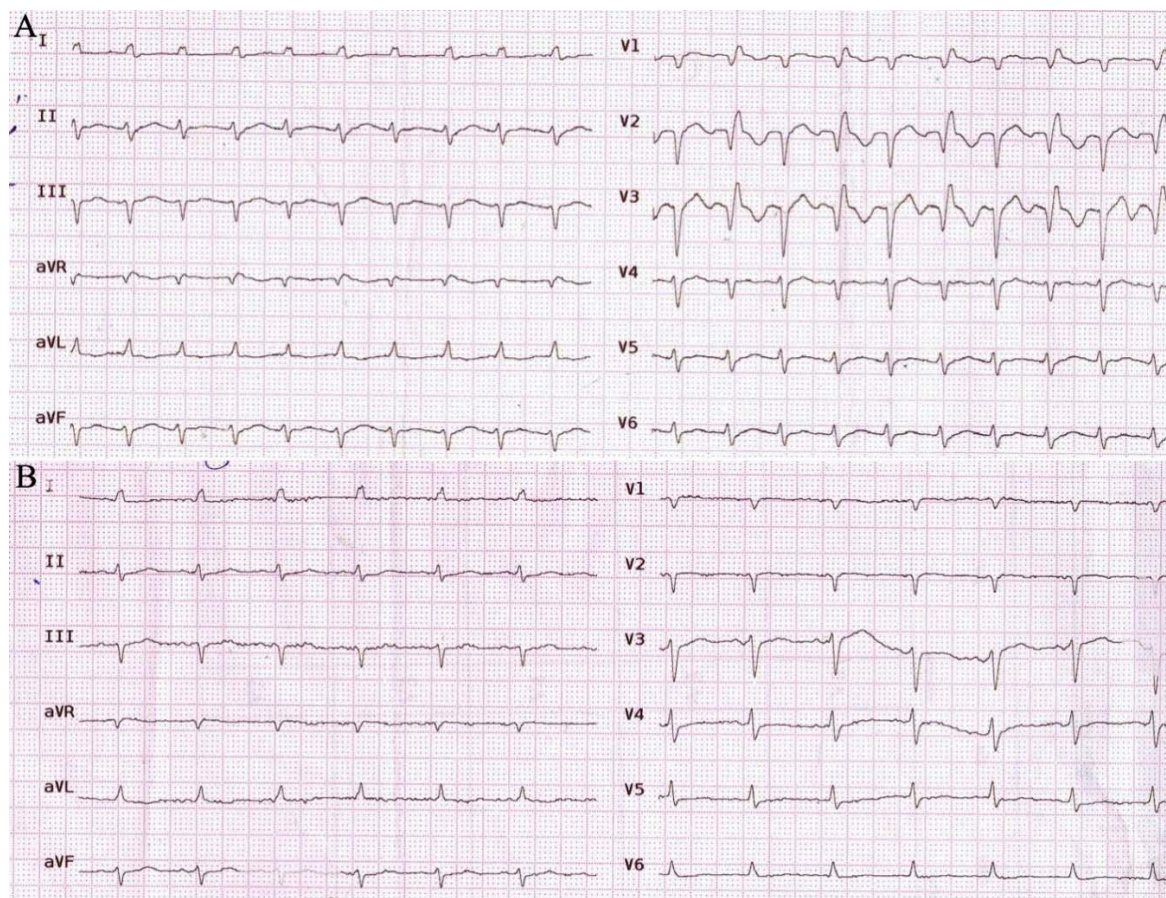


Figure 1 A. Electrocardiogram in arrhythmia, two-to-one right bundle branch block during a regular tachycardia B, electrocardiogram in sinus rhythm after intravenous adenosine administration.

## DISCUSSION

We presented an interesting case which developed supra-ventricular tachycardia, most probably AV nodal reentrant tachycardia, with intermittent RBBB. The initial and superficial diagnosis of cardiology resident as a first view was bidirectional VT, which may be attributable to a complex situation and possible electrolyte or ischemic problems. However, detailed reevaluation of the ECG showed opposite diagnosis, which had totally different treatment approaches. Moreover, the patient drug history and lab tests were less favorable with diagnosis of bidirectional VT.

Although the ECG of arrhythmia may confuse us to a bidirectional VT, but with more careful observation, it is evident that the QRSs alternatively change to a narrow and wide complex (RBBB pattern). However, in bidirectional VT, all the QRSs are wide with a RBBB pattern and the axis changes alternatively in the frontal plane.

Also, the bidirectional VT is mostly seen in the setting of digoxin toxicity or in the cases of catecholaminergic polymorphic ventricular tachycardia [1-3].

A wide complex QRS may originate from the ventricle (as in premature ventricular contraction) or is an aberrant conduction of a supraventricular beat [4]. As in the arrhythmia ECG, the cycle length of the beats is completely the same, so one can argue that it is a supraventricular tachycardia with 2:1 RBBB.

Most probably, the mechanism of this observation is based on the concept of first-second degree RBBB. This concept is similar to first or second-degree atrioventricular block. When the heart rate increases, the block in the RBB aggravates to 2:1 conduction. So, during the blocked beats, the bidirectionally blocked RBB has enough time to recover from its refractoriness. So, in the next beat, it conducts normally (Figure 2) [4, 5].



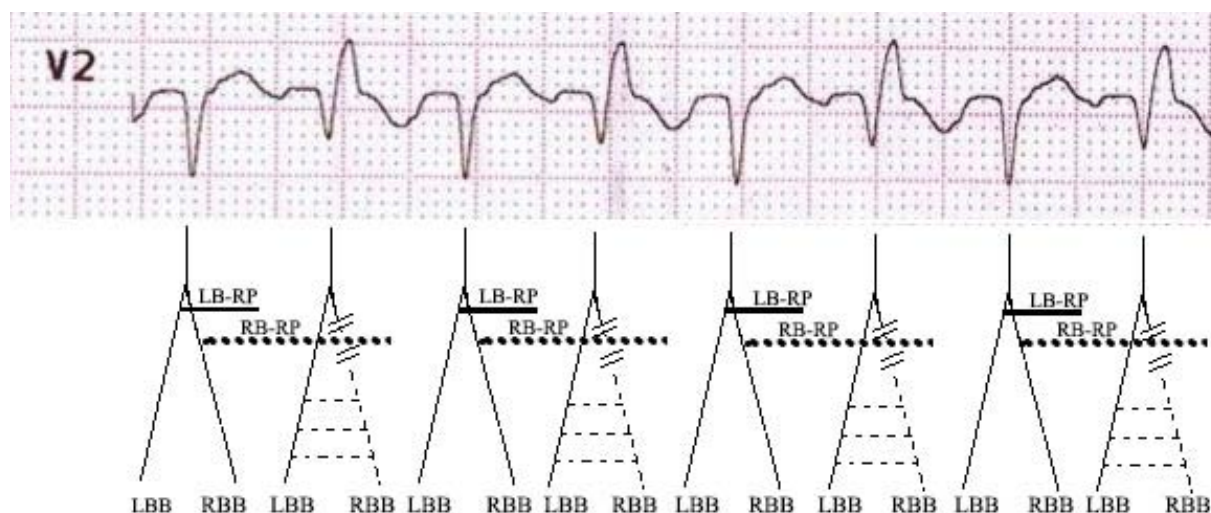


Figure 2. 2:1 block in the right bundle branch. Top, rhythm strip of lead V2. Bottom, the accompanying ladder diagram. The solid lines represent normal Spread of impulse through conduction system. The dashes represent trans-septal activation from the left bundle branch into the right bundle branch, and the bold horizontal solid and dots lines represent the refractory periods of left and right bundle branch, respectively. Accordingly, during the arrhythmia, every impulse was conducted from left bundle branch, however, in the right bundle branch every alternate impulse was blocked completely. This has happened due to prolonged refractoriness of right bundle branch (more than arrhythmia cycle length). This block provided sufficient time for the right bundle branch to recover and conduction in the next beat. RB-RP: right bundle refractory period. LB-RP: left bundle refractory period. LBB: left bundle branch. RBB: right bundle branch.

Simple rate dependant aberrancy cannot explain this observation. Because in this kind of aberrancy, with an increase of heart rate, the bundle branch block persists in the continuous beats, except for the heart rate that changes intermittently. This pattern may be explained by some other rare mechanisms such as bradycardia-dependent bundle branch block or supernormal conduction, but these mechanisms are the least probable [5-7].

Termination of the arrhythmia with adenosine, small negative deflections that follow immediately after each normally conducted QRSs during arrhythmia (better seen in lead V1) and the same morphology of the narrow QRSs during arrhythmia and sinus rhythm are clues that document the arrhythmia as paroxysmal supraventricular tachycardia, most probably AVNRT. A 2:1 bundle

branch block was reported in patients with AV nodal reentrant tachycardia, AV reentrant tachycardia, sinus tachycardia, atrial flutter, atrial fibrillation, and pulmonary embolism [6-8].

This case underscores the importance of discrimination of ventricular arrhythmia, including bidirectional VT from supraventricular arrhythmia with intermittent conduction abnormalities. Also, it emphasizes that clinical approach could be changed dramatically based on the initial diagnosis, particularly in the emergency units that medical internists, emergency clinicians, cardiology students and residents may be in a stressful condition and make an incorrect decision due to the first pitfall.

**Conflict of interest.** All authors declare no conflict of interest (or financial relationships) related to this study.

*O pacientă în vârstă de 95 de ani s-a prezentat la camera de primiri urgențe pentru dureri abdominale. După tratamentul chirurgical al abdomenului acut pacienta a fost trimisă pe secția de terapie intensivă și intubată. Pacienta a dezvoltat o aritmie diagnosticată de medicul resident ca fiind tahicardie ventriculară bidirecțională datorită modificărilor axei complexului QRS la fiecare bătaie. Totuși o analiză mai atentă a EKG-ului a sugerat o tahicardie supraventriculară, cel mai probabil tahicardie cu reintrare AV cu bloc de ramură dreaptă 2:1.*

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