Canadian Journal of Cardiology 31 (2015) 1493–1496

Training/Practice
Contemporary Issues in Cardiology Practice

A Practical Approach to the Investigation of an rSr' Pattern in Leads V_1-V_2

Sahil Koppikar, MD,[a] Raimundo Barbosa-Barros, MD,[b] and Adrian Baranchuk, MD, FACC, FRCPC[c]

[a] *Department of Internal Medicine, Kingston General Hospital, Queen's University, Kingston, Ontario, Canada*

[b] *Hospital de Messejana Dr Carlos Alberto Studart Gomes, Fortaleza, Ceara, Brazil*

[c] *Heart Rhythm Service, Kingston General Hospital, Queen's University, Kingston, Ontario, Canada*

ABSTRACT

The differential diagnosis of an rSr' pattern in leads V_1-V_2 on electrocardiogram is a frequently encountered entity in clinical cardiology. This finding often presents itself in asymptomatic and healthy individuals. The causes might vary from benign and nonpathological, to severe and life-threatening diseases, such as Brugada syndrome or arrhythmogenic right ventricular dysplasia. Workup of these patients involves a history and physical examination to screen for underlying cardiac disease and potential triggers. Routine investigation involves blood work and a thorough electrocardiographic examination. Echocardiography has a role in evaluating patients in whom structural heart disease is suspected. Pulmonary testing using computed tomography can be conducted if right ventricular enlargement is identified. More advanced testing is not warranted if these initial investigations are reassuring. Referral to an arrhythmia specialist should be considered for patients in whom this finding is due to Brugada syndrome, arrhythmogenic right ventricular dysplasia, or Wolf-Parkinson-White syndrome. We propose a clinical and electrocardiographic algorithm that will assist clinicians in narrowing their differential diagnosis.

RÉSUMÉ

Le diagnostic différentiel d'un aspect rSR' en V_1-V_2 à l'électrocardiogramme constitue une entité fréquemment rencontrée en cardiologie clinique. Cette découverte se présente souvent chez les individus sains et asymptomatiques. Les causes varieraient des affections bénignes et non pathologiques à des affections graves et mettant en danger la vie du malade telles que le syndrome de Brugada ou la dysplasie arythmogène du ventricule droit. Le bilan diagnostique de ces patients comprend l'anamnèse et l'examen physique pour dépister la maladie cardiaque sous-jacente et les déclencheurs potentiels. L'examen systématique comprend les analyses sanguines et un examen électrocardiographique approfondi. L'échocardiographie joue un rôle dans l'évaluation des patients chez qui l'on suspecte une maladie cardiaque structurelle. L'épreuve fonctionnelle pulmonaire utilisant la tomodensitométrie peut être réalisée si une dilatation ventriculaire droite est décelée. Des tests plus poussés ne sont pas justifiés si ces examens initiaux sont rassurants. L'orientation vers un spécialiste des arythmies devrait être envisagée pour les patients chez qui cette découverte est due au syndrome de Brugada, à la dysplasie arythmogène du ventricule droit ou au syndrome de Wolf-Parkinson-White. Nous proposons un algorithme clinique et électrocardiographique qui aidera les cliniciens à recouper leur diagnostic différentiel.

The normal QRS morphology recorded in leads V_1-V_2 on an electrocardiogram (ECG) is the consequence of electrical activation of the ventricles. This is explained by 3 vectors.[1] The first is generated by septal activation from left to right. The second is due to the activation of the free walls of both ventricles from endocardium to epicardium. Finally, the third vector is a consequence of the depolarization of the basal regions of both ventricles.

An abnormal rSr' pattern in the right precordial leads is relatively common, and has been described in up to 7% of patients without heart disease.[2] If the QRS is wide, r' usually points to a complete right bundle branch block (RBBB). However, when the QRS duration is < 120 ms, there is a wider differential diagnosis. Although it can be from an incomplete RBBB, poor lead placement, or just an electrophysiological variant, serious pathological conditions can also produce an rSr' pattern. The challenge lies in identifying the few patients who have potentially life-threatening causes. Patients usually present with the ECG finding, and no pathognomonic history,

Received for publication March 5, 2015. Accepted April 8, 2015.

Corresponding author: Dr Adrian Baranchuk, Cardiac Electrophysiology and Pacing, Kingston General Hospital, Queen's University, Kingston, Ontario K7L 2V7, Canada. Tel.: +1-613-549-6666 ×3801; fax: +1-613 548 1387.

E-mail: barancha@kgh.kari.net

See page 1496 for disclosure information.

http://dx.doi.org/10.1016/j.cjca.2015.04.008

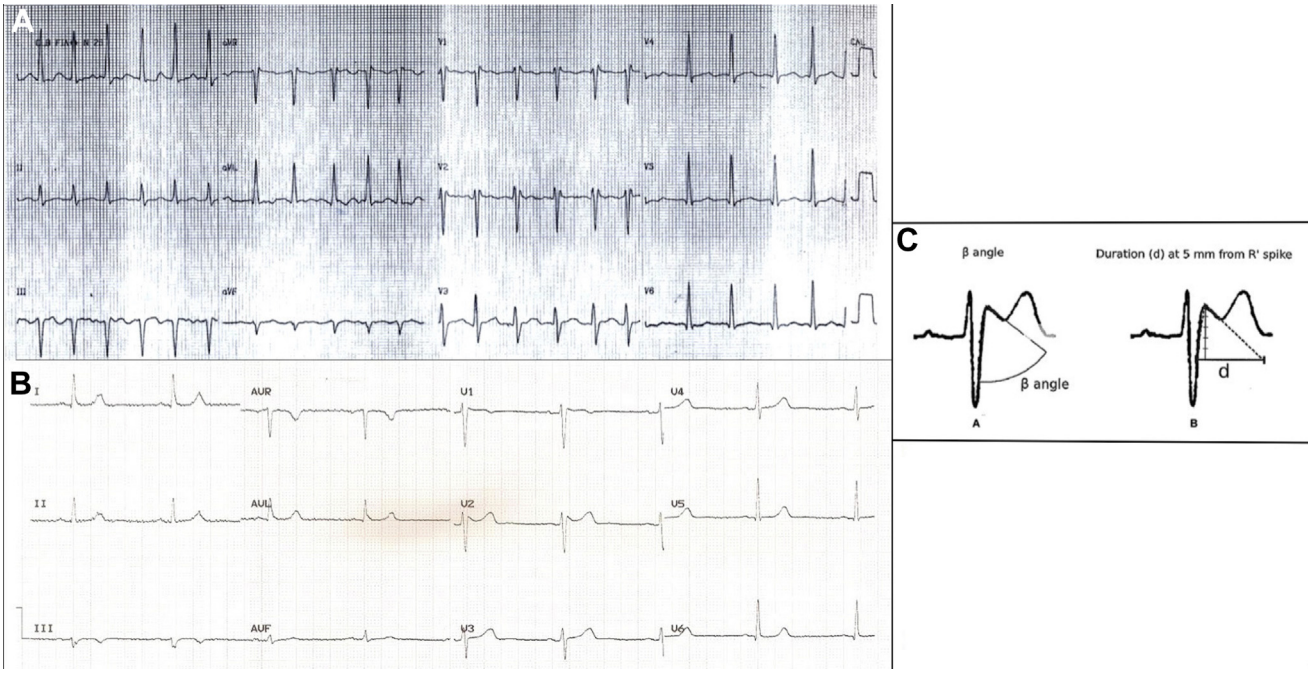

Figure 1. (**A**) Electrocardiogram of a 69-year-old man, depicting atrial fibrillation and a rSr' pattern in leads V_1-V_2. (**B**) Electrocardiogram of a 48-year-old man with recurrent syncopal episodes and rSr' pattern in leads V_1-V_2. (**C**) Measurement of the β-angle (**A**) and base of the triangle of the r' wave (**B**). (**C**). Reproduced from Baranchuk et al.[1] with permission from John Wiley and Sons.

physical, or diagnostic data. Therefore, a safe and efficient approach is needed to identify those who might need further investigations and treatment.

Our article focuses on the approach to an rSr' pattern in leads V_1-V_2 with QRS duration $<$ 120 ms. We have not included the ECG patterns induced by supraventricular tachycardias, which produce a pseudo r'. The goal of this article is not to perform an exhaustive review of the literature, but rather to provide clinical guidance based on existing evidence and clinical experience.

Clinical Scenario 1

A 69-year-old man with a history of well controlled atrial fibrillation presents to the emergency department with palpitations. There was no presyncope or syncope. He has obvious pectus excavatum on examination, with a characteristic ECG showing an rSr' pattern in V_1-V_2 (Fig. 1A). His medications include diltiazem and apixaban. Blood work shows all metabolic values to be within normal parameters. An echocardiogram shows no evidence of structural heart disease. Family history is negative for sudden cardiac death. The ECG changes disappear when the electrodes are placed in the fifth intercostal space. What ECG features are useful in identifying if the rSr' pattern is from a benign or pathological cause? Is further testing warranted in this patient?

Clinical Scenario 2

A 48-year-old healthy man presents to the emergency department with recurrent syncopal episodes in the context of a viral infection. His family history is significant for sudden, unexplained death in a brother at 30 years of age. He is not receiving any medications. On examination he is febrile. His ECG shows an rSr' pattern with ST-elevation in V_1-V_2 (Fig. 1B). His cardiac enzymes are normal. The echocardiogram is normal. The ECG returns to normal sinus rhythm, with no rSr' in leads V_1-V_2, after defervescence. What clinical and ECG features should be further elicited in this patient? Is referral to an arrhythmia specialist indicated?

History and Physical Examination

The history and examination should focus on identifying signs and symptoms of underlying causes, benign and pathological, along with potential reversible contributors. Patients should be questioned about palpitations, syncope (situation, relation to exercise, prodrome, etc) and a family history of arrhythmias or sudden cardiac death. A positive history raises concern for pathological conditions that have a high risk of converting to malignant arrhythmias, such as Wolf-Parkinson-White (WPW) syndrome, type 2 Brugada, and arrhythmogenic right ventricular (RV) dysplasia (ARVD). An rSr' pattern in V_1-V_2 can also alert to the possibility of RV enlargement. Hypertrophy and/or dilatation will result in delayed activation of some regions of the right ventricle, resulting in the classic rSr' pattern.[1] The history should focus on causes of pulmonary hypertension and RV enlargement such as previously diagnosed valvular conditions (mitral stenosis, pulmonary stenosis), congenital abnormalities (atrial septal defect), chronic obstructive pulmonary disease and chronic pulmonary emboli. Furthermore, hyperkalemia is a potentially reversible cause of an rSr' pattern on ECG. Triggers for hyperkalemia, such as renal dysfunction, dialysis, medications (angiotensin-converting enzyme inhibitors, angiotensin receptor blockers), and adrenal failure must be elicited. The social history can also help