CASE REPORTS

The Presence of Giant Epsilon Waves in a Patient with Arrhythmogenic Right Ventricular Cardiomyopathy

Huihui Bao, M.D., Ph.D., Kui Hong, M.D., Ph.D., Juxiang Li, M.D., Ph.D., and Xiaoshu Cheng, M.D., Ph.D.

From the Department of Cardiology, the Second Affiliated Hospital of Nanchang University, Jiangxi, China

Epsilon wave, which is a major diagnosis criterion for arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVD/C), is defined as small amplitude potentials. The present case is a 49-year-old man with a history of syncope and palpitations for 6 months. The ECG documented ventricular tachycardia (VT) when the patient has palpitations. However, there has been a giant epsilon wave in sinus rhythm. Electroanatomic mapping also has a prominent double potential identified on ABL catheter. The amplitude of epsilon wave reached 0.9 mV, which might be the maximum epsilon wave until now.

Ann Noninvasive Electrocardiol 2012;17(3):277–279

ARVD/C; giant epsilon wave; Fontaine lead

Epsilon wave, which is a major diagnosis criterion for arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVD/C),¹ reflects on the surface electrocardiogram (ECG) the presence of delayed activation of some right ventricular fibers. It was once defined as a wiggle, small spike wave, and smooth potential between the end of the QRS complex and the beginning of the ST segment. But the present study is to report a giant epsilon wave in a patient with ARVD/C.

CASE REPORT

A 49-year-old man had a history of recurrent attacks of rapid palpitations associated with syncope and dyspnea for 6 months. The ECG on admission showed a sinus rhythm, "QR" complex in V₁-V₂ prolongation (160 ms), large "R" amplitude 0.9 mV, and duration 80 ms. There were prominent epsilon waves of which duration also was 80 ms in leads V₃-V₄ (arrow) and inverted T waves in anterior leads, and also the epsilon waves were also visible in leads I, II, III, avL, and avF (Fig. 1). ECG documented ventricular tachycardia (VT) when

Figure 1. A "R" wave in lead V₁-V₂, epsilon wave in lead V₃-V₄.

the patient has palpitations (Fig. 2). Transthoracic echocardiography documented a mildly dilated left ventricle, marked RV dilation with moderate systolic dysfunction, mild tricuspid regurgitation, and right atrial enlargement (Fig. 3). And cardiac ventricular tachycardia (MRI) also confirmed the diagnosis of ARVD/C. Fontaine lead

Figure 2. The giant epsilon wave in Fontaine lead.

Figure 3. Ventricular tachycardia of left bundle-branch block morphology negative QRS in leads II, III, and aVF and positive in lead aVL.

Figure 4. Transthoracic echocardiography showed PLAX RVOT = 35 mm (18–34 mm), RVD = 34 mm (<25 mm), RAD = 54 mm (30–40 mm), LVEED = 56 mm (35–55 mm), LVESD = 44 mm (25–37 mm), LVEF = 45% (50–70%). RVOT = right ventricular outflow tract; RVD = right ventricular diameter; RAD = right atrium diameter; LVESD = left ventricular end-systolic dimension; LVEF = left ventricular ejection fraction.

system (the left arm lead was placed over the xyphoid process, the right arm lead on the manubrium sterni, and the left leg lead over V₄) revealed the “giant” epsilon wave (arrow) (Figcon. 4). Do you agree that “R” wave in lead V₁-V₂ may be a “giant” epsilon wave?

Figure 5. A prominent double potential on ABL catheter. The second potential followed a wide split of 80 ms and corresponded to the abnormal giant and sharp deflection seen on surface ECG.

An implantable cardioverter defibrillator (ICD) was implanted and taken oral amiodarone and β block. But he had four episodes of VT which were quickly terminated by the ICD over the subsequent 6 months. Electroanatomic mapping and VT catheter ablation were performed by Ensite3000 (Ensite Array, St. Jude Medical, Inc., St. Paul, MN, USA). There was prominent double potential identified on ABL catheter (Fig. 5). The second potential followed a wide split of 80 ms and corresponded to the abnormal giant and sharp deflection seen on surface ECG. The QRS duration was 80 ms; however, the total QRS duration including the late depolarization abnormality measured 160 ms. Three different VT morphologies were mapped with the noncontact system and ablated successfully in the right ventricular. VT was no longer inducible after ablation.

DISCUSSION

Epsilon wave has been first described in patients with ARVD/C by Fontaine in 1977. Myocytes of these patients are replaced with fibro-fatty forming islands of the viable myocytes surrounded by fat, which causes epsilon waves. Fontaine leads can significantly improve epsilon waves detection rate. Detection rate of epsilon waves was only 30% in ARVD/C by routine 12-lead ECG, but it was up to 75% by Fontaine bipolar precordial leads.²

The present case was featured by several points. First, the initiation, terminal, and duration of “R” wave in lead V₁-V₂ were completely equal to epsilon wave in V₃-V₄. Moreover, a markedly delayed, high-amplitude wave separated from the QRS waves obviously in Fontaine leads. As a contrast Fontaine leads ECG were detected in two patients with non-ARVC/D. ECG demonstrated no

waves occurring after the QRS at the beginning of the ST segment in these patients (ECGs not shown). Second, transthoracic echocardiography and cardiac MRI supported the diagnosis of ARVD/C. Finally, electrophysiologic mapping verified the right ventricular late potentials during sinus rhythm.

Santucci et al.³ named the giant Epsilon wave as the secondary QRS. He used electroanatomic mapping to characterize the right ventricular substrate abnormalities and demonstrate markedly delayed activation of the entire RV free wall. Recently, Fassa et al.⁴ have reported another giant Epsilon wave, the amplitude was 0.3 mV. Previously, epsilon wave was considered as a small amplitude potential wave, Wang et al. reported there were 16 patients with epsilon waves, the mean amplitude was 0.086 ± 0.04 mV (range 0.05–0.2 mV).⁵ But in this case, the amplitude of epsilon wave was 0.9 mV, which might be the up-to-date maximum epsilon wave.

As in the early stage of the ARVC/D, structural change may be absent or subtle and confined to a

localized region of the right ventricular, but progression to more diffuse right ventricular disease and left ventricular involvement was common, typically affecting the posterior lateral wall.¹ The epsilon waves were also visible in leads I, II, III, avL, and avF, as well as the precordial leads V₁–V₄.

REFERENCES

1. Marcus FI, McKenna WJ, Sherrill D, et al. Diagnosis of arrhythmogenic right ventricular. *Circulation* 2010;121: 1533–1541.
2. Peters S, Trummel M. Diagnosis of arrhythmogenic right ventricular dysplasia cardiomyopathy: Value of standard ECG revisited. *Ann Noninvasive Electrocardiol* 2003;8: 238–245.
3. Santucci PA, Morton JB, Picken MM, et al. Electroanatomic mapping of the right ventricle in a patient with a giant epsilon wave, ventricular tachycardia, and cardiac sarcoidosis. *J Cardiovasc Electrophysiol* 2004;15:1091–1094.
4. Fassa AA, Didierb D, Burria H, Just pulmonary embolism? *J Kardiologische Medizin* 2009;12(12):336–338.
5. Wang J, Yang B, Chen H, et al. Epsilon waves detected by various electrocardiographic recording methods: In patients with arrhythmogenic right ventricular cardiomyopathy. *Tex Heart Inst J* 2010;37(4):405–411.