

**Case report**

**Point-of-Care Ultrasound (POCUS) and Epsilon wave**

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**Abstract**

Arrhythmogenic right ventricular cardiomyopathy (ARVC) is often underdiagnosed in ruling out the cardiac cause for any syncope. It is an inherited cardiomyopathy characterized by fibro-fatty replacement of right ventricular myocardium. ARVC is the second most common cause of sudden cardiac death (SCD) after hypertrophic obstructive cardiomyopathy (HOCM), causing up to 20% of SCD in younger patients (age <35 yo). The prevalence is 1:5000 people overall. We described a case report of suspected ARVC and the role of bedside electrocardiography (ECG) and point-of-care ultrasound (POCUS) in Emergency Department.

**Keywords:** ARVC, electrocardiography, POCUS, emergency department

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**Introduction**

Arrhythmogenic right ventricular cardiomyopathy (ARVC) is a rare genetic disorder (autosomal dominant trait) which is characterised by progressive replacement of the RV myocardium by fatty and/or fibrofatty tissue.<sup>1</sup> Subsequently, leads to poor contractility and right ventricle dilatation.<sup>2</sup> This condition will predispose patient to developed fatal arrhythmias such as ventricular tachycardia and risk of sudden cardiac death especially in young athletes.<sup>2,3</sup> In hectic and busy Emergency department (ED), the diagnosis is quite challenging. However, in the presence of abnormal right ventricular features on point-of-care ultrasound (POCUS) aided with Epsilon wave on electrocardiogram (ECG) it will expedite early detection of possible ARVC and facilitate timely management this rare condition especially in resource-limited setting.

**Case Report**

A 17-year-old boy presented with syncope while riding a motorbike. Prior to this, he was well and had no preceded complaints. There was no loss of consciousness after the road traffic injury. On further questioning, he denied any significant history of cardiac related death or sudden death in his family

Primary and secondary survey revealed no life-threatening injuries. Cardiac monitor showed sinus arrhythmias with no evidence of ventricular arrhythmias or ectopic features.

CT Brain showed no evidence intracranial bleed or infarction. CK/CK-MB ratio was normal. Blood results showed normal blood glucose level (6 mmol/L) and normal renal/liver function test.

Resting ECG showed Epsilon wave at V1, T wave inversion from V1-V3, prolonged S wave

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upstroke (55ms), localised QRS widening (110ms) in V1-V3, RSR pattern at precordial leads. No other remarkable findings were detected on ECG. (Figure 1 & 2)

Focused cardiac ultrasound (FoCUS) showed right atrial and ventricular dilation as shown in Figure 3.

Subsequently, patient was referred to cardio team and planned for Holter and MRI in CCU (coronary care unit). Throughout the stay he was stable and discharge after 3 days of admission with normal Holter and was planned for early outpatient MRI appointment. Unfortunately, he didn't turn up for follow up.

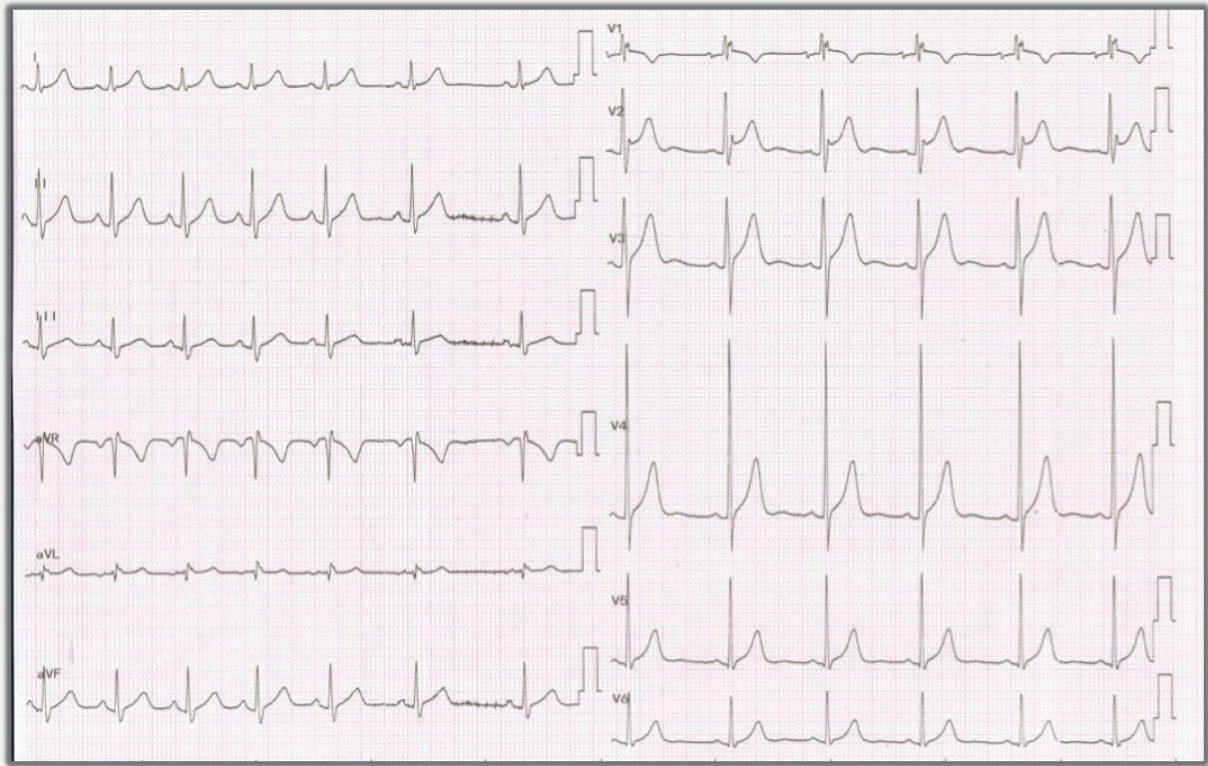


Figure 1: Epsilon wave at V1, T wave inversion from V1-V3, prolonged S wave upstroke (55ms), localised QRS widening (110ms) in V1-V3, RSR pattern at precordial leads.

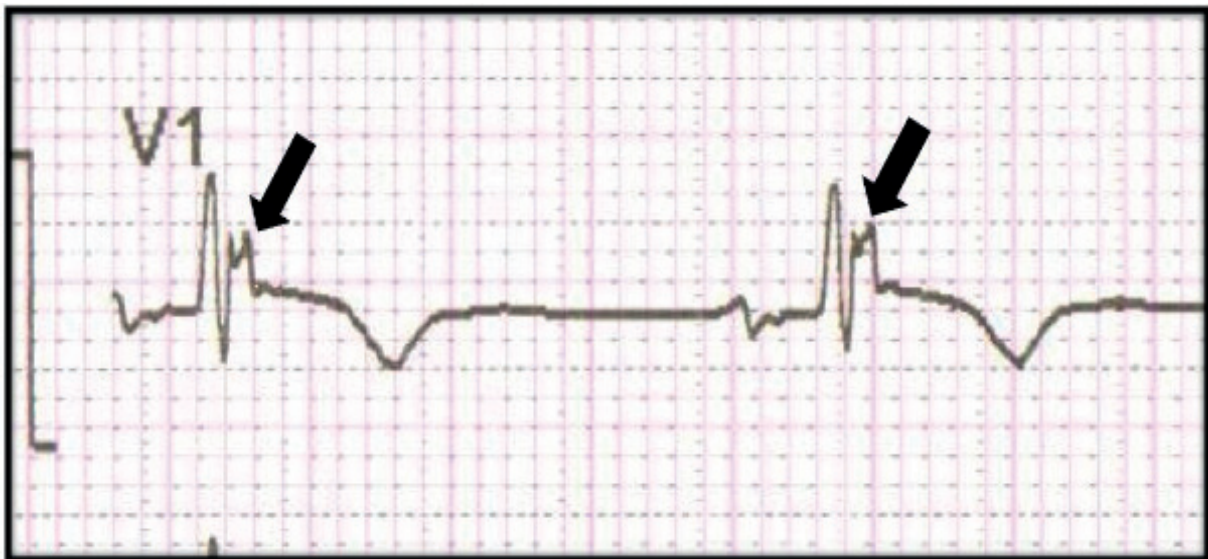


Figure 2: : ECG of Epsilon wave, a reproducible low amplitude signal between end of QRS complex to onset of T wave in right precordial leads particularly V1.



Figure 3: Apical 4 Chamber view shows dilated RA/RV on Focused Cardiac Ultrasound (FoCUS). RV was bigger than LV and loss normal triangular shape.

### **Discussion**

Diagnosing ARVC in ED is difficult and there is no single diagnostic tool for ARVC. The diagnosis is a combination of clinical, electrocardiographic and radiological features, as defined by 2010 Task Force Criteria.<sup>2,3</sup> RV dilation based on ECHO, endomyocardial biopsy confirmation of fibro-fatty changes of right myocardium, presence of Epsilon waves in V1-V3, T wave inversion in precordial leads, arrhythmias are all major criteria.<sup>2</sup>

In Emergency department (ED), ECG and ultrasound are two modalities that widely available, low cost and easy to use. Approximately 50-90% of ARVC patient will have ECG characteristics finding such as T-wave inversion in the anterior precordial leads (V1 through V6), epsilon waves, or VT with a left bundle branch block pattern, although polymorphic and right bundle branch block patterns also have been reported.<sup>4,7</sup> The epsilon wave is described as slurring tiny signals at the end of right precordial QRS complex ECG and was found 30% in ARVC patients.<sup>5</sup> It represents delayed activation of right ventricular myofibres<sup>4</sup>. Although ECG has higher false positive results, the role of ECG screening as a tool to rule out cardiac syncope is worthwhile in all kinds of emergency

setting.

Over the years, point-of-care ultrasound (POCUS) has been extensively used by EM fraternity and become part of the mandatory training.<sup>8</sup> It is useful as an extension of physical examination. POCUS could help the physician in detecting potential ARVC cases by looking at RA/RV dilatation and regional hypokinetic RV wall.<sup>3,4</sup> Even though MRI still the goal standard in diagnosis ARVC<sup>6</sup> previous studies have shown that POCUS is a one of the major tools for diagnosis of ARVC.<sup>3,9</sup> However, POCUS especially cardiac ultrasound have some limitations such as patient habitus especially in obese patient that led to inadequate images. It also unable to localised regional abnormal findings on RV wall in certain condition like minor ventricular bulge and focal aneurysms<sup>10</sup>.

Despite limitations, we believed that abnormal RV on POCUS aided with Epsilon wave on ECG could help clinician in early detection of this rare condition especially in resource-limited setting whereby other advanced imaging techniques such as transoesophageal echo (TEE) and CT scan/ MRI are not available. Thus, urgent referral to appropriate team can be done in timely manner.

### **Conclusion**

All young and healthy adult patients present with syncope should consider ARVC in their differential diagnoses. Usage of POCUS and ECG as bedside investigation could help in early identification and fasten the management

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