



## Case Report

### Resolution of Premature Ventricular Contraction (PVC) cardiomyopathy by radiofrequency ablation.

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#### Abstract

Radiofrequency ablation was performed for PVC mediated cardiomyopathy. We used a combination of 12-lead ECG vector analysis, local activation time mapping, pace mapping and 3 dimensional electroanatomic mapping combined with contact force technology and irrigated ablation to accurately identify the PVC focus and deliver radiofrequency energy to the target area. This resulted in abolition of the ectopic beats and restoration of normal left ventricular function 1 month post ablation.

This case report highlights the indication for ablation in PVC mediated cardiomyopathy and the utility of the latest generation 3 dimensional mapping systems. Generally, greater than 10,000 monomorphic PVC in a 24 hour period indicates that the patient should be considered for catheter ablation as this increases the likelihood that the ectopics will be mappable at invasive EP study. Careful vector analysis of PVC morphology can be used to predict the site of origin and therefore predict the ablation target. The analysis of PVC morphology on 12 lead ECG helps to concentrate mapping to a specific region, thereby minimising overall duration of the procedure as well as patient and staff exposure to fluoroscopy.

This case report also highlights the reversible nature of PVC mediated cardiomyopathy.

#### Introduction

A 52 year old Asian male (Filipino) boilermaker presented with a transthoracic echocardiogram demonstrating moderately severe left ventricular systolic dysfunction (LVEF 30%) and mild left ventricular dilation (LVEDD = 62mm). A coronary angiogram demonstrated normal coronary arteries and a cardiac MRI excluded ARVD/C, scar and infiltrative disease. A Holter monitor demonstrated 12500 VEBs in a 24 hour recording period. The 12 lead ECG documented frequent monomorphic PVCs with an axis suggestive of endocardial right ventricular origin at the mid-cavity level. The provisional diagnosis was PVC mediated cardiomyopathy and the patient was referred for electrophysiology study and ablation.

#### Indications for ablation

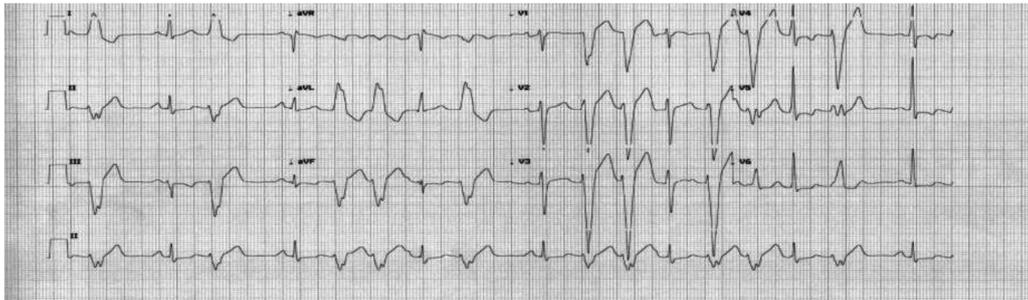
PVCs can be a result of abnormal automaticity, triggered activity or re-entry<sup>(1)</sup>. The natural history of PVCs has not been well studied, and although determinants of spontaneous resolution in some patients and their persistence in others remain unknown, it is known that a subgroup with very high PVC frequency is at risk of developing cardiomyopathy – so-called PVC cardiomyopathy which is a distinct entity and not simply due to tachycardia<sup>(1)</sup>.

Although frequent PVCs may not increase the risk of death, especially sudden death and are not the only determinants of PVC induced cardiomyopathy, frequent PVC burden increase the potential of developing cardiomyopathy,<sup>(1)</sup> which is apparent in the case of this patient. The patient in this case study also falls into the category of idiopathic VEBs, which is the most successful patient group to benefit from ablation.<sup>(2)</sup> The presence of moderately severe left ventricular dysfunction and mild left ventricular dilation in this patient were the main reasons supporting the decision to proceed with catheter ablation in this case. Other factors: unifocal morphology, high PVC burden, predicted endocardial site of origin and patient preference<sup>(1)</sup> are also contributing factors in this decision.

#### 12 lead ECG interpretation

At the initial consultation as well as at the start of the procedure, prior to insertion of sheaths and catheters, 12 lead ECGs with frequent PVC were available for analysis and planning (Figure 1). Care was taken to ensure that the clinically relevant PVC was mapped during the procedure rather than catheter induced ectopic beats. A 'snapshot' of the clinical PVC was used as a reference throughout the procedure.

The clinical PVC with negative QRS in lead V1, i.e a left bundle branch morphology, suggests a right ventricular focus<sup>(3,4,5)</sup>.



**Figure 1.** Pre-procedure 12-lead ECG of the clinical VEB morphology. Note the LBBB pattern and inferior QRS axis

A left bundle branch morphology is present in almost all right ventricular foci.<sup>(3,4,5)</sup> PVC QRS also demonstrated an inferior axis, with negative QRS observed in leads II, III and AVF suggesting a site closer to the apex than the base.<sup>(3,4)</sup> Therefore prior to mapping and ablation, a right sided mid-cavity focus towards but not at the apex was predicted, narrowing the mapping target area.

### Mapping and ablation

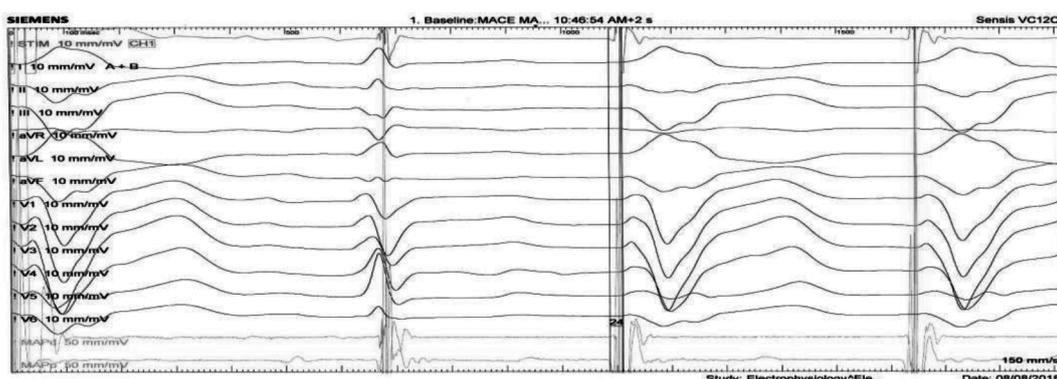
Under light sedation and local anaesthesia, a 3.5mm irrigated contact force catheter (Smarttouch Thermocool, Biosense-Webster, Diamond Bar, California, USA) was inserted through the right femoral vein, into the right ventricle and was used for mapping and ablation. Local activation time (LAT) mapping was performed, using a 3-dimensional electroanatomic mapping system (CARTO, Biosense-Webster, Diamond-Bar, California, USA) and sequentially comparing the local intracardiac signal with a fixed reference surface QRS complex.

The earliest ventricular signal was identified at the anterior papillary muscle near its attachment to the right ventricular free wall with the local signal preceding the PVC QRS onset, by 24ms (Figure 2).

Pace mapping at this location reproduced an almost identical pace match, compared to the spontaneous PVC reference, further supporting clinical PVC origin site (Figure 3).

Prior to radiofrequency delivery, the anatomical position of the ablation catheter was confirmed with 3-dimensional mapping system and fluoro imaging. The 3-dimensional localisation of the ablation site was consistent with the attachment of the anterior right ventricular papillary muscle (Figure 4).

Radiofrequency application was delivered to the anterior papillary muscle for 2 minutes and 52 seconds (power 30-40 watts, mean contact force 21g). At the commencement of energy delivery 'warm up' effect with more frequent and rapid clinical ectopy was observed and this was soon followed by complete suppression of PVCs (Figure 5). This pattern during energy delivery is highly suggestive of acute success which was confirmed during prolonged observation in the catheter laboratory post ablation with repeated isoprenaline challenge. Contact force technology was used to confirm good tissue contact throughout the lesion radiofrequency delivery.



**Figure 2.** Local ventricular signal on the map/ablation catheter preceding the PVC by 24ms at the earliest endocardially mapped site.



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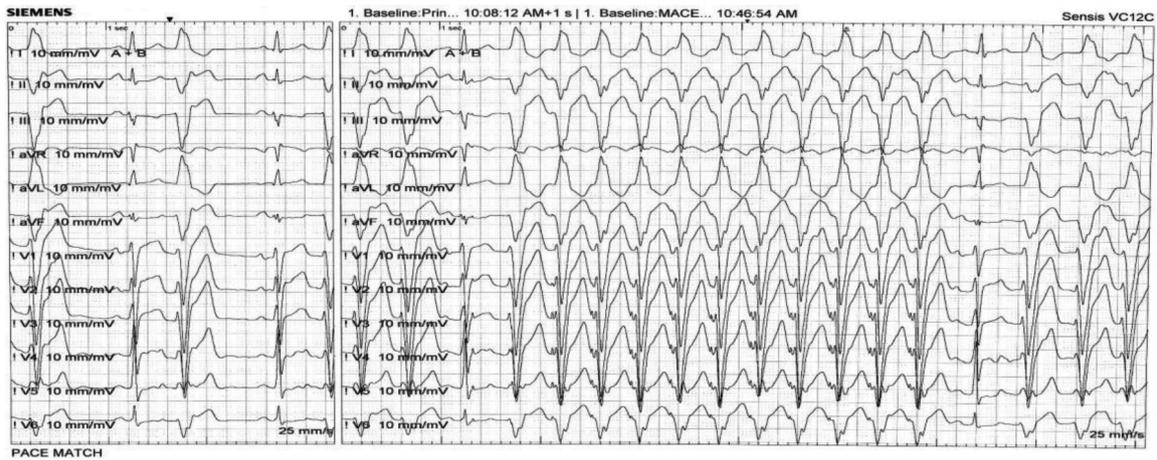


Figure 3. Pace mapping at right free wall location. There is an 11/12 pace match, compared to the spontaneous PVC on the left side of the image.

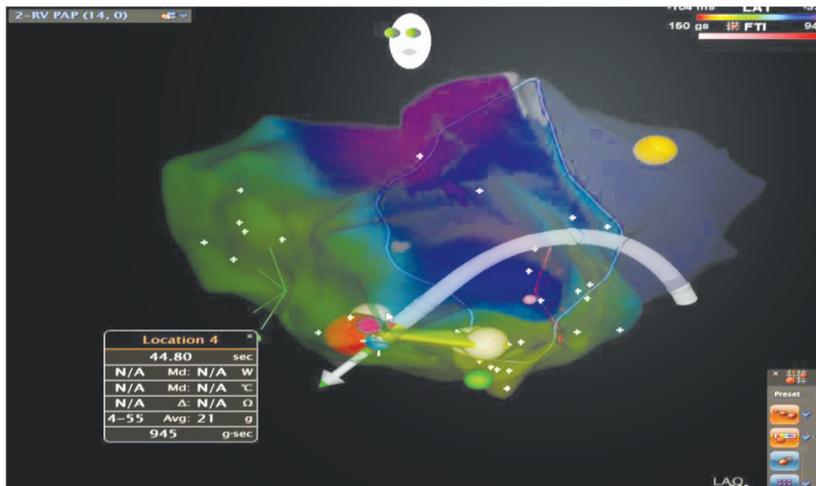


Figure 4. CARTO 3-dimensional mapping system image showing LAO view of the ablation catheter at the successful ablation site on the anterior papillary muscle of the right ventricle. Red tag indicates successful ablation site. Yellow tag indicates bundle of His. Note that the tricuspid valve has been segmented.

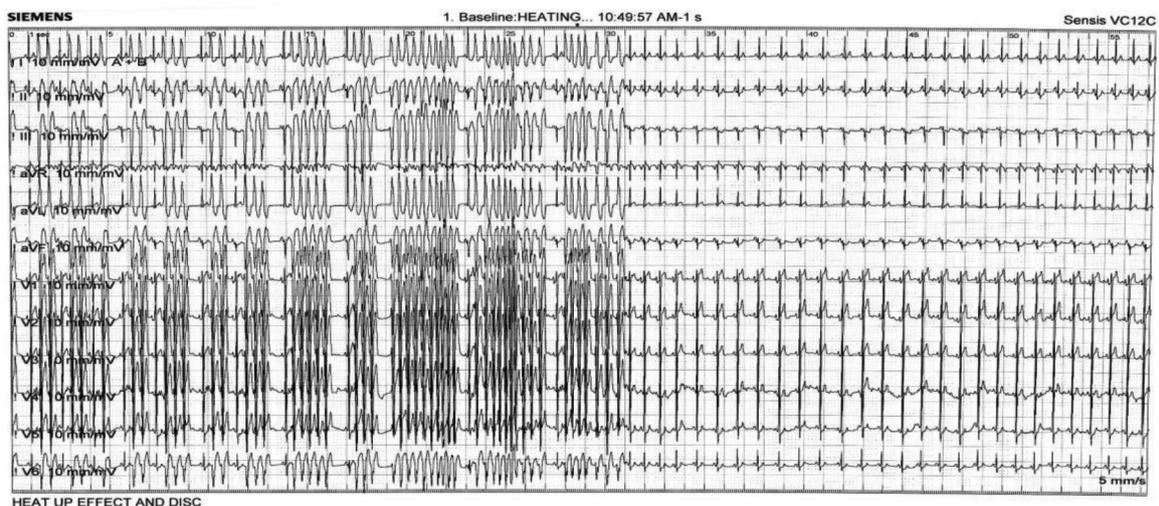


Figure 5. ECG 12-lead rhythm strip at 5mm/second demonstrating 'warm-up' effect and then rapid suppression of PVCs during the successful ablation.



## Discussion

Prior to mapping and ablation the target area was narrowed down to the right ventricle near the anterior papillary muscle by interpretation of the clinical PVC QRS axis and morphology. Activation mapping confirming the ventricular signal >20ms prior to QRS onset<sup>(6)</sup> indicated a successful site for ablation. This site was further confirmed with an 11/12 lead pace map. Perfect pace maps are rare. A pace map of >10/12 lead when comparing the QRS morphology to the targeted ventricular QRS morphology, is often used to indicate a 'matching pace-map'<sup>(6)</sup>.

There is evidence that ablation therapy may be more effective than medical therapy for PVC suppression.<sup>[1]</sup> However treatment options need to be individualised depending on PVC origin, patient comorbidities and patient preference<sup>(1)</sup>. In patients with frequent (>10000 per 24 hours) monomorphic PVCs, originating from an endocardial location, catheter ablation has a high success rate with a low complication rate and may be the preferred option for patients with PVC induced cardiomyopathy<sup>(1)</sup>.

## Conclusion

Post ablation, the patient in this case report had a complete abolition of PVCs and resolution of cardiomyopathy at 1 month follow up.

Suppression of PVCs should be attempted in patients with frequent PVCs, when there is evidence of PVC induced cardiomyopathy as a successful ablation usually leads to improvement or even complete resolution of cardiomyopathy<sup>(1)</sup>.

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