

Premature ventricular contractions with two QRS morphologies originate from one focus in great cardiac vein



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Introduction

It has been demonstrated that catheter ablation may be a reliable technique for curing ventricular arrhythmias originating from the great cardiac vein (GCV),¹⁻³ and there are some challenges and risks with this therapeutic method.⁴ Although some reports described successful catheter ablation of ventricular tachycardias originating from the GCV, premature ventricular contractions (PVCs) with left bundle branch block (LBBB) and right bundle branch block (RBBB) with a right inferior axis originating from a single focus in the GCV has rarely been reported.

Case report

A 44-year-old woman had spontaneous PVCs with 2 QRS morphologies before the procedure. PVC with LBBB and right inferior axis was designated as PVC1, and PVC with RBBB and right inferior axis was designated as PVC2 (Figure 1, 100 mm/s). A total of 43,697 PVCs (15,372 with LBBB morphology and 28,307 with RBBB morphology) were recorded on a 24-hour Holter monitoring of 96,357 heart beats. PVC1 was mapped in the right ventricular outflow tract (RVOT) via the right femoral vein. The earliest ventricular activation preceding the QRS onset (V-QRS) was recorded at 28 ms with an excellent pace map similar to PVC1. PVC1 was mapped in the GCV with V-QRS of 14 ms and the pre-potential was far field (Figure 2A). PVC2 was mapped in GCV with V-QRS of 40 ms (Figure 2B). Pace mapping produced 2 QRS morphologies similar to PVC1 and PVC2. The pace map with LBBB morphology showed a

longer stimulus-to-QRS interval (St-QRS) (126 ms) than that with RBBB morphology (44 ms) (Figure 2C and D). Radiofrequency energy was delivered at the distal electrode of the irrigated-tip ablation catheter with a target temperature of 43°C; the radiofrequency energy was 25 W with an infusion rate of 30 mL/min in the GCV. After 4.5 seconds, successful radiofrequency ablation was achieved with elimination of both PVCs. The last one showed LBBB morphology and the penultimate one showed RBBB morphology (Figure 2E). Neither PVC recurred, even with inducement by isoproterenol infusion 30 minutes after ablation. The target was in the proximal segment of the GCV, and the ablation catheter accompanied the left circumflex coronary artery with a distance of 0.8 cm (Figure 3A and B). The patient had no chest pain during ablation and no other electrocardiography changes after the procedure. Neither of the PVCs recurred during a 6-month follow-up.

Discussion

The main finding of this case is that PVCs with LBBB and RBBB morphologies can be successfully ablated at a single site in the GCV. Previous studies found that electrograms that exhibit multiple exit sites and pace-mapped induction may be specific for sites critical to reentry during pace mapping.⁵ In this case, pace mapping also captured the myocardium and reproduced 2 QRS morphologies (LBBB and RBBB) at the same pacing site in the GCV, and the St-QRS of the LBBB morphology was longer than that of the RBBB morphology (126 ms vs 44 ms) (Figure 2C and D). It may be associated with multiple exit sites at the origin site during pace mapping. After successful radiofrequency ablation, both PVCs were eliminated in 4.5 seconds. These findings suggest that PVCs with 2 morphologies may originate from 1 focus in the GCV. This phenomenon may be based on the apposed anatomic positions of the RVOT and proximal GCV. The RVOT is at the anterior part of the heart, and the proximal segment of the GCV is a continuation of the coronary sinus, which is under the epicardium left

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KEY TEACHING POINTS

- Premature ventricular contractions with left bundle branch block and right bundle branch block morphology and inferior axis could be successfully ablated at a single site in the great cardiac vein (GCV).
- Preferential conduction might exist between the GCV and right ventricular outflow tract (RVOT), which showed functional conduction.
- The RVOT is at the anterior part of the heart, and the proximal segment of the GCV is a continuation of the coronary sinus, which is under the epicardium left anterior to the RVOT.

anterior to the RVOT (Figure 3C and D). The myocardium between the RVOT and proximal segment of the GCV possesses conduction characteristics. Previous studies suggested that ventricular arrhythmias originating from the

aortic sinus cusps (ASC) often showed preferential conduction to the RVOT, and an insulated myocardial fiber across the ventricular outflow septum may exist in some cases.⁶ In our previous study, PVCs originating from the ASC often showed preferential conduction to the RVOT, leading to PVCs with LBBB morphology on 12-lead electrocardiography.⁷ This case indicates that insulated myocardial fiber traveling from the origin in the GCV to the endocardium could break out in the RVOT. The St-QRS of the LBBB morphology was 126 ms and that of the RBBB morphology was 44 ms. PVC1 was mapped in GCV V-QRS recorded as 14 ms and showed far field pre-potential. This finding indicates that the stimulation needed to pass through a longer conductive pathway (82 ms) and capture the myocardium in RVOT before the LBBB QRS morphology emerged, and the RBBB QRS morphology was obtained by capturing the epicardium around the origin and propagating in the GCV directly; this morphology was similar to previous reports.¹⁻⁴ These findings implied that preferential conduction might exist between the GCV and RVOT as well as between the ASC and RVOT,⁶ and that insulated myocardial fibers with functional conduction caused PVCs with 2 morphologies originating from the GCV.

Conclusion

PVCs with LBBB and RBBB morphologies and inferior axis can be successfully ablated at a single site in the GCV. Preferential conduction might exist between the GCV and RVOT.

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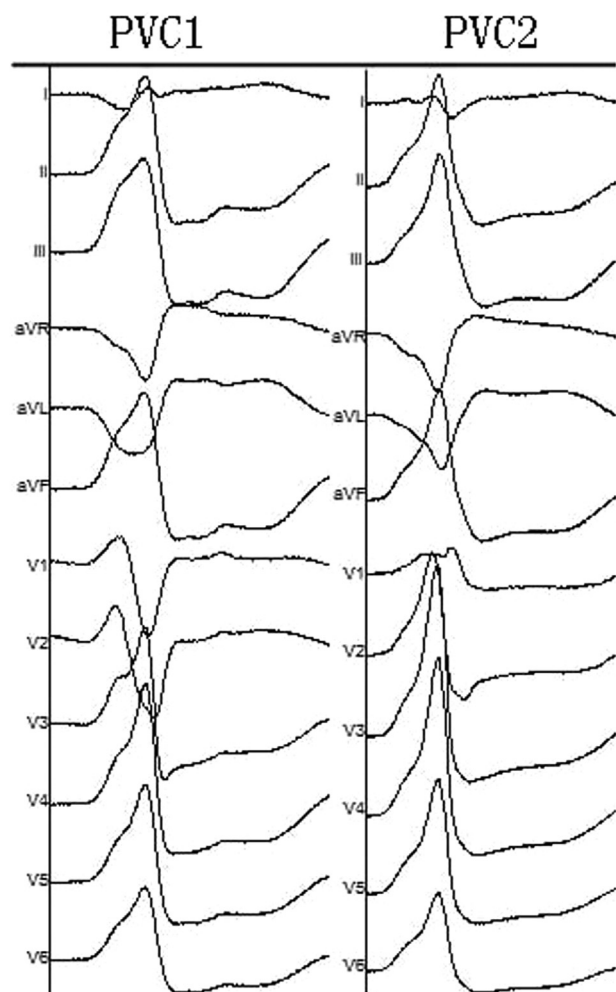


Figure 1 Electrocardiography of premature ventricular contractions (PVC1 and PVC2) shown as left bundle branch block and right bundle branch block morphology (100 mm/s).

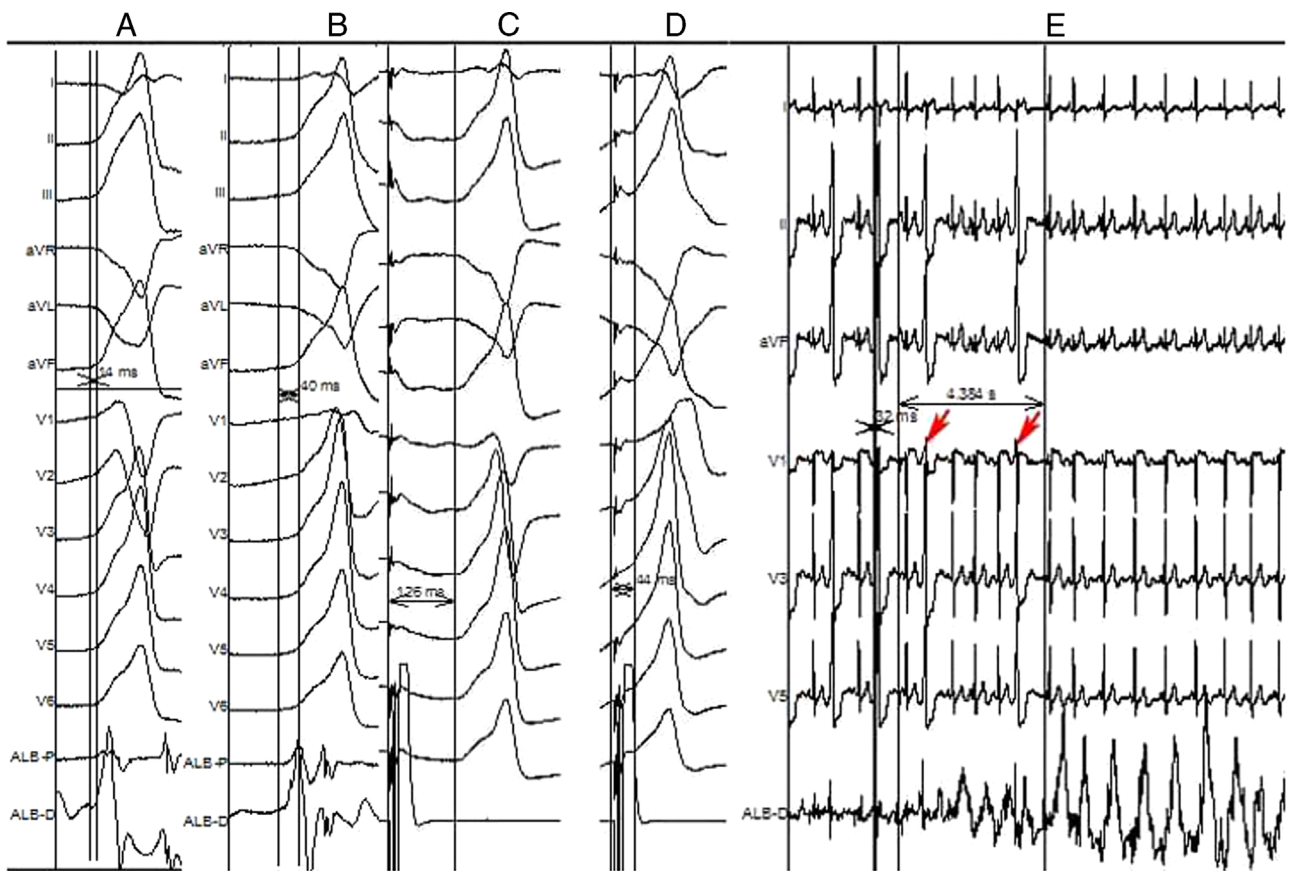


Figure 2 Activation mapping and pace mapping in right ventricular outflow tract (RVOT) and great cardiac vein (GCV). **A:** Activation map recorded earliest ventricular activation preceding the QRS onset (V-QRS) as 28 ms in RVOT. **B:** Activation map recorded V-QRS as 40 ms at the target site in GCV. **C, D:** Pace maps in GCV presented 2 QRS morphologies at the same site. The stimulus-to-QRS interval of left bundle branch block (LBBB) morphology was longer than that of right bundle branch block (RBBB) morphology (126 ms vs 44 ms). **E:** Premature ventricular contractions with 2 QRS morphologies that were eliminated after 4.5 seconds of ablation; the last one showed LBBB morphology and the penultimate one showed RBBB morphology (red arrow).

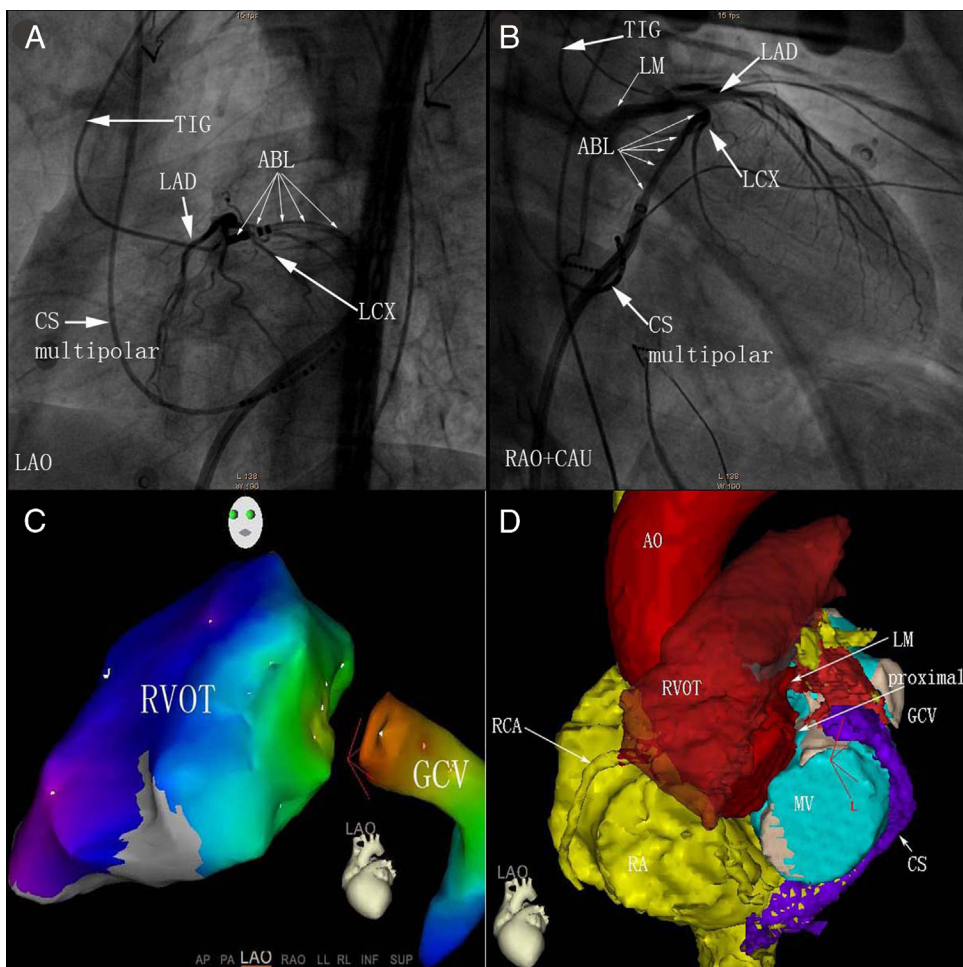


Figure 3 Fluoroscopic images and anatomic relationship of right ventricular outflow tract (RVOT) and great cardiac vein (GCV). **A, B:** Left anterior oblique (LAO) (45°) and right anterior oblique (30°) + caudal (20°) (RAO+CAU) (showing left circumflex coronary artery) fluoroscopic images of the mapping catheter and coronary angiography at the target. **C:** The electroanatomic map presents the relationship between RVOT and GCV. **D:** CARTO merge presents the relationship between RVOT and GCV. ABL = ablation catheter; AO = aortic; CS = coronary sinus; LAD = left anterior descending coronary artery; LCX = left circumflex coronary artery; LM = left main coronary artery; MV = mitral valve; RV = right ventricle; TIG = TIG catheter.

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