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Letter to Editor

Cardiac Memory T Waves After Termination of Fascicular Ventricular Tachycardia in the Emergency Room

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Abstract
Left posterior fascicular tachycardia (LPFVT) is a common type of idiopathic ventricular tachycardia that might be misdiagnosed as supraventricular tachycardia. Memory T wave is an inverted T wave that is seen after altered depolarization states such as pacemaker rhythm, ablated accessory pathways, ventricular tachycardia, or intermittent bundle branch blocks. Herein, we presented a young male patient who was admitted to the emergency room with FVT. After termination of tachycardia negative T waves (memory T wave) were seen. Memory T waves might be seen after the termination of FVT and must be differentiated from other causes of inverted T waves such as ischemia.

Keywords: Idiopathic ventricular tachycardia; T-wave inversion; memory T-wave

Dear Editor,

Left posterior fascicular ventricular tachycardia (LPFVT) is the most common type of idiopathic left VT [1]. The presence of the right bundle branch block and the left anterior hemiblock are the main features of electrocardiography (ECG) that are seen in these patients. It is usually hemodynamically well-tolerated, seen in patients without any structural heart disease, and responds well to calcium channel blockers, especially verapamil [2]. Due to its clinical features and ECG findings, it can be misdiagnosed as a supraventricular tachycardia with aberrancy.

Memory T waves, also known as the Chatterjee phenomenon, are one of the rare reasons for diffuse T wave inversion in ECG, seen after previous ventricular tachycardia, pacemaker implantation, bundle branch block, or Wolf-Parkinson-White syndrome. It is a benign process and there is no need for treatment. However, it must be differentiated from other reasons for T wave inversion such as ischemia [3].

Herein, we presented a patient with LPFVT, in which after the termination of tachycardia memory T waves were observed in the emergency room.

A 17-year-old male with no history of any diseases was admitted to the emergency room with a complaint of palpitations. A 12 lead ECG revealed a wide QRS tachycardia with right bundle branch block and left anterior fascicular block, fascicular ventricular tachycardia that originated from the left posterior fascicle was diagnosed (**Figure 1**). After the first examination, intravenous 25 mg diltiazem was administered. Control ECG revealed sinus rhythm with deep symmetrically negative T waves at the V_{3-6}, DII, DIII, and aVF derivations (**Figure 2**). His cardiac markers were within normal reference limits and

transthoracic echocardiography showed no abnormality. The patient underwent catheter ablation of FVT originating from the left posterior fascicle using a 3-dimensional electroanatomical mapping system after induction of the tachycardia during index hospitalization. The remaining hospital stay was unremarkable. He was discharged without any anti-arrhythmic medication.

There are several causes of T-wave inversion in the emergency room. An exact differential diagnosis is critical to avoid unnecessary tests, procedures, and prolonged hospital stay for the patients. In this paper, we presented a young male patient without any history of systemic illness, medication, or illicit drug use who was admitted with a wide QRS complex tachycardia consistent with FVT, and memory T waves were observed after termination of the tachycardia.

Left posterior FVT has a right bundle branch block, and left anterior fascicular block morphology at the ECG. Due to its ECG features, usually being hemodynamically well tolerated, seen in young patients without structural heart disease, and being sensitive to calcium channel blockers, it can be misdiagnosed as supraventricular tachycardia with aberrancy. Michowitz et al. [3] noted four ECG features favor FVT rather than supraventricular tachycardia; (a) presence of atypical V_1 morphology for RBBB, (b) QRS duration <140 milliseconds, (c) R/S ratio ≤1 in V_6 derivation, and (d) presence of positive QRS in aVR derivation. The presence of 3 or more of these features favors FVT. In our patient, all variables (QRS width 130 ms, V6 R/S ratio <1, and positive aVR) except for typical RBBB morphology (0 points) support VT. So the total score of 3 supported the diagnosis of FVT [3].

Memory T waves are one cause of T wave inversions, which are seen in patients' sinus rhythm ECG, when patients have transient abnormal ventricular conduction and turned into sinus rhythms, such as VT, bundle branch blocks, transient ventricular pacing, and intermittent Wolf-Parkinson-White patients [4]. First Chatterjee et al. described transient T wave inversion and ST segment depressions after ventricular pacing. They claimed T wave inversion is caused by artificial depolarization of ventricle changes repolarization and this finding has been seen as T wave inversion [5]. In 1982 Rosenbaum and colleagues postulated electrotonic modulation of ventricular repolarization and described the term, cardiac memory. They implicated, that T waves of the sinus follow the direction of the QRS complex of abnormal activation and its amplitude is proportional to the duration of abnormal activation so called accumulation [6]. In memory, T wave inversion is related to the loss of function of Ito and potassium channels [7].

One of the biggest challenges of T wave inversion in the emergency room is differentiating memory T waves from ischemic T wave inversion. Different algorithms are defined for this purpose. Shvilkin et al. [8] declared that positive T wave in aVL, positive/isoelectric T wave in lead I, and bigger T wave inversion in precordial derivations than inferior derivations favor memory T waves caused by ventricular pacing more than ischemia. Nakagawa et al. [9] also proposed criteria including (i) positive T wave in aVL derivation, (ii) negative or isoelectric T wave in lead II, and (iii) negative T wave in V4-6 derivations, or (iv) QTc <430 ms with a 100% sensitivity and 96% specificity for the cardiac memory compared to ischemic etiology. Based on proposed criteria in previous studies, T-wave

Table 1. Review of the literature about the cardiac memory T waves after termination of the left posterior fascicular ventricular tachycardia (LPFVT).

Article	Year	Patient #	Age	VT type	T wave inversion	Catheter ablation	Disappearance of T-wave inversion
Park et al. [10]	2012	n=1	28 yo	LPFVT	After electrical cardioversion	Yes	3-months later
Sorgente et al. [7]	2012	n=1	26 yo	LPFVT	After verapamil	Yes	Not reported
Kim et al. [13]	2012	n=1	41 yo	LPFVT	After catheter ablation	Yes	1-month later
Josephson et al. [11]	2015	n=1	24 yo	LPFVT	After verapamil	Not reported	Not reported
Nakagawa et al. [9]	2016	n=16	Mean 35 ± 17 yo	LPFVT	9/16 patients after verapamil or electrical cardioversion	Yes	Within 6-weeks
Siroky et al. [12]	2020	n=1	24 yo	LPFVT	After amiodarone	Yes	Not reported
Gunaseelan et al. [4]	2020	n=1	36 yo	LPFVT	After diltiazem	Not reported	Not reported
Kara et al.	2024	n=1	17 yo	LPFVT	After diltiazem	Yes	Not reported

inversions in our patient's sinus rhythm ECG were consistent with cardiac memory (T wave was positive in lead aVL and I, T waves were deeper in precordial derivations than inferior derivations, negative T wave in lead II, and negative T wave in V4-6 derivations).

In Table 1, we reviewed the previously reported patients of cardiac memory T waves after FVT. Park et al. [10] reported a patient with FVT in whom the T-wave inversion was observed after the termination of tachycardia with electrical cardioversion and T-wave inversion disappeared after 3 months. Josephson et al. [11] presented a case in which FVT terminated with intravenous verapamil infusion and also showed inverted T waves after termination of tachycardia. Sirotky et al. [12] and Kim et al. [13] represented other cases of LPVT in which T-wave inversions were observed after catheter ablation and disappeared in the first week and first month of follow-up. In our patient, memory T waves were also observed after termination of the tachycardia with diltiazem administration.

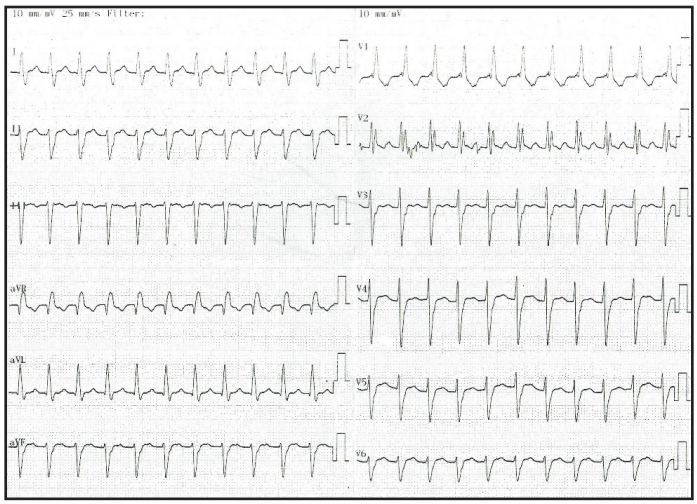

Figure 1. The patient's admitting ECG revealed a wide QRS complex tachycardia with right bundle branch block and left anterior fascicular block morphology, fascicular VT originating from the left posterior fascicle was diagnosed.

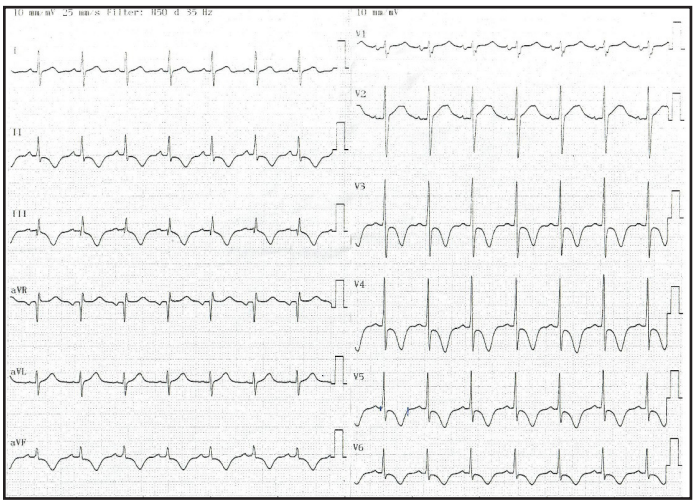

Figure 2. Control ECG after administration of intravenous diltiazem revealed sinus rhythm with deep, symmetrical T wave inversion at the V_{3-6}, DII, DIII, and aVF derivations, and positive T waves at the DI, V_{1-2}, aVL, and aVR.

In conclusion, LPFT is a common type of idiopathic ventricular tachycardia and memory T waves might be seen after its termination. Differentiation of LPFT from supraventricular tachycardias, and memory T waves from ischemic inverted T waves are challenging issues that must be solved.

Kind Regards,

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Written and verbal informed consent was obtained from the patient before the publication of this case report.

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