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Ablation of heterogeneous zone eliminates ventricular tachycardia: Can cardiac MR be a criterion for successful ablation?

Heterojen bölgenin ablasyonu ventriküler taşikardiyi elimine etmiştir: Kardiyak MR başarılı ablasyon için bir kriter olabilir mi?

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Introduction

Surviving myocytes in the heterogeneous infarct borders of the scar tissue due to previous myocardial infarction, may provide a critical arrhythmogenic substrate for ventricular tachycardia (VT) (1). Ablation of this critical substrate can eliminate VT. Cardiac magnetic resonance (CMR) imaging can visualize scar tissue, and CMR may allow detailed characterization of infarcts by differentiating the core and peripheral regions. Imaging of heterogeneous zone by CMR has prognostic significance. A clinical study with CMR has reported the associations of the heterogeneous zone with inducible ventricular arrhythmias (2). However, significance of heterogeneous zone ablation has never been studied.

In this report, we present a case of post-myocardial infarction (MI) patient with VT in whom ablation that eliminated the VT caused severe decrease in heterogeneous zone percent seen on CMR.

Case Report

A 75-year-old man was referred to our laboratory due to further evaluation. He experienced inferior myocardial infarction 14 years ago and underwent coronary bypass surgery. A month ago, he was admitted to ER due to palpitation. Electrocardiogram showed monomorphic VT at a rate of 162 beats/min with right bundle branch block morphology and northwest axis (Fig. 1). He was hemodynamically stable. Medical cardioversion attempt with amiodarone failed. He was then electrically cardioverted and oral amiodarone treatment was started. A month after cardioversion he was referred to our institution for further evaluation. The echocardiography showed mild systolic dysfunction (LVEF:45%), inferior and posterior akinesia and basal and mid lateral hypokinesia with normal left ventricular diameters.

CMR was performed in multiple anatomic planes using T1-weighted and cine steady-state free precision sequences. Left ventricular end-systolic volume and end-diastolic volume were 130.10 mL and 72.18 mL, respectively. Gadolinium- enhanced sequences to evaluate early myocardial perfusion and delayed myocardial enhancement were also performed, using 0.1 mL/kg gadobenate dimeglumine. DE-CMRI demonstrated transmural scar in inferior and inferoseptal mid- and basal segments, non-transmural scar in mid-inferolateral segments, which included heterogeneous enhancement pattern in mid inferior segment (Fig. 2A). A custom developed program was used for quantification of the scar core and the heterogeneous zone based on SI thresholds (>3SDs and 2 to 3 SDs above remote normal myocardium, respectively). Coronary angiography showed patent bypass grafts. During electrophysiologic study hemodynamically stable sustained monomorphic VT (CL: 347 msec) was easily induced. Catheter ablation was performed using CARTO (Biosense Webster, New Brunswick, USA). Based on bipolar voltage amplitudes of scar ≤0.5 mV, scar border 0.5-1.5 mV, and healthy tissue ≥1.5 mV, an electro-anatomical map of the left ventricle in sinus rhythm revealed an infero-lateral scar (Fig. 3). During sinus rhythm, diastolic potentials and fragmented potentials were detected on the corresponding regions that were represented as heterogeneous zones by CMR. Because of the repetitious termination of the tachycardia by pacing maneuvers, the entrainment mapping could not be performed and pace mapping was preferred. Pace mapping at a border zone revealed

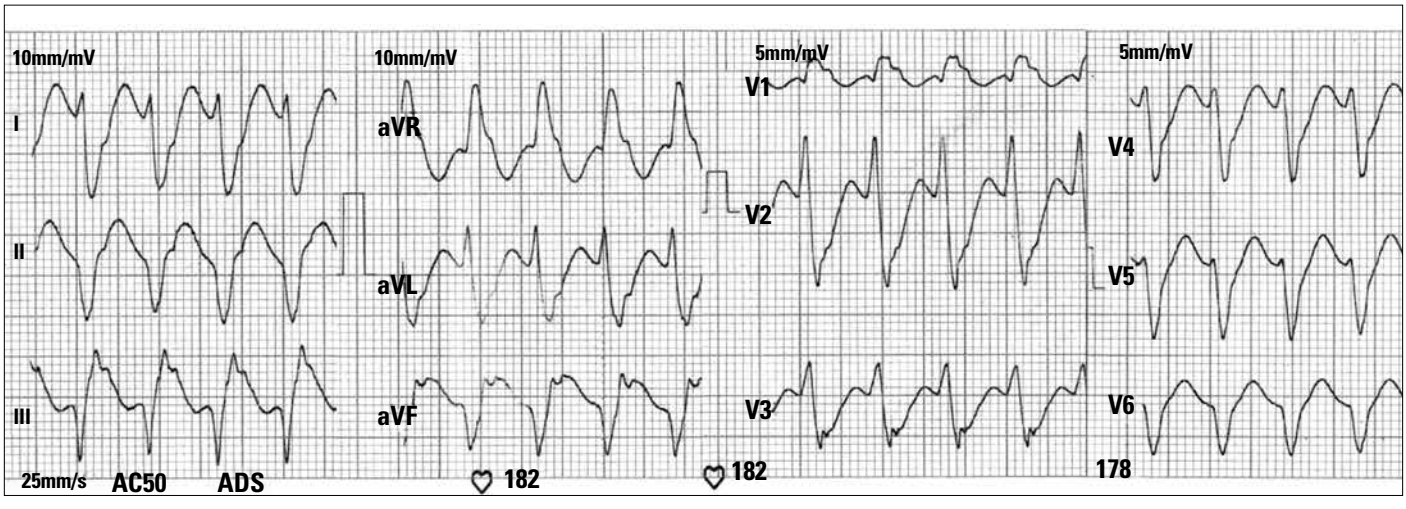

Figure 1. Electrocardiogram during sustained and well-tolerated monomorphic ventricular tachycardia

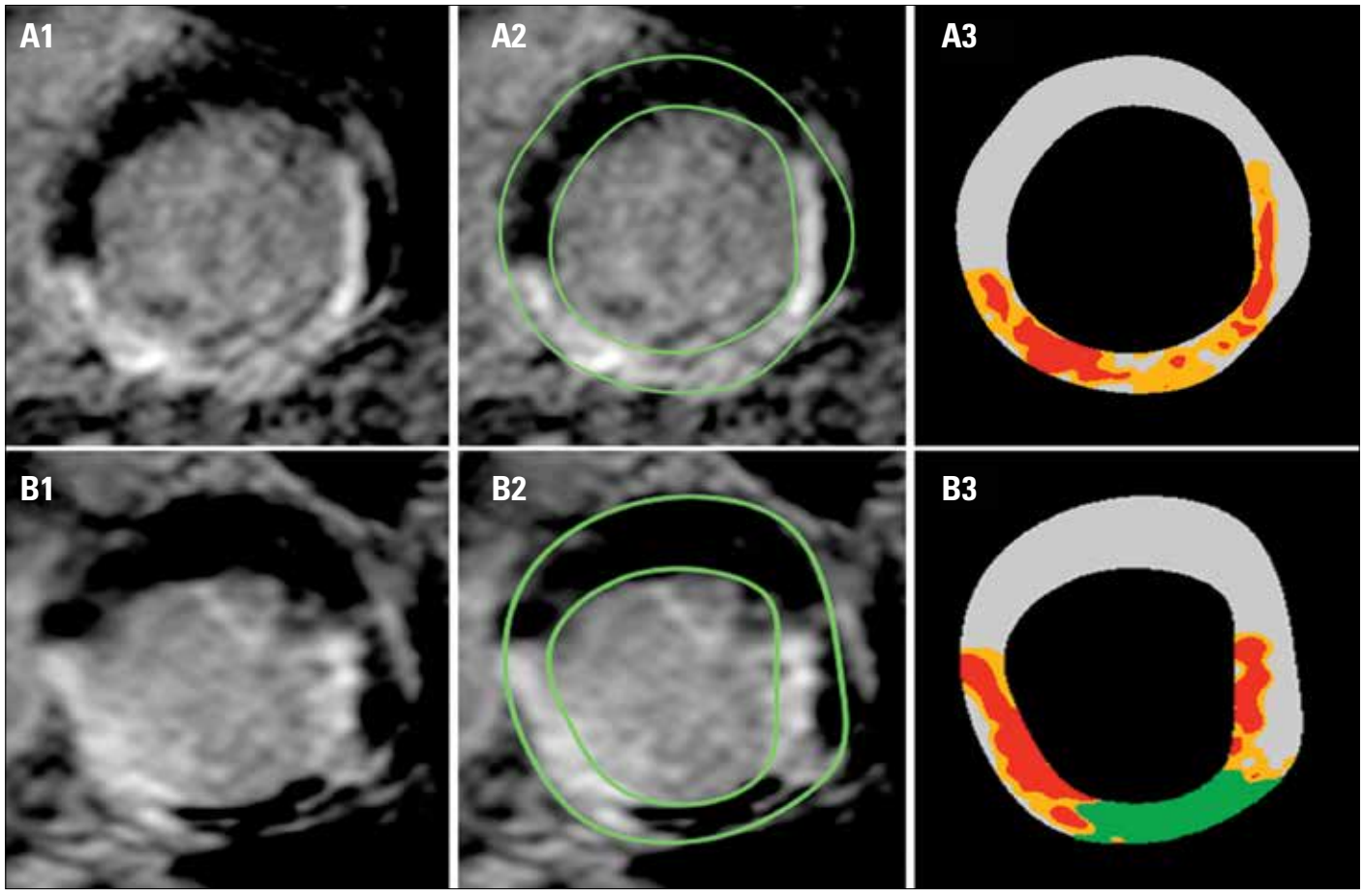

Figure 2. Delayed-enhancement CMR before and after the ablation procedure (A, B). A1- A mid-short axis image shows inferoseptal and inferior transmural, inferolateral non-transmural scar and a large heterogeneous zone. A2- Endocardial and epicardial borders were manually traced. A3- Scar core and heterogeneous zone are encoded in red (>3SD) and in yellow (2 to 3 SD above remote myocardium) respectively. B1-The corresponding image after ablation procedure shows RF lesions as non-reflow areas. B2- The image was traced manually as done as in image A2. B3- Scar core and border zones were defined same as pre-ablation study, green area represents non-reflow area and corresponds to the area of heterogeneous zone seen by pre-ablation study

CMR - cardiac magnetic resonance imaging, RF - radiofrequency ablation

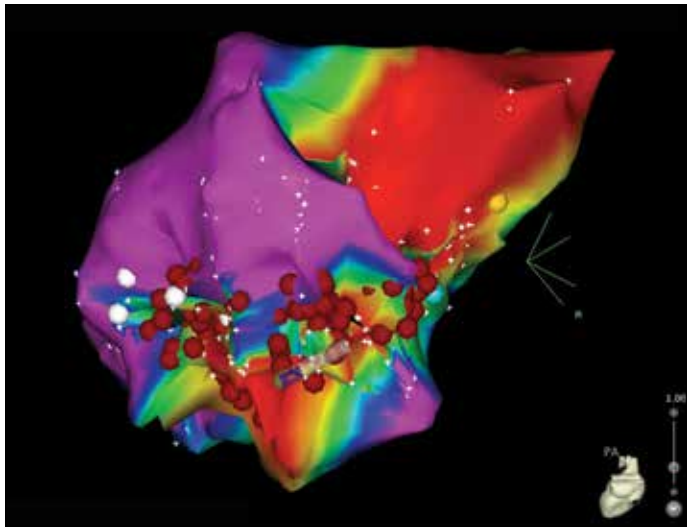

Figure 3. 3D reconstruction of the left ventricle (CARTO system). A voltage map during sinus rhythm is shown. Normal myocardium electrograms are codified in purple (>1.5mV); scar border in yellow (0.5-1.5 mV) and scar in red (≤0.5 mV)

12/12 match. Ablation at this site eliminated the clinical VT. However, non-clinical fast (CL=248 ms) VT with different morphology was induced by PVS and caused hemodynamic compromise. Anti-tachycardia pacing stopped the tachycardia. Forty-eight separate ablation lesions (each lasting up to 1 minute with powers up to 30 W, maximum temperature 50˚C) were made linearly from the border zones including diastolic double potentials and fragmented potentials and the points of pace maps to the healthy tissue or anatomic barriers by an 3.5 mm irrigated-tip Navistar Thermocool ablation catheter. After ablation lines were completed, there was no inducible VT.

Post-ablation DE-CMRI performed 24 hours later as part of a research study demonstrated ablation lesions as distinct areas of non-reflow reaching into the area of previously observed heterogeneous enhanced zone (Fig. 2B). Ablation resulted a decrease in the percent of heterogeneous zone (Table 1). During a 6-month follow-up period, the patient remained off antiarrhythmic drugs and has not experienced any episodes of ventricular arrhythmia.

Discussion

Magnetic resonance imaging (MRI) can visualize scar and viable tissue, as well as ablation lesions (3, 4). Reddy et al. (5) used CMR to see

Table 1. Pre-ablation and post-ablation scar measurements

Parameters	Pre-ablation	Post-ablation
Total scar, %	19.53	23.41
Heterogeneous zone, %	12.94	8.20
Scar core, %	6.60	9.77
Non-reflow area, %	0	5.43

gaps in RF ablation lines after pulmonary vein isolation for atrial fibrillation ablation. They correlate magnetic resonance imaging with invasive electro-anatomical mapping in a patient with recurrent atrial fibrillation after multiple unsuccessful ablations for atrial fibrillation. In a study by Estner et al. (6) ablation of the heterogeneous zone resulted in no inducible VT in animals.

Our case demonstrated that; 1) MRI identifies the presence of heterogeneous zone that contains critical substrate for VT, 2) Ablation lesions can be visualized by CMR as no-reflow areas, 3) Ablation decreased the heterogeneous zone percentage, which eliminated the VT. To the best of our knowledge this is the first human report identifying that heterogeneous zone ablation seen by CMR may eliminate VT. Therefore, decrease in the heterogeneous zone may be a criterion for successful ablation of ischemic VT and it needs to be studied.

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Severe tricuspid regurgitation after blunt chest trauma due to chordal rupture: a rare complication

Künt göğüs travması sonrası korda rüptürüne bağlı ciddi triküspit yetersizliği: Nadir bir komplikasyon

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Introduction

Tricuspid insufficiency is a rare complication of non-penetrating chest trauma (1, 2). The growing number of this complication has been encountered due to more frequently encountered motor vehicle accidents. The early diagnosis of traumatic tricuspid regurgitation is important because traumatic tricuspid injury could be effectively corrected with reparative techniques, early operation is considered to relieve symptoms and to prevent right ventricular dysfunction (3). Echocardiography can reveal the cause and severity of regurgitation. This complication is usually unthinkable and missed out.

We report a case of severe traumatic tricuspid regurgitation secondary to rupture of chordae tendinea following blunt chest trauma.

Case Report

A 17 years old male patient was admitted with complaints of increasing shortness of breath and fatigue for the last 3 months. On the history, he had motorcycle accident five months ago. He had no any complaint before trauma. Hepatomegaly and the holosystolic murmur,

Figure 1. Flail of anterior tricuspit leaflet