Mapping signatures of ventricular ectopy of endocavitary origin

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Case description

A 53-year old man with very frequent ventricular ectopy (39.4% burden) and a structurally normal heart, was admitted for percutaneous ablation. ECG showed a bigeminal unifocal ventricular ectopy (VE) pattern, with a right bundle branch block morphology and superior axis, indicating likely origin at the inferior left ventricle (LV).

During mapping at the inferior LV, multiple sites with good morphological match to the ectopic beats during pace mapping, and with early local electrograms relative to the QRS complex, were identified. Despite this, the proximal electrograms at these sites consistently preceded the distal bipolar electrograms (**Figure 1A**) with the mapping catheter oriented perpendicularly to the inferior LV wall (**Figure 1B & 1C**). **Figure 1D** shows the good pace matches obtained from these sites. The locations of these sites were roughly in a circle (**Figure 1B**), presumed to represent sites encircling the posteromedial papillary muscle, with the origin of the ectopy at the mid-papillary muscle, which would account for the consistent finding of proximal electrograms preceding distal electrograms at the surrounding sites.

At the final site of successful ablation at the mid-papillary muscle, distal electrograms preceded proximal electrograms during activation mapping (**Figure 2A**), unlike at sites surrounding the papillary muscle. On the intracardiac echocardiogram (ICE) (**Figure 2B**), the ablation catheter tip can be seen to maintain constant contact with the mid-papillary muscle. Following ablation, the patient was rendered free from ventricular ectopy, confirmed with ambulatory ECG monitoring at four months post-ablation.

VEs arising from endocavitary structures such as papillary muscles, moderator bands and false tendons are thought to account for 10% of VEs (1-3). The twin findings of proximal electrograms consistently preceding distal electrograms, found in a wide circular area with good pacemaps, should always prompt the operator to search for an endocavitary origin of ectopy, with the exit site located distant from the ventricular wall accounting for the proximal-to-distal direction of activation.

References:

1. Yamada T, Doppalapudi H, McElderry HT, et al. Electrocardiographic and electrophysiological characteristics in idiopathic ventricular arrhythmias originating from the papillary muscles in the left ventricle: relevance for catheter ablation. Circ Arrhythm Electrophysiol 2010;3:324–331.

2. Madhavan M, Asirvatham SJ. The fourth dimension: endocavitary ventricular tachycardia. Circ Arrhythm Electrophysiol 2010;3:302–304.

3. Doppalapudi H, Yamada T, McElderry HT, Plumb VJ, Epstein AE, Kay GN. Ventricular tachycardia originating from the posterior papillary muscle in the left ventricle: a distinct clinical syndrome. Circ Arrhythm Electrophysiol 2008;1:23–29.

Abbreviations:

ECG = electrocardiogram

VE = ventricular ectopy

LV = left ventricle

ICE = intracardiac echocardiogram

Figure legends:

Figure 1: Mapping of ectopy at the inferior left ventricle: (A) Intracardiac electrograms recorded from the mapping catheter (unipolar electrogram from distal electrode, distal bipolar electrogram and proximal bipolar electrogram) from six sites at the inferior LV and the corresponding surface ECGs, during ventricular ectopy. Red and yellow closed circles denote local activation times for unipolar and bipolar electrograms respectively. Despite good pace matches and early local signals relative to QRS onset, the proximal bipolar electrograms were consistently ahead in timing relative to the distal bipolar electrogram. (B) The locations of the six sites are shown on the inferior view of the left ventricle, and are located roughly in a circle, centered on the posteromedial papillary muscle (X). (C) Recordings from all six sites were with the catheter perpendicular to the inferior wall, as shown in the two representative examples. (D) Pace mapping at all six sites generated good 12-lead ECG morphological matches to the ventricular ectopic beats, as shown in two representative examples (paced beats in yellow, ectopic beats in green).

Figure 2: Ablation of ventricular ectopy arising from papillary muscle: (A) Intracardiac electrograms recorded at the apex of the papillary muscle, at the mid-papillary muscle (site of successful ablation), and at the inferior LV at the base of the papillary muscle. Red and yellow closed circles denote local activation times for unipolar and bipolar electrograms respectively. At both the apex and mid-papillary muscle, the distal bipolar electrograms now precede the proximal electrograms. At the mid-papillary muscle, the distal unipolar and bipolar electrograms were earlier than at the apex, with a true QS morphology in the unipolar electrogram, and this was the site of successful ablation. (B) Corresponding ICE images showing the three locations of ablation catheter tip (white arrow) relative the papillary muscle (orange arrow) (MV: mitral valve). At the successful site of ablation, the catheter tip is in clear contact with the mid-papillary muscle.

Figure 1:

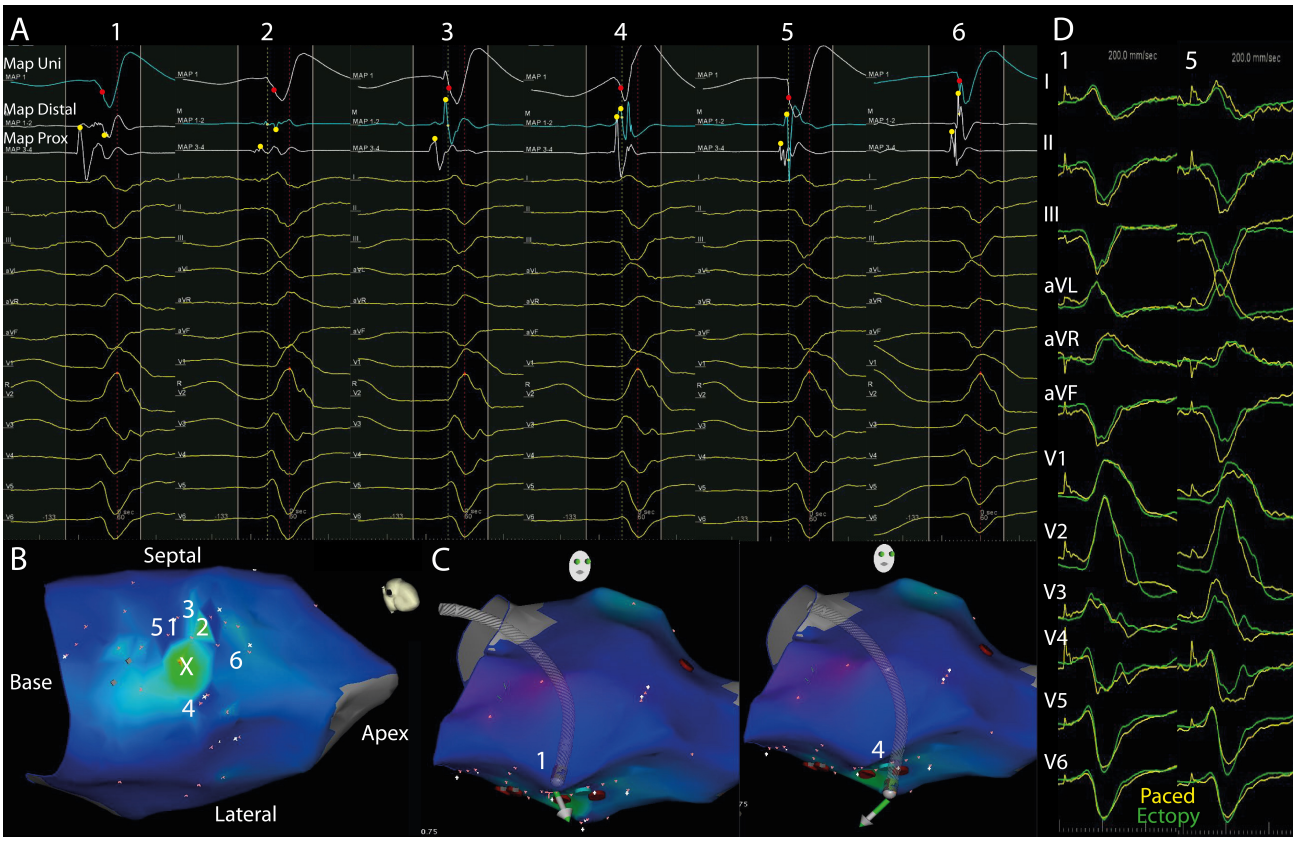
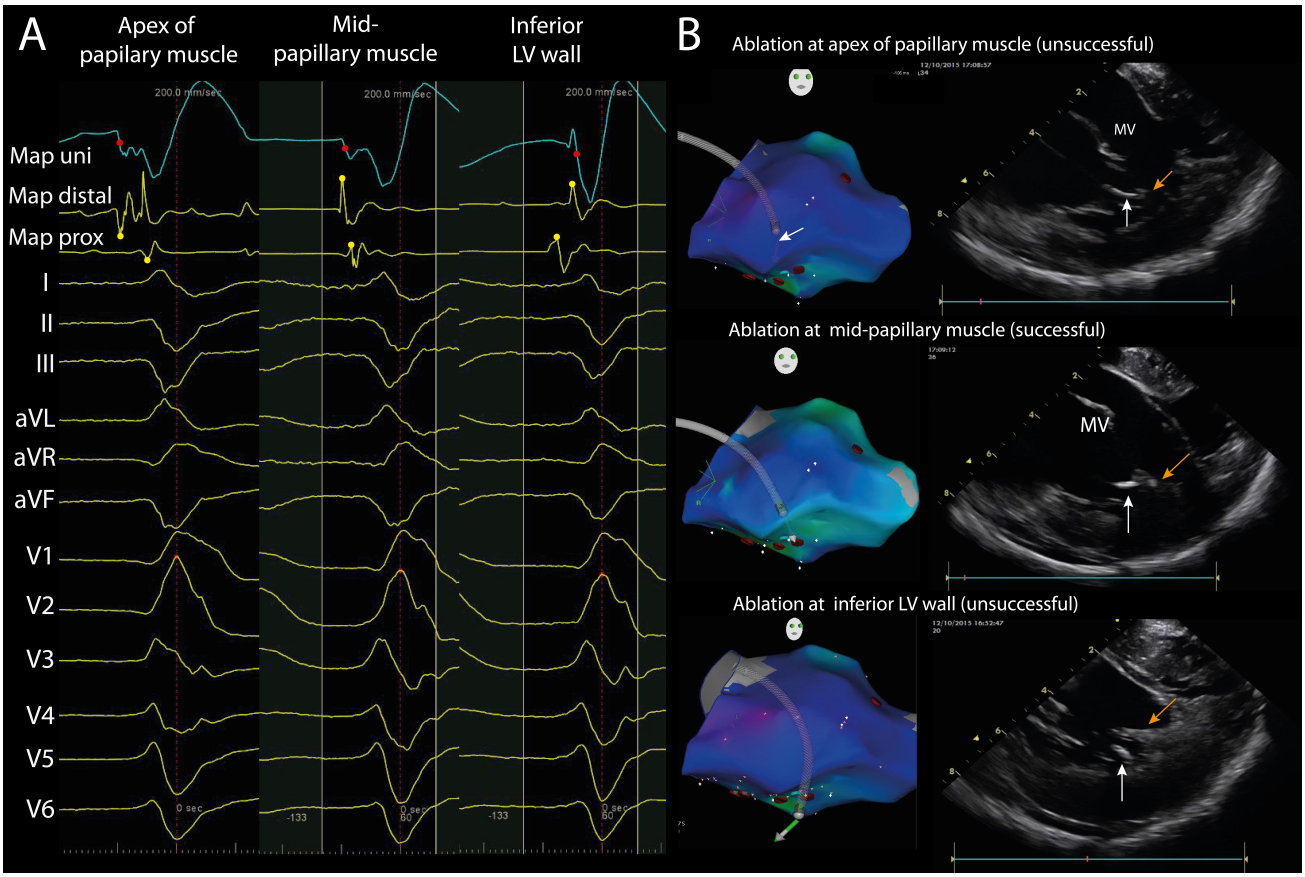

A
1
2
3
4
5
6
Map Uni
Map Distal
Map Prox
B
Septal
Base
Apex
Lateral
3
5
1
2
6
X
4
C
1
4
D
1
5
200.0 mm/sec
I
II
III
aVL
aVR
aVF
V1
V2
V3
V4
V5
V6
Paced
Ectopy

Figure 2:


A
Apex of papilary muscle
Mid-papillary muscle
Inferior LV wall
200.0 mm/sec
Map uni
Map distal
Map prox
I
II
III
aVL
aVR
aVF
V1
V2
V3
V4
V5
V6
B
Ablation at apex of papillary muscle (unsuccessful)
MV
Ablation at mid-papillary muscle (successful)
MV
Ablation at inferior LV wall (unsuccessful)