A case of pseudo-endocardial gap during mitral flutter: Pitfalls of the auto-annotation algorithm on the ultra-high-resolution mapping system

Short title: Pitfall of auto-annotation on 3D-mapping system

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Funding: none

Conflict of interest
MY: None, SY: None, MY: There is no COI to disclose directly related to this study.
Outside this study, Michihiro Yoshimura reports personal fees from Mochida Pharmaceutical Co., Ltd., personal fees from Daiichi Sankyo Co., Ltd., personal fees
from Pfizer Japan Inc., personal fees from Kowa Co., Ltd., grants and personal fees from Mitsubishi Tanabe Pharma Corporation, grants from Teijin Pharma Ltd., grants from Astellas Pharma Inc., grants from Shionogi & Co., Ltd. TY: There is no COI to disclose directly related to this manuscript. Speaker honoraria from DAIICHI SANKYO COMPANY, Ltd., Japan, Boerringer Ingelheim, Abbott Japan, Bristol-Myers Squibb, Medtronic Japan, and Japan LifeLine, and research grants from Boehringer Ingelheim.

**Key words:** catheter ablation, ultra-high-resolution mapping, vein of Marshall, mitral flutter, auto annotation

487 words
Case Presentation

We herein report a 53-year-old man with atrial tachycardia (AT) recurrence after atrial fibrillation (AF) ablation. In the initial procedure, pulmonary vein isolation (PVI) for AF and a mitral isthmus (MI) line for the intraprocedural mitral flutter were successfully performed. In the second procedure for recurrent AT, an endocardial activation map with an ultra-high-resolution mapping system (Rhythmia™; Boston Scientific, Marlborough, MA, USA) showed clockwise mitral flutter (cycle length [CL]: 240ms) via epicardial fiber with a breakout site 11 mm posterior from the previous MI line that simultaneously demonstrated a residual endocardial gap near the left inferior PV (Movie). A hexapolar 1.6-Fr catheter (EP Skinny; FMD Co., Ltd., Tokyo, Japan) advanced into the vein of Marshall (VOM) to assess the epicardial potentials clearly showed sharp epicardial potentials at the opposite site of the endocardial gap on the MI line with tiny and dull potentials (Figure 1A). The activation map of endo- and epicardial mapping satisfied the entire AT-CL, and the post-pacing intervals during entrainment pacing at the septal and inferior region along the mitral annulus and the VOM were equal to AT-CL, but that was much longer than AT-CL at the great cardiac vein (Figure 2). These findings indicated a diagnosis of mitral flutter via VOM and the residual endocardial MI gap was considered to be bystander. After accidental AT termination by catheter stimulation, we targeted the epi-endo breakout sites along the ridge during pacing from the proximal coronary sinus, and MI was successfully established without any radiofrequency application to the previous MI line (Figure 1B). This case demonstrated a pseudo-endocardial gap at the previous MI line using the auto-annotation algorithm of the ultra-high-resolution mapping system; however, these
signals were in fact far-field potentials of the epicardial signals. It is important to correctly interpret the activation map when using an auto-annotation algorithm of an ultra-high-resolution mapping system. Differentiation between local near- and far-field potentials around the MI region can sometimes be difficult due to the presence of epicardial fibers, such as VOMs.
**Figure legends**

**Figure 1.** (A) Endocardial and epicardial local signals at the previous mitral isthmus (MI) line during atrial tachycardia. Ultra-high-resolution mapping showed tiny and dull potential (0.0864 mV) at the endocardium (pseudo-endocardial signals) that was identical to the conversely large and sharp epicardial signals (0.873 mV) in the vein of Marshall (VOM). (B) Successful ablation site for the MI line. The MI line was completed by sequential radiofrequency (RF) application at the low- and high-ridge region with endo-epi connection sites, whereas no RF application was required at the previous MI line.
**Figure 2.** Post pacing intervals (PPIs) during entrainment pacing at the vein of Marshall (VOM) and at the great cardiac vein (GCV). PPI during entrainment pacing at the VOM was equal to AT-CL (PPI-AT CL=0ms), while PPI at the GCV was much longer than AT-CL (PPI-AT CL=+70ms). AP indicates anteroposterior view, CS; coronary sinus, GCV; great cardiac vein, LAO; left anterior oblique view, VOM; vein of Marshall.
Key Teaching Points

1. Although the ultra-high-resolution mapping system (Rhythmia™) is useful to identify the detailed mechanisms of complex atrial tachycardia (AT), there is a limitation for the detection of the epicardial conduction.

2. Micro-mapping catheter (1.6Fr) can help make a diagnosis of mitral flutter via epicardial connection along the vein of Marshall (VOM) that occurs after mitral isthmus linear ablation.

3. It is important to correctly interpret the activation map when using an auto-annotation algorithm of an ultra-high-resolution mapping system. Differentiation between local near- and far-field potentials around the MI region can sometimes be difficult due to the presence of epicardial connection along the VOM. We need to incorporate multiple techniques and identify epicardial structures for accurate diagnosis.