Targeted endomyocardial biopsy using electroanatomical voltage mapping in the early stage of arrhythmogenic right ventricular cardiomyopathy

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Endomyocardial biopsy (EMB) is useful for making a diagnosis of cardiomyopathy. However, the sensitivity of conventional EMB specimens from the interventricular septum is low in arrhythmogenic right ventricular cardiomyopathy (ARVC), especially in the early stage, because of the limited location of the affected tissue. Therefore, it is important to be able to target only the affected tissue in order to improve the sensitivity of the EMB, especially in the early stage of ARVC. A significant correlation between the low voltage areas identified by the electroanatomical voltage mapping (EVM) and abnormal findings from the EMB in ARVC has been reported. We describe an innovative strategy for performing EMB, using EVM to identify the local affected area and to perform a selective EMB from that area.

Introduction
Obtaining a correct diagnosis of arrhythmogenic right ventricular cardiomyopathy (ARVC) may be difficult during the early stage of the disease. Although endomyocardial biopsy (EMB) is a definitive diagnostic tool for diagnosing ARVC demonstrating typical fibrofatty infiltration into the myocardial tissue of the right ventricle (RV), its sensitivity is low. Electroanatomical voltage mapping (EVM) has recently been developed to identify the presence, location, and extent of the pathological substrate of ARVC by detecting the low voltage areas that represent RV fibrofatty changes. In this report, we describe a case in which an accurate diagnosis of ARVC was obtained using a selective EMB sampling from low voltage areas guided by EVM.

Case report
A 33-year-old woman with a history of cardiopulmonary resuscitation due to ventricular tachycardia (VT) was referred to our hospital. The 12-lead electrocardiogram during sinus rhythm exhibited inverted T waves in leads II, III, aVF, and V1–V3, and no epsilon waves were present. The magnetic resonance imaging demonstrated a slightly enlarged RV with mild systolic dysfunction without any intramyocardial pathological signals. Sustained monomorphic VT with a right bundle branch block pattern and superior axis was induced reproducibly by double extrastimuli from the RV outflow tract. Mapping of the RV inferior septum near the tricuspid annulus revealed diastolic potentials during the VT. Additionally, concealed entrainment was demonstrated, and the post-pacing interval was similar to the VT cycle length. The VT was eliminated after point-by-point ablation at this area. Precise EVM of the RV using a CARTO system (Biosense-Webster Inc., USA) was performed during sinus rhythm to delineate the location and extent of the diseased myocardium.

Figure 1
Electroanatomical bipolar voltage mapping of the right ventricle (RV). The colour range setting for the amplitude of the intracardiac electrogram is 0.5–1.5 mV. Red indicates the low voltage areas with an amplitude of <0.5 mV (diseased myocardium) and purple indicates the high voltage areas with an amplitude of >1.5 mV (normal myocardium). The gradient colours indicate the areas with amplitudes ranging between 0.5 and 1.5 mV (border zone). Low-voltage areas were observed in the RV antero-septal outflow tract and infero-septal RV near the tricuspid annulus. RAO, right anterior oblique view; AP, anteroposterior view; PA, posteroanterior view.
from 83 sampling sites. An RV bipolar voltage mapping was reconstructed with a 0.5–1.5 mV colour range setting and demonstrated low voltage areas in the RV antero-septal outflow tract and the RV inferior septum around the successful ablation sites with the amplitude of the local intracardiac electrograms being <0.5 mV (Figure 1). Endomyocardial biopsy guided by the low voltage areas was performed using a disposable bioptome (Boston Scientific Corp., USA), with a long sheath inserted from the right femoral vein. The histopathological examination using a haematoxylin–eosin stain revealed fibrofatty infiltration into the myocardium consistent with ARVC (Figure 2). After a definitive diagnosis of ARVC was made, an implantable cardioverter-defibrillator was implanted and no VT recurred during 10 months of follow-up.

Discussion
The finding of fibrofatty infiltration into the RV myocardium demonstrated using EMB is one of the major diagnostic criteria reported by the international task force for ARVC. However, the sensitivity of EMB is low as first the existence of any affected tissue may be localized; secondly, myocardial degeneration begins from an epicardial site; and finally, the interventricular septum that is a common sampling site for minimizing any risk of perforation is rarely affected until the advanced stages of ARVC. Therefore, it is important to target the affected tissue to improve the sensitivity of the EMB, especially in the early stage of ARVC. Electroanatomical voltage mapping-guided EMB can be one simple solution for this challenge.

Conflict of interest: none declared.

References

Figure 2 An endomyocardial biopsy sample obtained from a low-voltage area in the infero-septal right ventricle near the tricuspid annulus. This histopathological finding reveals fibrofatty infiltration into the myocardium consistent with arrhythmogenic RV cardiomyopathy (haematoxylin–eosin stain).

CASE REPORT
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Pulmonary vein isolation after left-sided pneumonectomy: technically challenging but feasible and instructive
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We present a technically challenging case of pulmonary vein isolation (PVI) after complete left-sided pneumonectomy, resulting in uncommon cardiac rotation. Wide area circumferential PVI after pneumonectomy is technically challenging but feasible in experienced centres. Correct identification of the PV ostia is crucial before ablation.

Introduction
Catheter ablation has well been established in drug-refractory atrial fibrillation (AF). Post-operative uncommon cardiac rotation after left-sided pneumonectomy increases procedural complexity.

Case report
We present a 57-year-old male patient with highly symptomatic paroxysmal AF for 7 years, despite anti-arrhythmic drugs (AADs). Owing to hypertension, the CHADS2 score is 1. Thirteen years ago, complete left-sided pneumonectomy due to Aspergillus pneumonia. Prior to the ablation procedure, signed written consent was obtained from the patient, left atrial (LA) size was determined, and LA