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# Correspondence

## Non-invasive mapping of persistent atrial fibrillation and dextroposition of the heart



For the first time worldwide, a patient with cardiac dextroposition and persistent atrial fibrillation was mapped with the Cardiolnsight<sup>M</sup> non-invasive 3D mapping system. In this report we describe the distribution of the focal and rotor activities of this very rare case. Non-invasive phase mapping of atrial fibrillation (AF) is a relatively new tool that allows high-resolution recording of biatrial AF activation sequences under circumstances close to normal physiological conditions [1]. This technology has been used in patients with lone-AF undergoing catheter ablation [2] and has also been successfully used in patients prior to surgical ablation of AF [3].

The present report describes a 79-year-old male patient with a rare condition of dextroposition of the heart and with persistent atrial fibrillation that had recently undergone a MitraClip<sup>™</sup> NTR procedure because of mitral valve insufficiency (for computed tomography (CT) scan see Fig. 1 and Supplementary Video 1). During the procedure, partial tearing of the anterior mitral valve leaflet

occurred and resulted in high-grade mitral valve insufficiency. Two weeks after, the patient was admitted to our department for surgical correction and presented with severe mitral valve insufficiency (showing in echocardiography a jet directed posteriorly) and moderate to severe tricuspid valve insufficiency. Normal left ventricular and mild-moderately reduced right ventricular function were present; systolic pulmonary artery pressure was 61 mmHg; CT-scan measurements showed LA size:  $80 \times 65$  mm and RA size:  $64 \times 67$  mm.

The patient was mapped 3 days prior to surgery with a noninvasive three-dimensional, beat-by-beat mapping system (ECVUE, CardioInsight<sup>TM</sup>, Medtronic Inc., Minneapolis, Minnesota, USA). Normally patients planned for surgical ablation are not routinely mapped prior to surgery, therefore the electrophysiological mechanism and the anatomical distribution of their AF drivers is unknown. Details regarding the ECVUE mapping technique have been previously described [3]. In short, the CardioInsight<sup>TM</sup> is a non-invasive mapping system that collects chest ECG signals and combines these signals with CT scan data to produce and display simultaneous, bi-atrial, 3D epicardial maps (Supplementary Fig. 1). The patient had to receive intravenous infusion of metopro-



Fig. 1. CT-scan image acquired prior to the MitraClip<sup>™</sup> procedure. CTA, computed tomography angiography; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle.

lol 5 mg prior to mapping, because his initial heart rate was too fast and successful mapping would otherwise not have been possible. For successful mapping a T-R ECG interval of more than 800 ms is necessary to allow reliable data recording and appropriate phase mapping. Rotor and focal activities are recognized automatically and are being depicted as such by the algorithm in a



**Fig. 2.** 3D mapping results showing biatrial distribution of rotor and focal activity in this patient with cardiac dextroposition and persistent AF. Focal activities are depicted as orange diamonds while rotor activities are depicted as yellow and orange areas and the number at the center indicates the numbers of rotation. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

composite phase map and were checked manually and individually for plausibility. It is difficult to answer if metoprolol had an effect on the gained results or not in this particular case, this should be seen as a limitation.

Two focal activities as well as 19 rotor activities were recorded in the final composite map. The two focal activities were seen in the left atrial appendage (Bordeaux classification [4] area 1), whereas rotor activity was seen in the left as well as in the right atrium (see Fig. 2). Ten of the 19 rotors were detected in the right atrium (53%).

Due to the complexity of the operation, which was performed via a right lateral thoracotomy, the plan of performing a Cox Maze procedure had to be abandoned intraoperatively. The patient was successfully treated with a biological valve replacement (with a Mosaic<sup>™</sup> prosthesis, size 31 mm) and a tricuspid valve reconstruction (with a Contour 3D<sup>™</sup> annuloplasty ring, size 34 mm). The patient was discharged with Apixaban for oral anticoagulation and a low dose beta-blocker was started. Three months after the procedure the patient has undergone physical rehabilitation, is doing well, is in 'New York Heart Association (NYHA) functional class I' and unexpectedly in sinus rhythm. The beta-blocker has been further increased and he is being kept on Apixaban.

Atrial fibrillation is the most frequently observed rhythm disorder, and is associated with an increased risk of stroke, reduced survival and diminished quality of life [5], while cardiac dextroposition represents a rare anatomical condition with displacement of the heart into the right hemi-thorax [6]. Differential diagnosis of dextroposition of the heart includes dextrocardia, which is associated with situs inversus. Reports on successful interventional pulmonary vein isolation, all in patients with dextrocardia and situs inversus, have not described the atrial distribution of AF triggers [7].

To the best of our knowledge, this is the first report about a patient with persistent atrial fibrillation and dextroposition of the heart who underwent non-invasive 3D mapping. Until now it was unanswered whether the distribution of focal and rotor activities is similar to patients with normal anatomical conditions. Surgical ablation could not be performed, but we were able to document the electrophysiological mechanism of this patient's AF. We demonstrate that this particular case had, on the one hand, rotors detected in both atria, and on the other hand, just a few focal activities around the left atrial appendage. These findings correspond with the results of our previous studies [3,8] performed in surgical patients with normal cardiac anatomy, in which all patients with long-standing persistent AF showed biatrial involvement. Furthermore, this report shows that non-invasive 3D mapping could potentially aid planning of complex interventions or surgical ablation including procedures in patients with challenging anatomy.

## 1. Disclosures

Dr Ehrlich reports speakers' honoraria from Medtronic Inc. Dr Ad reports speakers' honoraria from Medtronic Inc., is consultant for AtriCure and LivaNova, and co-owner of LAA occlusion LLC.

All other authors have no disclosures regarding this work.

## 2. Patient consent

The patient gave written informed consent for publication.

#### **Declaration of Competing Interest**

The authors report no relationships that could be construed as a conflict of interest.

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## Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijcha.2020.100640.

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