Cardiovascular Flashlight

Three-dimensional real-time MRI-guided intracardiac catheter navigation

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Electrophysiological (EP) procedures guided by real-time MRI are highly attractive. Previously, we have reported first in man usage of such diagnostic EP studies as well as RA isthmus ablation. Passive catheter tracking, however, is one of the main limitations. Here, we present first results from MRI-guided active catheter tracking used for real-time 3D intracardiac navigation, mapping, and ablation.

In a 60 kg swine, a 3D data set containing heart and large thoracic vessels was acquired in a 1.5 T MRI scanner. Auto-segmentation algorithms created auto-registered 3D models of all cardiac chambers (Panel A: yellow, RA; blue, LA; green, right ventricle; purple, left ventricle; red, aorta).

Active catheter tracking was performed using the magnetic field to localize inductive coils assembled on the EP catheter. The coils were shown as a virtual catheter icon displayed in real-time in the auto-segmented/auto-registered 3D model, in the pre-acquired MRI planes, and during further scanning (Panels B–F).

After transfemoral catheter introduction, the CS was intubated (Panel B) and the position confirmed with real-time scanning (Panel C, arrow-marked catheter shaft; Supplementary material online, Movie S1). After blunt transseptal access (Panel D, red icon; Supplementary material online, Movie S2), the catheter was brought into all PVs (Panel E, red icon, arrow-marked branches of the inferior PV; Supplementary material online, Movie S3). Subsequently bi-atrial SR activation map was performed with a reference catheter (green icon) in the CS (Panels F and G, activation times colour-coded on the 3D model; Supplementary material online, Movie S3). Eventually, after right ventricular outflow tract access (Supplementary material online, Movie S5), the catheter was used to ablate the AV node (Supplementary material online, Movie S6).

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Supplementary material is available at European Heart Journal online.

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