DGM is able to Distinguish between Dominant and Bystander Cycles in In-Silico and Clinical Double Loop Atrial Tachycardias

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Background

Recently, Directed Graph Mapping (DGM) has shown to be able to automatically identify the reentry cycles and targets to ablate complex atrial tachycardias (ATs). However, sometimes, DGM found an additional reentry circuit which was not confirmed with entrainment maneuvres (EM) as a dominant reentry but as a bystander reentry.

Objective

We aimed to optimize the DGM software and add new features to automatically distinguish between the dominant and bystander cycle in clinical ATs with the aid of in-silico simulations. The simulations were based on a clinical case of AT and were used to test and experiment with the physiological and dynamical conditions of the double loop.

Methods

We made use of an accurate model of the left atrium and openCARP (Figure 1 A) to induce an in-silico double loop. A localized reentry at the anterior wall around a scar and a mitral valve reentry were initiated and depending on the size of the scar tissue (Figure 1 B), the mitral reentry shifted from a bystander to equally dominant with respect to the localized reentry. In-silico EMs were performed to test the behavior of each reentry DL cycle (Figure 1 B).

Results

Upon increase of the length of the scar, the region of collision between the colliding wavefronts of the dominant and bystander cycle shifted from connectivity with the mitral valve to an intermediate position between the scar and the mitral valve. This region emerged in the directed graphs by visualization of the opposing arrows (called Region Of Collision or ROC) in DGM (Figure 1 B). This was then tested on 9 cases of complex double loop ATs (Figure 1 C (for 2 cases)).

Discussion

In 8/9 clinical cases of AT, DGM is able to distinguish between dominance in double loop ATs. The ROC is therefore a valuable addition to DGM.

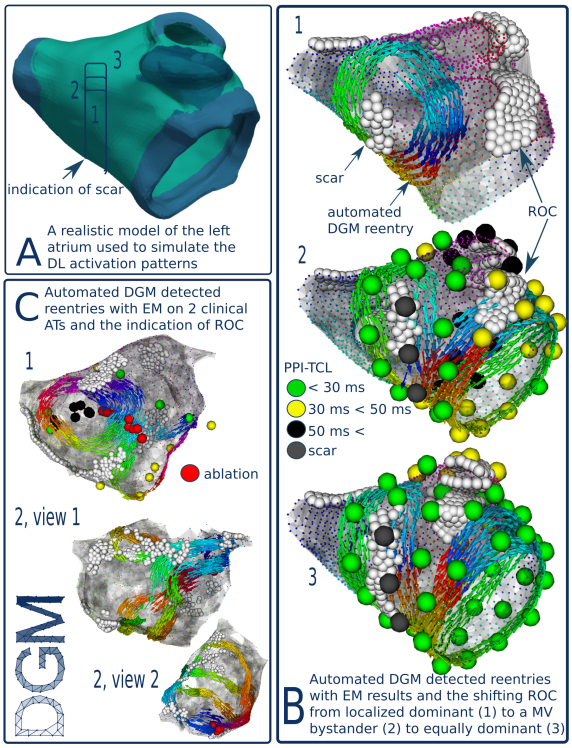

Figure 1: A. The in-silio LA setting with the indication of the scar regions for a shifting dominance. B. Application of the ROC on the in-silico AT cases with shifting dominance and C. for 2 clinical cases of AT.