Stationary and Recurrent Properties of Atrial Fibrillation Conduction Patterns in Goat

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Introduction. Electrical mapping of the atria is used to assess the substrate of atrial fibrillation (AF). Targeted ablation of the AF substrate assumes spatiotemporal stationarity of AF drivers but limited data is available on the stationarity of substrate during AF and conduction pattern recurrence. In this study we analysed long AF recordings in a goat model of AF using high-density contact mapping.

Methods. In 12 goats AF was maintained for 3-4 weeks. Ten successive 60s files within a single AF episode were recorded on the left atrial free wall with a 249-electrode array. AF cycle length, fractionation index (FI), lateral dissociation, conduction velocity, breakthroughs and preferentiality of conduction (Pref) were assessed per electrode to construct AF-property maps. The Pearson correlation coefficient (PCC) between AF-property maps of consecutive recordings was calculated to investigate spatiotemporal stationarity. The number of waves and presence of re-entrant circuits were analysed in one 60-second file. Recurrence plots and recurrence quantification analysis were used to identify recurrent patterns.

Results Spatiotemporal stationarity for the 6 property maps was high, PCC ranged from 0.66±0.11 for Pref to 0.98±0.01 for FI. The time delay between files did not affect PCC. Yet, highly dynamic patterns were found, with 7.7±2.3 waves/cycle propagating within the mapping area. Beat-to-beat conduction direction difference was 66±10°. Recurrence plots revealed few (1.6±0.7) recurrent patterns in individual animals, which consisted of repetitive focal activity or epicardial wave fronts. Recurrence rate was as low as 0.11±0.19 and was strongly related to number of waves.

Conclusions During non-self-terminating AF in the goat, AF properties were stationary. This cannot be attributed to stable recurrent conduction patterns during AF suggesting that spatial properties of the atrium may determine AF properties even if the conduction patterns are very variable. Recurrence analysis will be further explored to assess right-to-left interactions and transitions towards cardioversion.