CHARACTERISING THE RELATIONSHIP BETWEEN FORCE AND CATHETER STABILITY DURING MANUAL AND ROBOTIC PAROXYSMAL AF ABLATION


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Introduction: Optimal catheter contact force (CF) is associated with better lesion creation and improved outcomes for the ablation of paroxysmal atrial fibrillation (pAF). However it is unknown whether this is in part attributable to improved catheter stability.

Method: MAST-AF is a prospective randomized controlled trial (NCT01583855) of Manual versus robotic control with the Amigo Remote Catheter System (Catheter Robotics Inc.), using the SmartTouch catheter and Carto 3 (Biosense Webster), in first time pAF ablation. All patients had point-by-point L and R WACA (wide area circumferential ablation) around ipsilateral pairs of pulmonary veins, with the operator blinded to CF. Energy was delivered at 40W throughout.

The 3D location of the ablation catheter tip was recorded during RF delivery, and tip displacement calculated as the Euclidean distance between each consecutive sample. The corresponding CF at that time point was also extracted. All data was grouped according to Human / Robot and L / RWACA, and sorted by CF. Data was analysed visually by percentile, and the correlation coefficient relating force and catheter displacement was calculated on log-transformed data using Matlab (R2014a, Mathworks).

Results: 6452 ablation points were analysed from 14 manual and 16 robotic subjects, totalling 294,099 CF/displacement data pairs.

Visual evaluation (see figure 1) shows that when considering human or robot in isolation, overall variation in displacement across CF appears similar. However in both L and RWACA (essentially independent groups), a complex but consistent relationship for the displacement spread (IQR) is shown; specifically, at the extremes of force, robotic displacement variation is similar to or more than that of the human, with the reverse occurring in the central force range.

The correlation coefficient, its confidence intervals, and statistical significance (r, CIs, p) were calculated for Human LWACA (0.022, 0.014-0.030, <0.0001); Human RWACA (0.031, 0.021-0.038, <0.0001); Robot LWACA (0.011, 0.004-0.018, 0.0022); and Robot RWACA (-0.045, -0.038 to -0.052, <0.0001). The robot RWACA group uniquely demonstrates a significant negative correlation, suggesting that robotic RWACA tends to provide greater stability as CF rises when compared with a manual procedure, and is concordant with our previous analysis showing higher CF application patterns for this particular group.

Conclusions: CF is inversely correlated with catheter stability during WACA for pAF, except for Amigo ablation of the RWACA, where higher CF may be achievable due to superior robotic stability. Overall, for typical target CF ranges, Amigo assistance may improve catheter stability compared to manual ablation.