Comparison of ultralow temperature cryoablation and classical cryoballoon ablation for pulmonary vein isolation in patients with atrial fibrillation

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Introduction: Pulmonary vein isolation (PVI) has become the standard-of-care in the treatment of atrial fibrillation (AF). In cryoablation cell damage is caused by freezing using predominantly nitrous oxide gas allowing temperature drops down to -60°C usually using a cryoballoon-based catheter (CB). Ultralow temperature cryoablation (ULTC) represents a novel ablation technique promising higher efficacy rates by achieving better transmurality of generated lesions. By using Nitrogen near its liquid vapor critical point (Near-critical nitrogen) in a linear catheter, ULTC achieves cooling temperatures as low as -196 °C. First studies using ULTC for PVI reported promising success rates. However, to date there is only limited data on outcomes of patients undergoing cryoablation with ULTC compared to CB.

Material and Methods: Our study aimed to compare the efficacy and safety of CB and ULTC ablation for PVI in AF patients. 90 consecutive patients with AF undergoing PVI by cryoablation at our university hospital between July 2020 and November 2022 were included in the analysis. The primary outcome was freedom from atrial arrythmia after 12 months. Furthermore, procedural parameters and periprocedural complications were compared.

Results: In total 90 patients, n=72 treated by CB ablation and n=18 by ULTC, were included in our study. Median age was 64yrs in CB and 70yrs in ULTC patients. Majority of patients of the CB (64%) and of the ULTC group (72%) were male. Paroxysmal AF was present in 57% of CB and 55% in the ULTC group. Median follow up was 365d for the CB and 232d for the ULTC group, respectively. The primary endpoint (Atrial arrhythmia recurrence) occurred in 24/72 patients in the CB and in 10/18 patients in the ULCT group (HR: 0.47; 95% CI: 0.19-1.16; p=0.037).

There were no differences in periprocedural complications (CB: 12.5% vs. ULCA: 17%). Analysis of procedural parameters showed that the total procedure time was longer in the ULTC group (CB: 135 [124, 167] min, ULTC: 198 [168, 242] min; p=<0.0001). Fluoroscopy time was increased (CB: 23 min [16, 28] min, ULTC: 44 [38, 48] min; p=<0.0001) as was the median number of required freezes per vein in the ULTC group (ULTC: 4 [3, 6] vs CB: 1 [1, 2]; p=< 0.0001).

Conclusion: The findings of this retrospective analysis comparing cryoablation by ULTC vs. CB for PVI in AF patients suggests that ULTC is not yet equivalent to CB ablation with respect to procedural parameters and freedom from AF. Nevertheless, learning curve and limited device handling experience has to be taken into account. Future controlled studies and randomized trials are required to further elucidate the value of ULTC in AF ablation procedures, especially in the context of the novel Pulsed field ablation technology.