



# Signal- or temperature-based approach for cryoballoon ablation of atrial fibrillation: still an unsolved issue

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Real-time (RT) recordings of the pulmonary vein (PV) electrograms can be visualized during the cryoballoon ablation (CB; Arctic Front Advance™, Medtronic, USA) using a dedicated inner lumen mapping catheter (ILMC: Achieve, Medtronic, USA). This tool provides useful information regarding time to isolation and on the conduction properties of the left atrium-pulmonary vein (LA-PV) junction [1]. Currently, there is a great variability in ablation protocols and dosing strategies among EP Centres. Two main approaches are today most frequently used during CB ablation: (1) a signal-guided approach in which the freezing duration and quantity are titrated by the “real-time” visualization of PV potentials and (2) a temperature-guided approach where the main target is to achieve a complete PV occlusion regardless of the presence of PV potentials and the ablation strategy is then guided by the temperatures attained during the freeze.

The latest technological modifications to the CB went in favor of the former approach promoting a higher rate of real-time visualization of PV EGMs. As a matter of fact, time to isolation has been shown to be one of the best predictor of persistency of electrical isolation following CB ablation [2, 3]. Among these, the new Achieve included a new solid core providing improved rotational response, as compared with the previous version [4]. The greater flexibility and improved rotational response of the new device have provided a better positioning of the mapping catheter in the proximal portion of the PV resulting in improved visualization of electrical activity in the PV itself [4].

In addition, the third-generation CB was designed with a 40% shortened tip length compared with the former second-

generation CB device [5, 6]. Indeed, due to a more proximal positioning of the inner lumen mapping catheter, more RT recordings could be documented [5, 6]. However, due to certain technical issues, the third-generation CB was quickly removed from the market. In 2018, the fourth-generation CB became widely available bringing enhanced catheter maneuverability and ergonomics while still maintaining the shorter distal nose tip [7–9]. The fourth-generation CB seems to have visualization rates of PVs around 78%, cumulative for all veins [7]; however, it is still controversial if this novel generation significantly increases the rate of PV potentials’ visualization compared with the second generation [8, 9].

Despite the considerations mentioned above, real-time recordings might not be appreciated in up to 25% of veins [8]. On the other hand, the temperature-guided approach has the advantage of being a purely anatomical intervention entailing a considerable simplification and standardization of the procedure. This might hypothetically result in safer, shorter, and more reproducible procedural times.

A recent study sought to evaluate a temperature-guided approach based on the attainment of the specific parameter of  $-40\text{ }^{\circ}\text{C}$  within the first 60 s during CB applications, without the use of ILMC, compared with the conventional “electrogram-guided” approach [10]. A total of 52 patients were enrolled for each group (wire group vs ILMC group) and compared using the propensity score match analysis; over a mean follow-up period of  $12.4 \pm 3.0$  months, the freedom from AF without antiarrhythmic drugs did not significantly differ between both groups. Of note, electrical isolation could be obtained in 99% of all PVs in the wire group, confirming the effectiveness of the temperature-guided approach. Although procedural times were not significantly different between the 2 groups, the fluoroscopy time was significantly reduced in the “wire group” [10]. In a previous article by Fürnkranz et al. [11], a nadir temperature of  $< -51\text{ }^{\circ}\text{C}$  proved to be a strong independent predictor of permanency of PV isolation. These findings were further confirmed by Scala et al. [12] in a recent publication.

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In conclusion, it is still controversial if a signal-guided approach during CB ablation should be preferred to a temperature-based approach. Larger, randomized trials of comparison are needed to determine if CB ablation can be performed by the sole guidance of complete PV occlusion and achieving a temperature cut-off in time without the need of verification of PV isolation. If this would prove true, temperature-guided CB ablation would further simplify the ablation procedure and make it more cost-effective.

### Compliance with ethical standards

**Conflict of interest** GBC and CdA receive compensation for teaching purposes and proctoring from AF solutions, Medtronic. CdA is consultant for Daiichi Sankyo. GM received an educational grant from Medtronic for Postgraduate in Cardiac Electrophysiology and Pacing academic course.

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