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Quantifying pulmonary vein antrum contact area with novel dual-sized cryoballoon to optimize pulmonary vein isolation

CLINICAL PERSPECTIVE

WHAT'S NEW

- This is the first study that has aimed to correlate differences in ablation area to the intraprocedural performance of POLARx™ FIT using geometric models.

WHAT'S IMPORTANT

- The study demonstrates that the 31mm size has enlarged balloon-antrum contact, suggesting greater substrate modification.

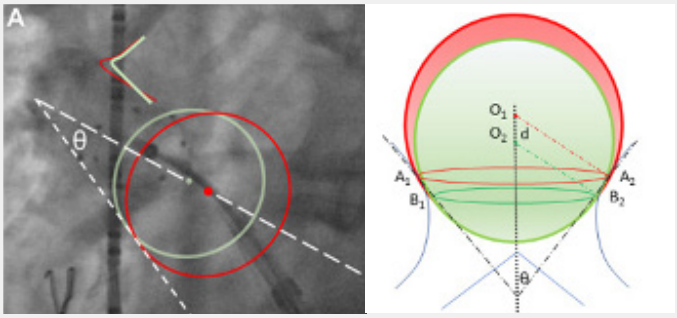
OBJECTIVE

- Using geometric models, they aimed to correlate differences in ablation area to the intraprocedural performance of the POLARx FIT cryoballoon.

METHODS

- Quantitative analysis of balloon-tissue contact during PVI was done for 8 patients from the **FROzEN-AF** trial (NCT04133168) who underwent de novo cryoablation with the POLARx FIT cryoballoon.
- Venography with continuous injection of contrast was performed while the cryoballoon was inflated from 28mm to 31mm, maintaining grade 4 occlusion, and cine images were used to build 2-dimensional (2D) and 3-dimensional (3D) models to estimate the contact area differences between the 2 balloon sizes.
- In the 2D model, the cine images were overlapped, and a line of centers and outer tangent line (connecting to the contact point where the balloon met the PV/PV antrum) were drawn (Figure 1, left image). The angle (θ) between these 2 lines and the distance between 2 centres (d) were measured. The differences in PV antrum contact area between balloon sizes were calculated with a formula*, derived from the lateral surface area of a cone (Figure 1, right image).

Figure 1.



*ΔContact area (cm^2) = 2.95 π cos $\sqrt{d^2\cos^4\theta+(0.15\cos)^2}$

Figure 2.

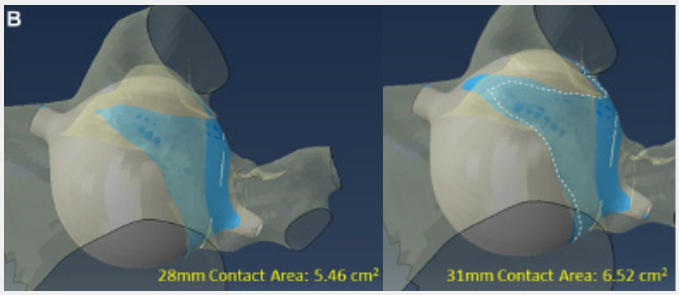


Figure 2:
Example of contact area increase. B: 3-dimensional model of cryoballoon–PV antrum interface and contact area in side view (shaded blue) with a 28mm (left) and a 31mm (right) cryoballoon in the left inferior PV of one patient. The white dashed line is the projection of 28mm cryoballoon contact area; the difference in contact area between the 2 balloon sizes was 1.06 cm^2.

Figure 1:
Modelling of cryoballoon–pulmonary vein (PV) antrum contact area. A: Cine images (left) of PV engagement with a 28mm (green circle) and a 31mm (red circle) cryoballoon overlapped to build a 2-dimensional model to calculate cryoballoon–PV antrum contact area as surface area of a cone (right).

RESULTS

- Successful cryoballoon PVI was achieved in all PVs with no procedure-related adverse events.
- Using the 2D model, the 31mm cryoballoon showed an increased PV antrum contact area of 1.68 ± 0.92cm^2 with a mean 0.28 ± 0.11cm proximal displacement of the balloon's centre.
- The 3D model assumptions for balloon shape were successfully met for 6 of 8 PVs and PV antrum contact area increased by 1.35 ± 0.67cm^2 with the 31mm cryoballoon, 14.4% greater than that with the 28mm cryoballoon (see example of contact area increase in Figure 2, on the previous page).
- Of the 8 patients included in this study, 7 were free from AF at 1-year follow-up. One patient had recurrent typical atrial flutter and frequent premature atrial contraction that was treated by redo ablation.

CONCLUSION

The expandable size feature of the POLARx™ FIT cryoballoon allows more proximal antrum engagement and increased ablation area when inflated from 28mm to 31mm in dimension without exchanging the catheter.

This feature may lead to a higher rate of single-shot PV isolation as well as reduce the risk of PV stenosis and phrenic nerve injury.

The 31mm POLARx FIT cryoballoon size is associated with a higher rate of complete PV occlusion and enlarged balloon-antrum contact area as demonstrated in this study. This suggests greater substrate modification: another determinant of long-term sinus rhythm maintenance after AF ablation.

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Liao Y., *et al.*, 2024
doi.org/10.1016/j.hrthm.2024.05.047

EP-1995501-AA

CE 0123