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The "bow and backbend" technique with a balloon lever for challenging right inferior pulmonary vein isolation in cryoballoon ablation

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1. Case description

A 71-year-old man with symptomatic atrial fibrillation underwent cryoballoon catheter ablation under general anesthesia (Fig. 1A). Right femoral venous access was achieved, followed by a transseptal puncture under intracardiac echocardiography guidance. A 15 Fr cryoballoon delivery sheath (Flexcath Advance; Medtronic, Minneapolis, MN) was introduced into the left atrium. Following confirmation of occlusion through contrast injection, the left superior and inferior pulmonary veins were isolated using a cryoballoon catheter (AFA-Pro; Medtronic), with a freeze applied to the superior vein (240 s) and the inferior vein (180 s).

In the right inferior pulmonary vein (RIPV), despite inserting the Achieve catheter (Medtronic) into the lateral and inferior branches and confirming placement through cryoballoon inflation and contrast injection, complete occlusion was not initially achieved (Fig. 1B). Adjusting the position of the Achieve catheter in the inferior branch and advancing the balloon lever forward resulted in complete occlusion (Fig. 1C and D). Freezing commenced in this state, but isolation was not achieved even after pulling down the cryoballoon position 35 s post-freezing. Considering the possibility of a crosstalk phenomenon [1], a 180-s freeze was administered. Subsequently, isolation of the right superior pulmonary vein was accomplished by applying a 180-s freeze. Further examination revealed that the RIPV remained non-isolated, prompting additional freezing attempts. Insertions of the Achieve catheter into the lateral and superior branches did not achieve complete occlusion despite manipulation of the balloon lever. Transseptal puncture was not reattempted to avoid a second iatrogenic atrial septal defect. Similar to the initial attempt, the Achieve catheter was reinserted into the inferior branch and complete occlusion was verified upon advancing the balloon lever (Fig. 1D and E). As before, isolation remained unachieved after pulling down the cryoballoon 35 s post-freezing (Fig. 1F). Additionally, moving the balloon lever backward to enhance contact with the posterior bottom 60 s post-freezing successfully resulted in isolation at 80 s, followed by a continuous freeze for 200 s (Fig. 1D, G, and 1H and Supplementary Video).

The balloon lever technique is particularly useful for RIPV cryoballoon ablation when conventional methods fail to achieve isolation [2]. This case highlights the efficacy of the "bow and backbend" technique as a bailout method for the balloon lever technique without additional complications, which initially involves tilting the balloon lever forward to achieve complete occlusion. After the tissue adheres to the balloon, it may be advantageous to not only pull down the cryoballoon but also to tilt the lever backward. This adjustment enhances the contact force towards the bottom of the RIPV, potentially improving the success rate of RIPV isolation (Fig. 2 and Supplementary Video). Our technique is especially useful for RIPV isolation since it is more challenging than isolating other pulmonary veins.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.ipej.2024.09.010

Statement of consent

Written informed consent for publication of this report was obtained

Peer review under responsibility of Indian Heart Rhythm Society.
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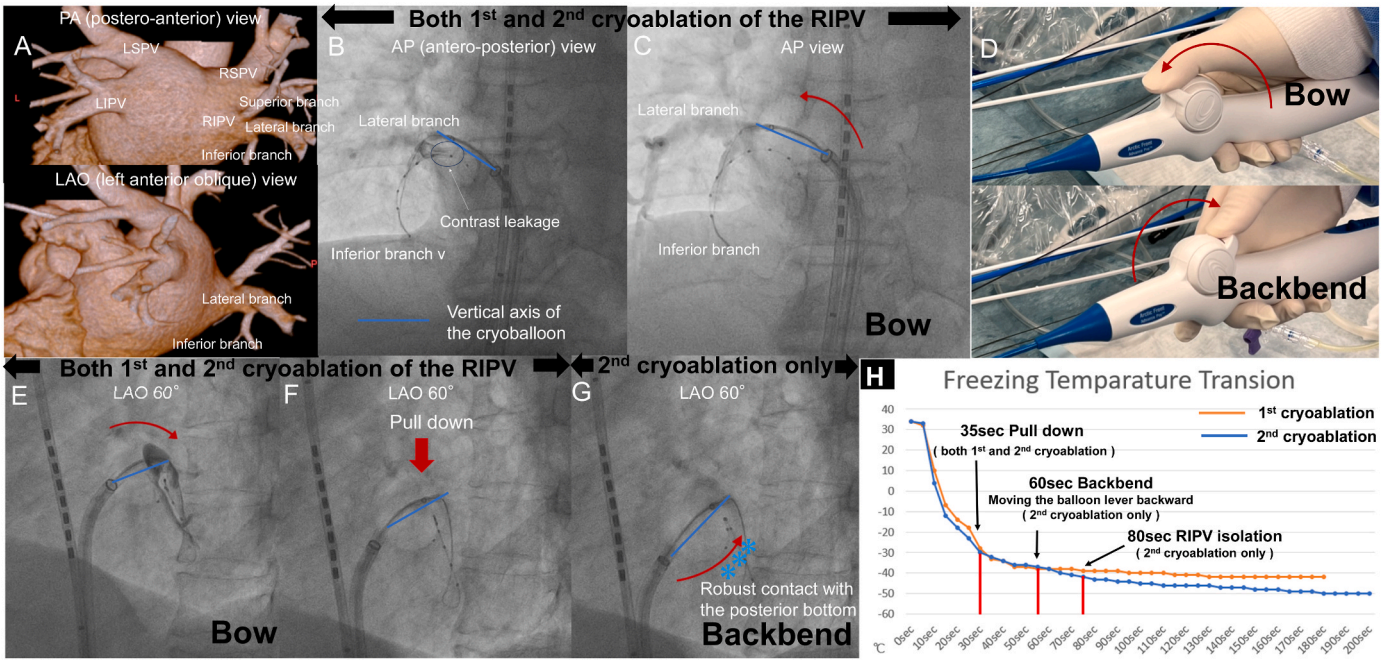

Fig. 1. Fluoroscopic and operational overview of cryoballoon ablation in the right inferior pulmonary vein isolation.
(A) Pre-procedural pulmonary vein three-dimensional computed tomography.
(B) Applied deflection to the cryoballoon delivery sheath to maintain greater coaxiality with the right inferior pulmonary vein (RIPV), but contrast leakage was observed, and complete occlusion was not achieved.
(C) Fluoroscopic image shows complete occlusion of the RIPV achieved by advancing the balloon lever prior to the 1st cryoablation of the RIPV
(D) Operation of the cryoballoon lever. Top panel: the balloon lever is moved forward, indicating a "bow" action. Bottom panel: the balloon lever is moved backward, corresponding to a "backbend" action.
(E) Fluoroscopic image shows complete occlusion of the RIPV achieved by moving the balloon lever forward before the 2nd cryoablation of the RIPV. (LAO 60-degree angle).
(F) Fluoroscopic image shows that, 35 s after initiating freezing, the cryoballoon was pulled down owing to tissue adhesion, while the balloon lever was returned to the neutral position.
(G) Pulmonary vein isolation was not achieved even 60 s after initiating freezing. Therefore, during the 2nd cryoablation of the RIPV, the cryoballoon was kept pulled down while the balloon lever was moved backward ('backbend').
(H) This graph compares the freezing temperature transitions between the first and second cryoablation. It demonstrates that only during the second cryoablation, moving the balloon lever backward resulted in further freezing of the cryoballoon, which successfully achieved isolation of the RIPV.

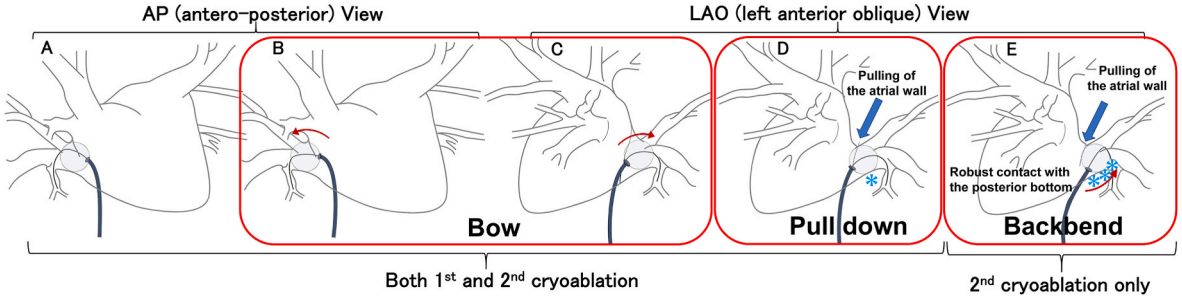

Fig. 2. Schematic drawing of the "bow and backbend" technique.
(A) Adjusted the cryoballoon delivery sheath for better alignment with the RIPV; however, contrast leakage occurred, preventing complete occlusion (corresponds to Fig. 1B).
(B), (C) Complete sealing of the RIPV was achieved by moving the balloon lever forward ('bow') (corresponds to Fig. 1C and E).
(D) 35 s into freezing, the cryoballoon was pulled down due to tissue adhesion, and the balloon lever was reset to neutral (corresponds to Fig. 1F).
(E) During the second cryoablation of the RIPV, the cryoballoon remained pulled down as the balloon lever was adjusted backward ('backbend') (corresponds to Fig. 1G).

from the patient in accordance with COPE guidelines.

Funding

None.

Data availability

Not applicable.

Ethical statement

This case report has been conducted in compliance with the ethical

standards of the institutional research committee and conforms to the provisions of the Declaration of Helsinki in 1964 and its later amendments. Written informed consent for publication of the case report and any accompanying images was obtained from the patient. All identifiable information has been omitted to ensure patient confidentiality.

Author contributions

Yuhei Kasai wrote the manuscript and was the operator in the procedure described.

Kizuku Iitsuka assisted the procedure.

Junji Morita supervised the writing of the manuscript.

Takayuki Kitai supervised the procedure and the writing of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ipej.2024.09.010.

References

[1] Hirao T, Yamauchi Y, Nakamura R, et al. Predictors of the "crosstalk" phenomenon during cryoballoon ablation in patients with atrial fibrillation. Int Heart J 2021;62(2):320–8.

[2] Wakabayashi Y, Kobayashi M, Ichikawa T, Koyama T, Abe H. Clinical utility of the "balloon lever technique" in the right inferior pulmonary vein cryoballoon ablation. J Arrhythm 2022;39(1):42–51. SUPPLEMENTARY VIDEO.