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CASE REPORT

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Modified hockey stick maneuver utilizing a steerable cryoballoon catheter for left inferior pulmonary vein isolation

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Abstract

Successful cryoballoon pulmonary vein (PV) isolation sometimes requires cryoballoon occlusion techniques including a hockey stick maneuver (HSM) using a steerable sheath, whose steerable segment should be positioned in the left atrium (LA) for left inferior PV (LIPV) occlusion. However, a small LA can cause a transseptal puncture site adjacent to both the LIPV ostium and the LA roof, leading to the steerable segment out of the LA during the HSM. This report illustrates a modified HSM utilizing a steerable cryoballoon catheter, which might be considered as an option when the standard one is not operated as the LIPV occlusion technique.

KEYWORDS

atrial fibrillation, cryoballoon ablation, hockey stick maneuver, left atrium, pulmonary vein isolation

1 | INTRODUCTION

Achievement of cryoballoon pulmonary vein (PV) isolation sometimes requires cryoballoon occlusion techniques including a hockey stick maneuver (HSM) using a steerable sheath.[1–3] In the HSM, a steerable segment of the sheath not only provides the optimal positioning of the wedged cryoballoon catheter coaxial to the PV but also enhances the transmission of forward pressure on the wedged cryoballoon shaft.

2 | CASE REPORT

A 49-year-old man with drug-refractory paroxysmal atrial fibrillation (AF) underwent cryoballoon PV isolation. For cardiac image fusion with preprocedural contrast 3-dimensional (3D) computed tomography (CT) and real-time fluoroscopy, noncontrast chest cone-beam CT was performed at the beginning of the procedure. Based on the thoracic vertebrae of the cone-beam CT image, the 3D CT image of the left atrium (LA) and PVs was merged into the live fluoroscopy by an image integration software (syngo 3D/3D fusion, Siemens Healthineers) to guide cryoballoon PV isolation. Thereafter, left atrial access was gained by radiofrequency transseptal puncture (TP) in the posteroinferior region of the fossa ovalis under intracardiac echocardiography guidance. Following successful left superior PV isolation, the Achieve Advance Mapping Catheter (Medtronic) was placed into the distal left inferior PV (LIPV) for LIPV isolation. A HSM was performed using the FlexCath Advance Steerable Sheath (Medtronic) with the 28-mm Arctic Front Advance Cardiac Cryoballoon Catheter (Medtronic). The position of the cryoballoon shaft coaxial to the LIPV was confirmed in the left anterior oblique view during the maneuver, but the steerable segment of the sheath was pushed out of the LA, rendering the inflated cryoballoon position unsuitable for LIPV occlusion (Figure 1). Even using a direct approach as well as a pull-down technique using the steerable sheath,[1,2] LIPV occlusion could not be obtained. Therefore, following retraction of the steerable sheath with restoration of the deflection in its straight configuration, the steerable cryoballoon catheter

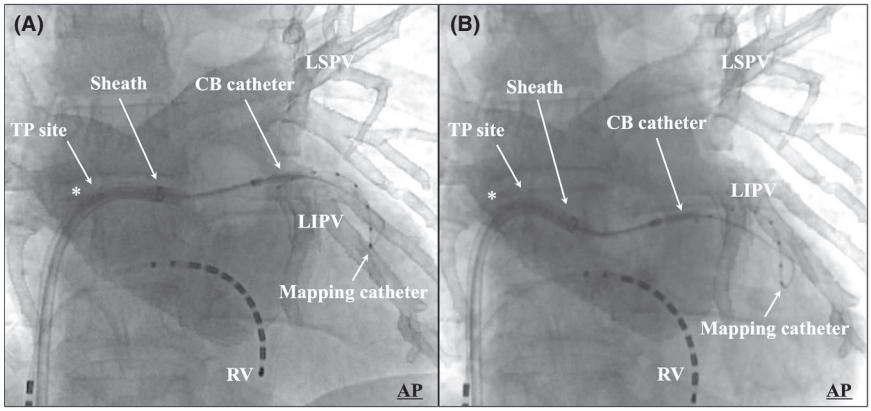

FIGURE 1 Fluoroscopic image merged with the preprocedural contrast-enhanced computed tomography image of the left atrium (LA) and pulmonary veins (PVs) at the beginning (A) and end of the standard hockey stick maneuver for cryoballoon left inferior PV (LIPV) isolation (B). The asterisks indicate the steerable segments of the sheath out of the LA. Abbreviations: AP, anteroposterior projection; LSPV, left superior PV; RV, right ventricle catheter; TP, transseptal puncture

was deflected and advanced over the mapping catheter toward the LIPV ostium, thus accomplishing LIPV occlusion that was confirmed by venogram. Thereafter, the mapping catheter was pulled back for real-time monitoring of LIPV electrograms, and achievement of a nadir temperature of −39°C for a single freeze of 150 seconds resulted in successful LIPV isolation with a time to isolation of 14 seconds (Figure 2). PV isolation of the other PVs was then successful. No complication occurred.

3 | DISCUSSION

The favorable outcome of cryoballoon PV isolation is associated with optimal PV occlusion by wedging of the inflated cryoballoons.[4] In LIPV isolation, the HSM is often applied to occlude the LIPV ostium.[1–3] In the HSM for complete LIPV occlusion, a steerable segment of the sheath crossing the fossa ovalis should be positioned in the LA to optimize the coaxial arrangement of the cryoballoon shaft and the LIPV, as well as to push the wedged cryoballoon toward the LIPV ostium. However, the deflection point of the sheath out of the LA during that maneuver can cause detachment of the inflated cryoballoon from the LIPV ostium, which may result in failure to achieve successful LIPV isolation.

This report illustrated a modified HSM utilizing the steerable cryoballoon catheter for LIPV occlusion. In this case, a small LA (diameter, 30.3 mm; volume index, 23.8 ml/m^2) resulted in the TP site adjacent to both the LIPV ostium and the LA roof. The actual distance between the atrial septum and the LIPV ostium was approximately 5.5 cm on the preprocedural cardiac CT image. On the other hand, the length between the distal tip of the cryoballoon catheter and the steerable segment of the sheath is approximately 9 cm during the standard HSM. Therefore, those anatomical relationships between them may have led to the sheath with its steerable segment out of the LA during the standard maneuver. However, our modified HSM could overcome such anatomical restriction to complete LIPV occlusion. The length between the distal tip and steerable segment of the cryoballoon catheter during the modified maneuver is approximately 1 cm shorter than the relevant length during the stander one. The characteristics of the cryoballoon catheter could allow its steerable segment to be positioned in the LA, thereby contributing to the coaxial arrangement of the cryoballoon shaft and the LIPV even with lower forward pressure of the inflated cryoballoon wedged into the LIPV ostium.

This case demonstrates that the modified HSM using a steerable cryoballoon catheter might be considered as an option when the standard one using a steerable sheath is not operated as the cryoballoon occlusion technique for LIPV isolation.

CONFLICT OF INTEREST

Dr Kimura has an affiliation with the endowed department of Medtronic Japan. Dr Tomita is a concurrent professor in the

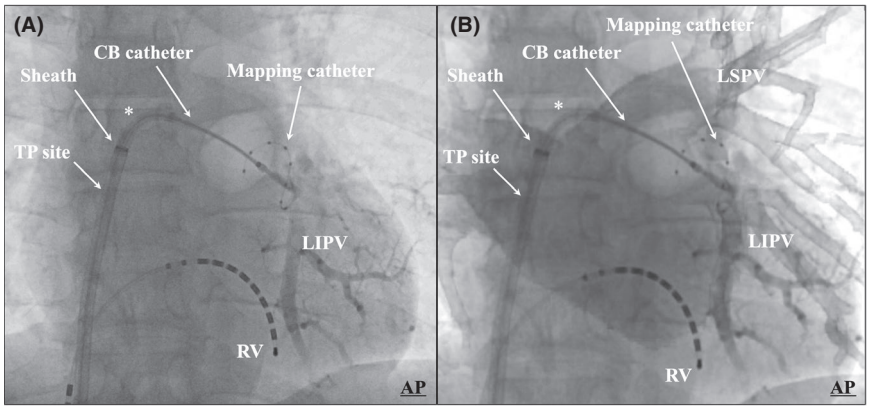

FIGURE 2 Fluoroscopic image without (A) and with the merged computed tomography image of the left atrium (LA) and pulmonary veins (PVs) exhibiting cryoballoon (CB) left inferior PV (LIPV) isolation using the modified hockey stick maneuver (B). The asterisks indicate the steerable segment of the CB catheter in the LA. Abbreviations as in Figure 1

endowed department by Medtronic Japan. All other authors declare no conflict of interests for this article.

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