EP CASE REPORT

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Pulmonary vein laceration during cryoballoon ablation for the treatment of atrial fibrillation

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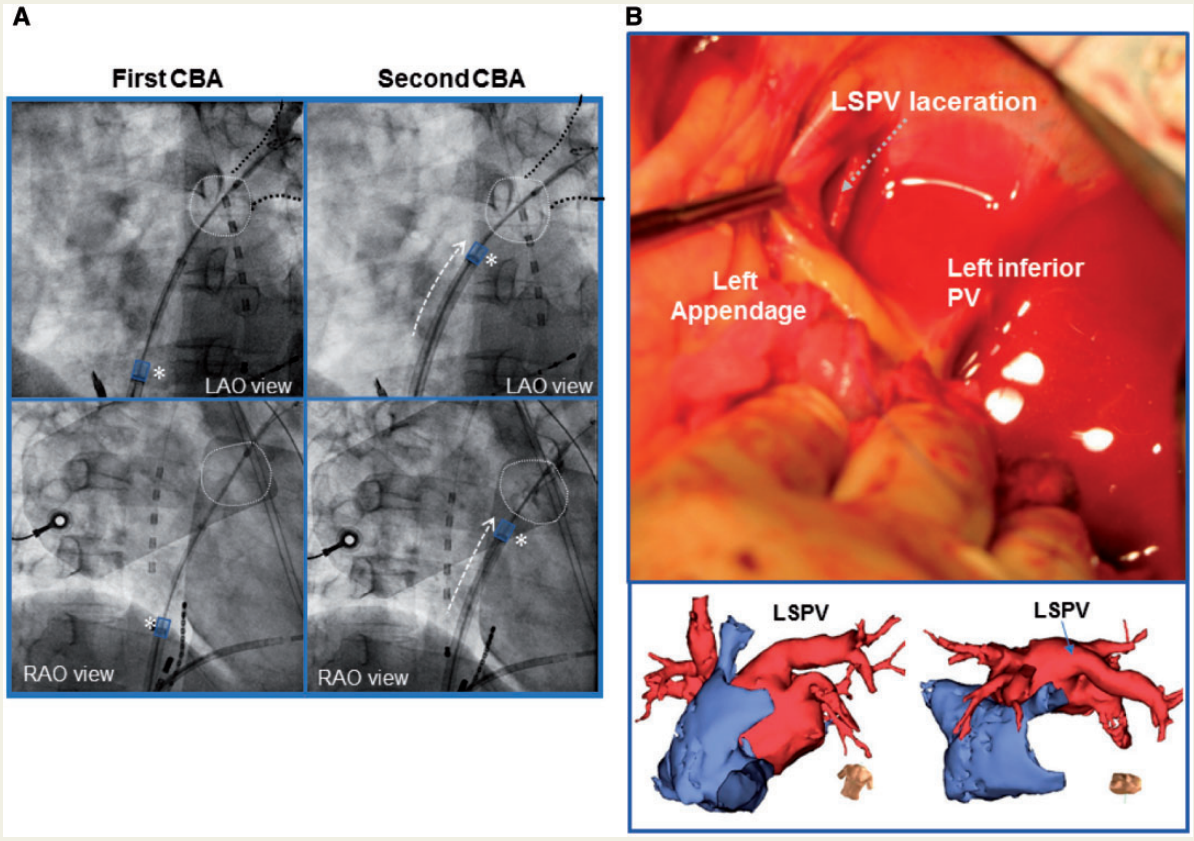
A 46-year-old man underwent a cryoballoon ablation (CBA) with the balloon positioned against the left superior pulmonary vein (LSPV) antrum. Venography demonstrated no LSPV contrast leakage. The first-CBA application demonstrated an adequate temperature drop, however, it was immediately stopped because the support sheath was still within the right atrium (*Panel A* left*), and was then advanced to provide mechanical support (*Panel A* right*). The second-CBA application demonstrated an excessive temperature drop (−59 °C within 60 s), suggesting the balloon was positioned inside the LSPV. After the balloon deflation, a rapidly progressing cardiac tamponade emerged, requiring an emergency thoracotomy that revealed a 1.5-cm longitudinal LSPV laceration (*Panel B*). A laceration repair and PV isolation were surgically performed, and the postoperative course was favourable.



In this case, intra-PV dilation of the cryoballoon resulted in a LSPV laceration. Cardiac computed tomography demonstrated an elongated LSPV shape with its ostium opening on the mid-posterior atrial wall (*Panel B*, lower). The characteristic form and pliant properties of the vein, allowed the balloon to be easily enclosed with slight distortion of its shape (*Panel A*, left). That situation caused a false recognition of the balloon positioning, and having advanced the sheath may have caused mechanical stress on the vein wall. The full balloon expansion during the second-CBA supported our hypothesis (*Panel A*, right).

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Case presentation

A 46-year-old male patient was referred to our hospital to treat drug resistant paroxysmal atrial fibrillation (AF). The patient's left atrial diameter was 37 mm on echocardiography. Cardiac enhanced computed tomography (CT) imaging demonstrated left superior pulmonary vein (LSPV) antral and right upper PV orifices of 23 mm and 24 mm, respectively. Therefore, a 28-mm cryoballoon ablation (CBA) catheter (Arctic Front Advanced^{TM}, Medtronic, Cryocath) was chosen for the CBA. After a transseptal puncture, the cryoballoon catheter was positioned against the LSPV antrum. A 3-mL initial radiopaque contrast injection demonstrated a blurred PV image and no contrast leakage from the PV ostium into the left atrium (*Panel A* left; see Supplementary material online, *Movie S1*). First, a cryoenergy delivery there demonstrated an adequate temperature drop to −25 °C within 22 s, however, the energy delivery was immediately stopped because the support sheath tip was still within the right atrium (*Panel A* left *). After re-inflating the cryoballoon, the sheath was advanced closer to the balloon catheter (*Panel A* right) to gain mechanical support for the balloon positioning. Fluoroscopy demonstrated a sufficient dilation of the balloon, and a radiopaque contrast injection provided venographic evidence of a balloon occlusion. Second, a cryoenergy delivery at that location demonstrated an excessive temperature drop to −59 °C within 60 s, suggesting the balloon was positioned inside the PV. Therefore, the energy delivery was immediately stopped, and no accidental or intentional movement of the balloon shaft occurred prior to the total cryoballoon thawing. Just after thawing, a rapid progression of a cardiac tamponade emerged. Due to uncontrollable haemorrhaging in the pericardial space, despite a percutaneous pericardial drainage, the patient was taken for an exploratory sternotomy. The intraoperative findings revealed a 1.5-cm-long single longitudinal laceration along the inferior aspect of the proximal LSPV (*Panel B* upper). After completely suturing the PV wall, a surgical PV isolation (Isolator®, ArtiCure, Inc., Ohio, USA) was also performed. The postoperative course was favourable, and no atrial arrhythmias have been observed during 10 months of follow-up.

Cryoballoon ablation is recognized as a safe procedure and cardiac tamponade is a very rare complication,[1] however, this case suggested the possibility of the occurrence of a fatal complication while using CBA. In our case, to avoid any venous trauma, a spiral mapping catheter was always advanced from the tip of the non-inflated balloon catheter during all catheter movements. Furthermore, just before the 2nd CBA, no pericardial effusion was documented under continuous intracardiac echo monitoring. Those findings suggested that no traumatic incidence occurred due to the catheter manipulation before the 2nd balloon inflation. Thus, in this case, from the first cryoenergy delivery, we speculated that the cryoballoon was placed within the LSPV, and not at the PV ostium. A radiopaque contrast injection at the first CBA location demonstrated a blurred PV image (see Supplementary material online, *Movie S1*), and no intentional pull or push catheter movements were performed to recognize the proximal sealing at the PV ostium. Cardiac CT also demonstrated that the LSPV had an elongated shape and its ostium opened to a relatively posterior side of the left atrium (*Panel B*, lower). The characteristic form and pliant properties of the PV due to the patient's younger age, allowed the balloon to be easily enclosed with a slight distortion of its shape (*Panel A*, left, RAO view). That situation caused the false recognition of the cryoballoon positioning, and advancing the sheath during the balloon inflation may have caused excessive mechanical stress on the vein wall, eventually resulting in the PV laceration. The full balloon expansion and excessive temperature drop during the 2nd CBA even with the same balloon positioning as in the 1st CBA may support our hypothesis (*Panel A*, right; see Supplementary material online, *Movie S1*). To avoid an intra-PV CBA, an adjustment of the balloon positioning is required after confirmation of venogram leakage, i.e. a 'proximal-seal' technique[2] is strongly recommended in every case. Another thing to note, is that the circular catheter could potentially become frozen to the PV during the cryoenergy delivery. To avoid any mechanical stress on the vein wall, the operator should avoid any pulling on the circular catheter until thawing has been completed.

Supplementary material is available at *Europace* online.

Conflict of interest: none declared.

References

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