

Is achievement of pulmonary vein isolation the only effect of cryoballoon ablation in long-standing persistent atrial fibrillation?

Uzun süreli direngen atriyum fibrilasyonunda pulmoner ven izolasyonunun sağlanması kriyobalon ablasyonun tek etkisi midir?

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Summary– A case of long-standing persistent atrial fibrillation (LPAF) that underwent hybrid treatment combining transvenous cryothermal and radiofrequency (RF) energy is described in the present report. Complex fractionated atrial electrogram (CFAE) maps before and after cryoablation revealed not only pulmonary vein isolation (PVI), but also a large antral ablation of CFAEs. Following cryoablation, a severe reduction in remote left atrial CFAE area was observed.

Özet– Bu yazıda, transvenöz kriyotermal ve radyofrekans enerjilerinin birlikte kullanımı ile tedavi edilen uzun süreli direngen atriyum fibrilasyonlu bir olgu sunuldu. Kriyo-ablasyon öncesi ve sonrası elde edilen kompleks fraksiyone atriyal elektrogram (KFAE) haritaları yalnızca pulmoner ven izolasyonunun değil ayrıca geniş antral KFAE ablasyonunun varlığını da gösterdi. Kriyo-ablasyon sonrası yakın sol atriyal KFAE alanında ciddi azalma mevcuttu.

Although pulmonary vein isolation (PVI) is usually effective in catheter ablation of paroxysmal atrial fibrillation (AF) in the majority of cases of long-standing persistent atrial fibrillation (LPAF) or associated structural heart disease, PVI as a standalone approach is often insufficient for long-term maintenance of sinus rhythm.^[1-3] AF termination in patients with LPAF can be achieved, usually at the cost of extensive ablation, procedural risks, and longer procedural and ablation times. As a potential indicator of atrial involvement, ablation of complex fractionated atrial electrograms (CFAEs) has shown contradictory benefit in randomized studies.^[4,5]

Although it has previously been revealed that PVI by radiofrequency (RF) catheter ablation reduces remote left atrium (LA) CFAE in patients with structur-

ally normal hearts or heart failure, the effect of PVI with cryoballoon on CFAE remote from ablation sites is not known.^[6,7]

CASE REPORT

A 54-year-old man, who had for 10 years suffered from long-standing, persistent AF refractory to amiodarone therapy, was admitted with a history of multiple cardioversions. Transthoracic echocardiography revealed left atrial diameter of 5.4 cm and left ventricular ejection fraction of 34%. Coronary angiography performed two years earlier showed normal coronary arteries. The patient denied any history of alcohol or cocaine abuse. Intracardiac thrombus was ruled out by transesophageal echocardiography before electrophysiology procedure, which was performed on continuous oral anticoagulation and under local anesthesia.

Two transeptal punctures were performed, one for a 12 French FlexCath steerable sheath (Medtronic Inc., Minneapolis, MN, USA), the other for an In-

Abbreviations:

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| AF | Atrial fibrillation |
| CFAE | Complex fractionated atrial electrogram |
| LA | Left atrium |
| LPAF | Long-standing persistent atrial fibrillation |
| PVs | Pulmonary veins |
| PVI | Pulmonary vein isolation |
| RF | Radiofrequency |

Received: June 28, 2015 Accepted: August 21, 2015

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quiry Optima PLUS multipolar mapping catheter (St. Jude Medical Inc., St. Paul, MN, USA). The patient was heparinized to activated clotting time >300 seconds after transseptal puncture. Three-dimensional reconstruction of the LA and pulmonary veins (PVs) was created using Ensite NavX mapping system (St. Jude Medical Inc., St. Paul, MN, USA) and open irrigated tip ablation catheter with 3.5-mm tip electrode (Therapy Cool Flex; St. Jude Medical Inc., St. Paul, MN, USA).

High-frequency atrial potentials demonstrating multiple deflections from the isoelectric line were detected by the NavX CFAE mean tool, as previously described.^[8] CFAE mean was defined as mean time between consecutive deflections during predefined recording period. Acquisitions were made until atrial endocardial surface was covered. All adjacent zones of CFAEs were annotated and the areas enclosed defined as CFAE area by the surface marker function. Atrial CFAE map was obtained before and after cryoablation. Number of acquired LA endocardial points was 577.

After baseline CFAE mapping, PVI was achieved by a 28 mm Arctic Front Advance cryoballoon

(Medtronic Inc., Minneapolis, MN, USA). Freezing cycle was applied twice for 4 min. Bidirectional block was achieved for each of the 4 PVs. All LA CFAE maps were superimposed on the geometry recorded after cryoablation. Reduction in CFAE area was 12.3 cm^2 on right PVs and 9.2 cm^2 on left PVs, comprising 12.4 cm^2 (49.6%) posteriorly (Figures 1, 2). During 5th minute of RF ablation of remaining CFAEs on the anterior wall, AF was terminated, and could not be induced by programmed stimulation. The patient was in sinus rhythm by end of 12-month follow-up.

DISCUSSION

The primary finding of the present case was that LA CFAE area was progressively reduced at remote sites following cryoablation in a patient with heart failure. In addition, the present case demonstrated that combined use of cryoballoon and focal open-irrigation RF ablation for treatment of LPAF resulted in sinus

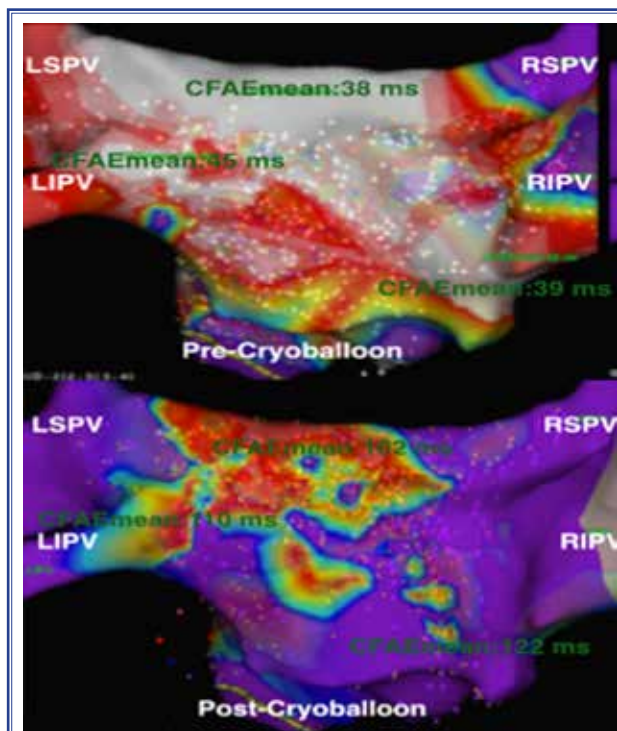


Figure 1. Pre (A) and post-cryoballoon (B) images recorded with the 3 dimensional electroanatomic mapping system. Please see the CFAE mean values before and after cryoballoon application.

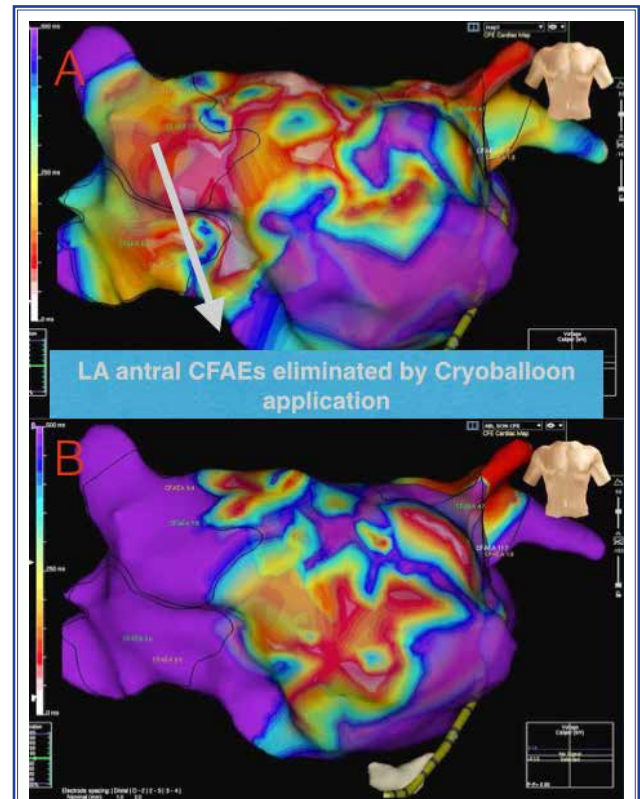


Figure 2. Pre (A) and post-cryoballoon (B) images recorded with the 3 dimensional electroanatomic mapping system. The scale on Ensite Nav X CFAE mean tool. The purple region represents voltage CFAE mean >200 ms, and the white region represents CFAE mean <60 ms.

rhythm and freedom from atrial arrhythmia by the end of follow-up, following a single procedure.

Previous studies have shown that PVI by cryoballoon may create larger LA lesions. Yorgun et al. reported that neighboring tissues including ganglionated plexi may be ablated during cryoablation procedure.^[9] They observed vasovagal response characterized by decrease in heart rate and/or blood pressure resulting in nausea, vomiting, or lightheadedness during procedure and concluded that this reaction may predict modification during cryoablation. In a recent study, Kenigsberg et al. described and quantified ablated surface area after application of cryoablation lesions with second-generation cryoballoon.^[10] It was determined that the area of the posterior LA wall ablation with the cryoballoon catheter is wide and antral, and that resulting posterior LA wall debulking could contribute to cryoballoon efficacy beyond discrete PVI. In our previous study, cryoablation resulted in a greater troponin increase, compared to previous studies using RF ablation.^[11] Our study revealed that lower post-ablation, high-sensitivity troponin I level is an independent predictor of AF recurrence. Though the role of troponin release after cryoablation of PVs for paroxysmal AF in predicting ablation outcome is not clear, it may result in larger myocardial lesion size after cryoablation.

Mansour et al. showed that combined use of cryoablation and irrigated RF ablation for persistent AF was feasible and related with favorable outcomes.^[12] Twenty-two consecutive patients with persistent AF underwent PVI by cryoballoon. Left CFAEs were ablated using an RF catheter, and linear ablations using RF catheter were performed. Of the 82 PVs targeted with cryoballoon, 77 (94%) were isolated, and 5 (6%) required use of RF energy to complete isolation. By the end of the study, 86.4% of patients were AF-free without antiarrhythmic drugs. However, mean left ventricular ejection fraction was 50.6 ± 20.3 , and the patients were not evaluated for remote side effects of cryoballoon. Furthermore, it was unclear if cryoablation reduced CFAEs.

In a recently published study, Jones et al. investigated biatrial impact of stepwise ablation on CFAE and factors influencing clinical outcome of catheter ablation in patients with advanced atrial substrate of persistent AF and heart failure.^[7] They demonstrated that surface area of CFAE was reduced from

18.3 ± 12.03 to 10.2 ± 7.1 cm² after PVI using RF energy. Baseline total surface area of left CFAE was 36 cm², significantly larger than had been previously reported for RF ablation. Reduction in the area of CFAE was also larger in the present case. A possible explanation is that structural remodeling of LA was greater in our patient due to AF history of 10 years. Mean time of AF history was 50 ± 38 months (range 20.5–72 months) in the previous study.

Consistent with previous studies, results of the present case showed that PVI by cryoballoon reduces fractionation at non-pulmonary vein LA sites. Left atrial effect of cryoballoon on CFAE in a patient with advanced atrial substrate of LPAF and heart failure was investigated in the present report.

The results of the present case may support the additional role of cryoablation in reducing CFAEs beyond PVI and may identify the possible mechanism by which cryoablation of PVs alone could terminate LPAF.

Conclusion

While results of the present case are encouraging, the possible role of cryoballoon on atrial substrate should be investigated in larger cohorts.

Conflict-of-interest issues regarding the authorship or article: None declared.

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- Keywords:** Atrial fibrillation; ablation; cryoballoon.
- Anahtar sözcükler:** Atriyum fibrilasyonu; ablasyon; kriyobalon.