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CASE REPORT

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Left-sided phrenic nerve injury during redo pulmonary vein isolation long after a previous contralateral self-limiting phrenic nerve palsy

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Abstract

We present a unique case of a left-sided phrenic nerve injury (PNI) long after a previous contralateral PNI following pulmonary vein isolation (PVI) procedures. Firstly, right-sided PNI after cryoballoon ablation, and secondly a left-sided PNI was observed following a redo PVI extended with box-lesion and left atrial appendage isolation (LAAI).

KEYWORDS

atrial fibrillation, catheter ablation, left atrial appendage isolation, magnet navigated ablation, phrenic nerve injury

1 | INTRODUCTION

Phrenic nerve injury (PNI) is a known complication related to pulmonary vein isolation (PVI) following catheter ablation (CA) for atrial fibrillation (AF), which can occur at both sides of the diaphragm. PNI has been described with the variety of catheters, and with the variety of energy sources. However, no report is available on both-sided PNI after sequential PVI procedures performed with different energy sources.[1-5] We present a unique case of the left-sided diaphragm PNI during redo radiofrequency PVI long after a previous contralateral PNI related to cryoballoon ablation.

2 | CASE REPORT

A 62-year-old male was referred to our hospital because of drug-refractory long-standing persistent AF for redo PVI and substrate ablation. The patient had undergone a cryoballoon ablation (Medtronic, 28 mm Arctic Front) for AF 12 years ago. It had been complicated with an asymptomatic, self-limited right hemidiaphragm palsy. The hemidiaphragm palsy was noticed neither during the procedure, nor during the post-procedural checkups. It was diagnosed by chest X-ray at readmission at the emergency ward two days after the procedure, which completely recovered until the second CA procedure. (Figure 1 Panel A, B). The thoracic ultrasound examination performed prior the redo intervention had confirmed a complete recovery with adequate diaphragm motion. He had a good left ventricular function with a dilated left atrium (LA) of 51 mm, and his current EHRA class was II.

The redo PVI ablation was performed under general anesthesia. A decapolar diagnostic catheter was positioned in the coronary sinus (CS), and after a double transseptal puncture, a Lasso catheter (LassoNav™; Biosense Webster Inc) was advanced into the LA. Mapping was performed using the CARTO 3D mapping system. A 4-mm tip Navistar RMT Thermocool ablation catheter (Biosense Webster

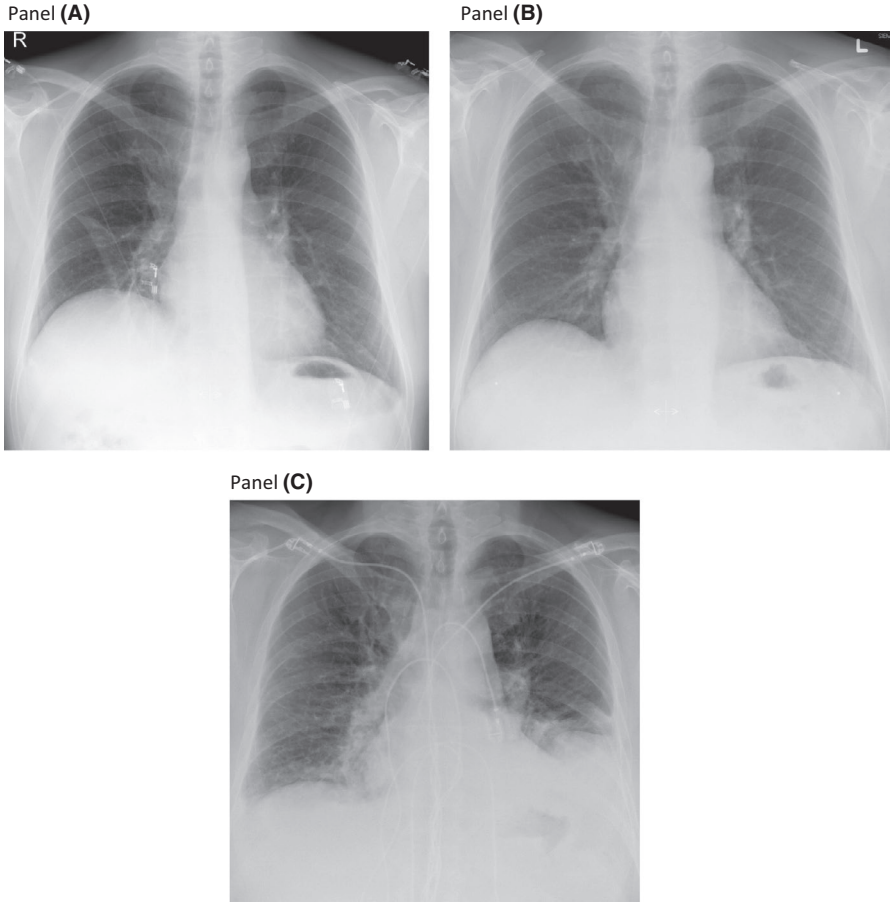

FIGURE 1 Chest X-rays of the presented patient. Panel A, Elevated right-sided diaphragm after cryoballoon ablation (2005). Panel B, Recovery of the right diaphragm' s position, performed before radiofrequency redo pulmonary vein isolation (2017). Panel C, Elevated left-sided diaphragm after redo radiofrequency ablation, with signs of cardiac decompensation and right infrahilar consolidation (2017)

Inc) was advanced into the LA and was controlled with magnetic navigation system (Niobe ES; MNS, Stereotaxis Inc). Mapping with the Lasso catheter confirmed reconduction of both left-sided pulmonary veins. These veins were reisolated applying touch-up radiofrequency lesions. Afterward, we performed a stepwise ablation. Based on this approach, a roofline and a subsequent posteroinferior ablation lines were formed to create a box-lesion in the LA. Additionally, the roofline on the LA was connected with the mitral annulus by an anterior ablation line. Eventually, the left atrial appendage (LAA) was isolated. In the right atrium, an intracaval ablation line was performed and it was connected with the tricuspid annulus. All applications were performed with the following radiofrequency settings: 40-45 W, 43°C. Conversion to sinus rhythm was achieved with electrical cardioversion. No intraprocedural complication occurred.

Two days after the procedure, the patient presented at the emergency department with progressive dyspnea. At the readmission, chest X-ray revealed left-sided diaphragm palsy and fluid accumulation due to cardiac decompensation caused by a short-lasting but fast postprocedural AF episode. (Figure 1 Panel C). No alteration in the LV function was revealed as compared to the previous normal values. His symptoms improved after diuretic therapy and fluid restriction, which was used during hospital stay and was discontinued after hospital discharge. The patient was discharged in sinus rhythm with a stable cardiopulmonary status two days after readmission. The patient was seen in the outpatient clinic every two months until 1 year after the procedure. His shortness of breath gradually improved. Patient experienced no recurrence of palpitations, and no AF recurrences were observed on electrocardiogram and 24-hour Holter rhythm monitoring.

3 | DISCUSSION

To the best of our knowledge, we present the first case of both-sided PNI related to PVI procedures for AF. Firstly, right-sided PNI after cryoballoon ablation with self-limited recovery was observed. Long after the first CA, a left-sided PNI was detected following a redo radiofrequency PVI extended with left atrial appendage isolation (LAAI) and box-lesion. As the demand for catheter ablation of drug-refractory AF is increasing, we need to keep awareness to avoid any possible complication of ablation procedures. Sacher et al showed that the prevalence of PNI in the

context of AF ablation is low (0.48%).[1] They found eighteen patients with PNI (16 right, 2 left) out of 3755 patients who underwent AF ablation procedures in a multicenter study. It is known that ablation of certain anatomical structures is more likely to associate with PNI. Right hemidiaphragm injuries are usually related to ablation lesions close to the inferoanterior part of the right PV ostium or the posteroseptal part of the vena cava superior. While left-sided diaphragm injuries are more prone to happen due to ablation at the proximal left atrial appendage roof.[1] Phrenic nerve injury has been described with the variety of catheters (4-mm, 8-mm irrigated-tip) and with the variety of energy sources (radiofrequency, cryoballoon, ultrasound).[2-5] Huemer et al reported that the phrenic nerve mapping and reconstruction is simple and may help to avoid serious PNI and might be considered when areas are targeted inside the LAA, near the LAA ostium or in the distal CS.[6] Sanchez-Quintana et al described three different courses of the left phrenic nerve: anterior, lateral, posteroinferior.[7] The most common lateral type passes the apex of the LAA. As a summary, the importance of ablation targets in and around the LAA grows with the increasing number of patients waiting for extended CA for persistent AF. Despite the combined method of PVI and LAAI is a promising ablation strategy, which could increase the success rate and reduce the recurrence rate of AF, conflicting results are available concerning the thromboembolic complications of this method.[7-10] In the present study, we confirm that left-sided diaphragm injury is a possible complication related to LAAI.[1]

In addition, there is an ongoing debate on the amount of energy delivery during AF ablation, as the optimal ablation settings are unknown. Despite the safety and efficacy of CA are increased with the utilization of contact force-sensing catheters, the transmurality of the ablation lesions, especially in the LAA region, is still crucial for successful isolation. This need for transmural lesion formation makes structures in close contact with the LA susceptible to damage. We guess that the sequential both-sided PNI, in this case, was most probably a coincidence, or was due to an atypical anatomical location of the phrenic nerve. Beyond the vigilance of physicians using careful power and temperature settings, one may consider to utilize pacing maneuvers before LAAI to exclude the close location of the left-sided phrenic nerve. Furthermore, pacing maneuvers might be applied at the predilection sites during extended PVI ablation for AF to prevent a potential lethal complication of both-sided PNI presenting at the same time.

4 | CONCLUSION

We present a unique case of a PNI of both sides after sequential PVI procedures performed with different energy sources. Firstly, right-sided PNI after cryoballoon ablation with self-limited recovery occurred. Secondly, a left-sided PNI was observed following a redo PVI extended with LAAI and a box-lesion.

In conclusion, CA in close proximity to LAA warrants conservative power settings and the vigilance of physician to avoid PNI related to ablation procedures.

CONFLICT OF INTEREST

None of the authors.

AUTHOR CONTRIBUTIONS

Zsuzsanna Kis MD, Anna Maria Elisabeth Noten MD: writing the manuscript, clinical data collection, critical evaluation of the clinical data, critical evaluation and acceptance of the manuscript. Sip Wijchers MD, Rohit Bhagwandien MD, Tamas Szili-Torok MD, PhD: electrophysiologist performing the ablation, follow-up of the patient, critical evaluation and acceptance of the paper.

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