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PR-segment depression during cryoballoon ablation of atrial fibrillation: a case report

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Cryoballoon ablation has been widely used in the treatment of atrial fibrillation (AF).[1] The main complications of the procedure include pericardial tamponade, pulmonary vein stenosis, and atrial esophageal leakage, *etc*.[2] But there has been hardly any reporting of PR-segment changes caused by cryoballoon ablation of AF.[3,4] In this case report, we describe the patient with a sudden onset of chest pain during the treatment of AF using cryoballoon ablation, and electrocardiogram (ECG) showed depressed PR-segment in the lead on the inferior wall lead, which was a manifestation of atrial ischemia.

The patient was a 50-year-old man who was admitted to General Hospital of Northern Theater Command, Shenyang, China for catheter ablation treatment of AF. The patient had a history of hypertension, diabetes and cerebral infarction, the CHA2DS2-VASc score of 4 points, and was on a medication of dabigatran 150 mg. On admission, his ECG was normal with a sinus rhythm. During a seizure, the ECG documented AF. Echocardiography showed the left atrium dimension as 31 mm, the left ventricle dimension as 46 mm, and the left ventricular ejection fraction as 63%. Transthoracic echocardiography did not reveal any atrial thrombus. In addition, pulmonary venous computed tomography angiography showed no obvious abnormalities of the pulmonary veins.

The patient signed the informed consent form for the procedure, and then began the frozen balloon ablation of AF. His preoperative ECG was shown in Figure 1A. Conventional puncturing of the femoral vein and internal jugular vein aimed to lay the right ventricular electrode and coronary sinus electrode, and puncturing of the atrial septum along the cryogenic ablation sheath was used to place the second-generation frozen balloon and the ring mapping electrode in the left atrium. Under the guidance of the electrode, frozen balloon ablation of the pulmonary vein was in the sequence of ablation of the left superior, left inferior, right superior, and right inferior pulmonary veins. The left inferior pulmonary vein was frozen three times in total, for 120, 180, and 120 seconds respectively; with the minimum temperature of –29°C, –43°C, and –39°C, respectively. When the left inferior pulmonary vein was being frozen for the second time, the patient developed chest pain which continued after the vein isolation and worsened. The surface ECG showed that the PR-segment of the II, III, and aVF leads had declined by 0.1 mV (Figure 1B).

Then, the patient was given intravenous morphine and immediately underwent coronary angiography (CAG), showing that the left main artery was normal, the middle segment of the left anterior descending artery was 40% stenosed, the left circumflex artery (LCx) was normal and extended grade II lateral branches to the right coronary artery (RCA), both RCAs were small with distal occlusion in one. With intraoperative observation for one hour, chest pain disappeared and the PR-segment restored nearly to its preoperative status (Figure 1C). Images of the cryoablation were shown in Figure 2.

After the patient returned to the ward, the ECG showed the PR-segment restored almost to its preoperative status. During the pre-discharge days, there were no significant abnormalities. Bedside cardiac ultrasound did not reveal pericardial effusion. Since the patient's admission to the hospital, the levels of myocardial enzymes had been normal. However, three hours after operation, the enzymes manifestations: serum creatine kinase level of 632 U/L, creatine kinase isoenzyme level of 85 U/L, and troponin level of 0.518 ng/mL. On the postoperative third day, the levels of

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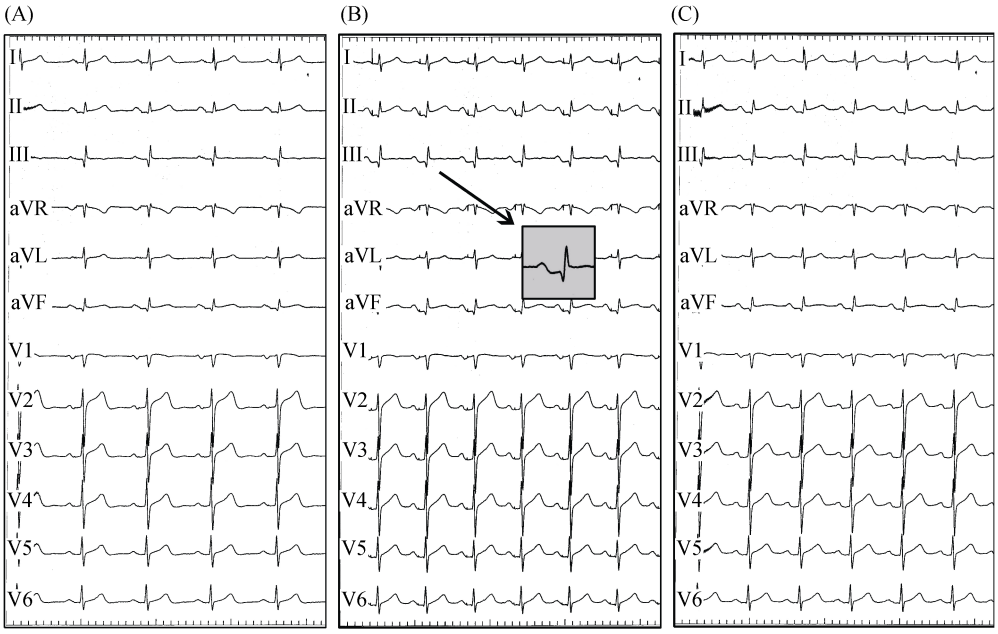

Figure 1. ECG performance. (A): Preoperative ECG; (B): during the operation, ECG showed that the PR-segment of the II, III, and aVF leads declined by 0.1 mV. The arrow indicates the amplified ECG of lead III; and (C): with intraoperative observation for one hour, the patient's chest pain disappeared and the PR-segment restored nearly to its preoperative status. ECG: electrocardiogram.

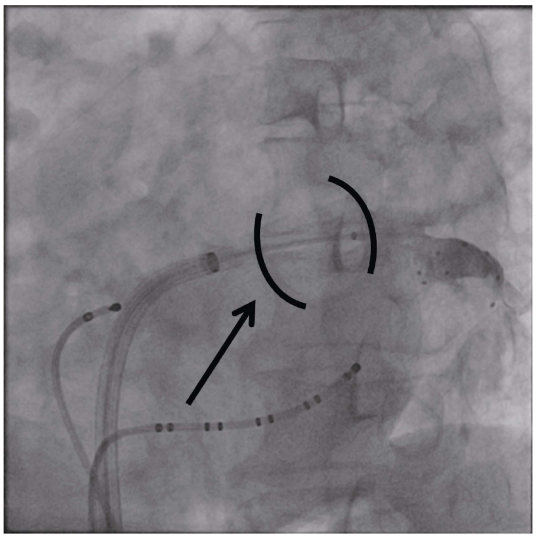

Figure 2. Images of the cryoablation of the left inferior pulmonary vein (LAO 45°). The arrow indicates the frozen balloon. LAO: left anterior oblique.

myocardial enzymes were measured again: the serum creatine phosphokinase level of 83 U/L, creatine kinase isoenzyme level of 11 U/L, and troponin level of 0.374 ng/mL, a significant decrease in all. At 6-month follow-up, the patient had no other symptoms, no recurrence of chest pain, and ECG and echocardiography findings were normal.

Catheter ablation is the most effective method for treating AF while maintaining the sinus rhythm, with significantly better efficacy than antiarrhythmic medicines.[5] Cryoballoon ablation has been used more extensively in recent years.[6] It has only a few complications such as phrenic nerve paralysis or injury, lower-extremity vascular complications resulting from the puncture, atrial esophageal fistula (rare), and pulmonary vein stenosis. However, cryoballoon ablation caused chest pain and PR-segment depression have rarely been reported in literature.

The measurement range of the PR-segment change is based on the baseline formed by the TP-segment. The vertical distance from the baseline to the start of the PR-segment is the PR-segment change. The mechanism of the offset may be related to recent myocardial injury which usually occurs in acute pericarditis, acute atrial myocardial infarction and injury.[7,8] Studies have shown that the PR-segment can also be slightly down-shifted in the normal population. When the degree of down-shifting is 0.08 mV or more, it may be highly suggestive of atrial infarction.[9]

The LCx starts at the left coronary artery and travels along the coronal ditch to the left and then back around the left heart to the left ventricular diaphragmatic surface. Small branches of the LCx include the sinoatrial node artery, left atrial spinous branch, left marginal artery, left posterior branch, and left atrium. The left atrial spinous branch from the LCx proximal segment parallels the LCx and then goes left behind the distribution of the left atrial wall; a number of small branches diverging from the left atrial branch are distributed in the left anterior and posterior walls. The RCA

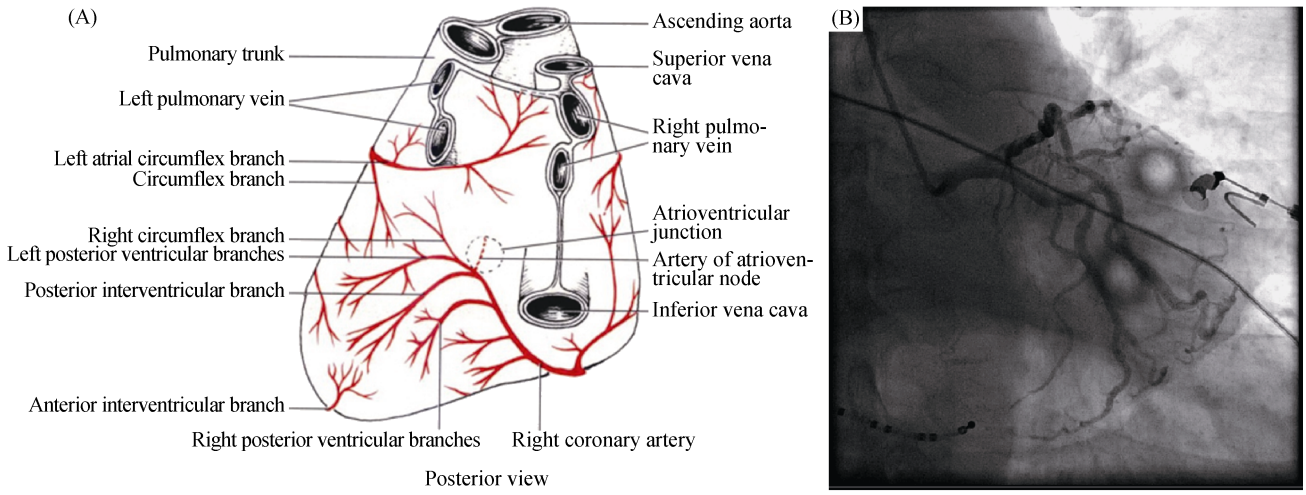

Figure 3. Schematic diagram and coronary angiography of LCx. (A): LCx branch adjacent to the left inferior pulmonary (The figure was chosen from Practical cardiac anatomy by Wang Haijie); and (B): coronary angiography showing that LCx artery was normal. LCx: left circumflex branch.

of the right circumflex artery and the L-branch anastomosis, which are distributed in the left atrial posterior wall, are common findings in the left atrial blood supply.[10] The patient had chest pain with concomitant reduction of the PR-segment in the inferior wall leads, which may be related to the injury or spasm of the small branches of the left coronary artery during the freezing process. The CAG in this case did not show stenosis or occlusion of LCx, which may be related to the remote of the branches being too small to be detected.

Both radiofrequency catheter ablation and frozen balloon ablation of AF can lead to atrial muscle injury.[11–13] The patient in our case had obvious abnormalities in postoperative myocardial enzymes and troponin, but it was difficult to determine the cause by the freezing or atrial myocardial infarction.

In patients with AF after radiofrequency catheter or frozen balloon ablation, there has been less reporting of the PR-segment depression on the body surface ECG. Antonio Sorgente, *et al.*[14] has reported the elevation of PR-segment in lead I and aVL during AF cryoballoon ablation. In nearly 1000 cases of AF with cryoballoon ablation at our center, this was the only case. To monitor for chest pain or hemodynamic changes during cryoballoon ablation, the surface ECG changes (including changes in the PR-segment) should be observed. When necessary, CAG is valuable in pre-operation for determining vascular conditions.[15,16]

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