

An acute ischemic stroke after the retrograde transaortic manipulation

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1 INTRODUCTION

Radiofrequency ablation has been demonstrated to be a low-risk and effective treatment for eliminating premature ventricular complexes (PVC).^{1,2} The retrograde transaortic approach is a widely used access route for the mapping and ablation of ventricular arrhythmias arising from the left ventricle, including the papillary muscles.¹ It has been reported that some complications were associated with the retrograde transaortic approach, including iatrogenic aortic dissection, coronary damage, valve leaflets damage, complete atrioventricular block and so on.^{1,3} However, acute ischemic stroke (AIS) associated with the retrograde transaortic manipulation during radiofrequency ablation of PVC was rarely reported.⁴ In this case report, we shared a case of AIS encountered after the retrograde transaortic manipulation, during a procedure of PVC ablation.

2 CASE HISTORY

A 66-year-old woman (Height 164cm, Weight 72Kg) was referred for radiofrequency ablation of frequent PVC (Figure 1A), after the treatment of which by medication had been ineffective. She had a history of palpitation for one year. Her PVC burden was 14.5%, with a total of 12735 PVCs during the 24-hour Holter. Regular examination confirmed the diagnosis of hypercholesteremia (total cholesterol 6.08mmol/L, low-density lipoprotein cholesterol 4.16 mmol/L). No other disease (hypertension, diabetic mellitus, stroke) was recorded. Before the procedure, transthoracic echocardiography revealed the patient had normal cardiac diameters and normal left ventricular ejection function (68%).

3 DIFFERENTIAL DIAGNOSIS, INVESTIGATIONS, AND TREATMENT

After written informed consent was obtained, the electrophysiology procedure was performed under the guidance of a three-dimensional electroanatomic mapping system (CARTO3). A 3.5-mm-tip saline irrigating catheter (NaviStar ThermoCool SmartTouch) was introduced into the aorta via an 8F short sheath inserted in the right femoral artery. A 3D image of the aorta was first reconstructed by the mapping catheter on the electroanatomic mapping system. The mapping catheter was then introduced into the left ventricle, using the retrograde transaortic manipulation approach, to find the ablation target of PVC. The earliest activation site of the PVC was located at the anterior papillary muscle of the left ventricle (31ms ahead the surface QRS wave, Figure 1B). Several radiofrequency applications (40w, 43°C) were performed around the target and eliminated the PVCs. During the 30-minute observation period, some provocative PVC was observed after the infusion of isoproterenol. Therefore, reinforcement ablation was attempted. After several attempts of retrograde transaortic manipulation, the mapping catheter had finally been introduced into the left ventricle

(Figure 2). However, about 40 seconds after the last retrograde transaortic manipulation (Figure 2), she presented a sudden large body movement from the bed (supplementary video). After returning to the normal supine position, she reported that a severe sense of weightlessness had led to her uncontrolled body movement. Moreover, she had also reportedly encountered the symptoms of vertigo, nausea, vomiting, and limb ataxia, coupled with an increased blood pressure (from the baseline of 120/76mmHg to the highest of 198/110mmHg). No more ablation was performed after that point, and the mapping catheter was subsequently withdrawn from the short sheath. No charring was observed at the tip of the ablation catheter. Urgent consultation with a neurologist was conducted. An emergency brain computed tomography scan was performed and excluded the occurrence of a hemorrhagic stroke. An AIS of the posterior circulation was suspected. Emergency cerebral arteriography and interventions was suggested but was refused by the patient, who had reported of a relief of symptoms at that point. Conservative treatments (low molecular weight heparin, atorvastatin, edaravone, betahistine, etc.) were administered to relieve her symptoms.

4 OUTCOME AND FOLLOW-UP

A cervical computed tomography angiography, performed on the second day after the ablation, revealed left common carotid artery atherosclerosis and an anomaly of the left vertebral artery, which directly originated from the aortic arch (Figure 3). Cranial magnetic resonance imaging, performed on the third day after the ablation, showed acute left cerebellar infarction and bilateral periventricular ischemic lesions (Figure 4). By the third day, her symptoms were significantly improved. On the 16th day after the ablation, she was discharged without obvious neurological sequelae after the conservative treatments. At the 6-month follow-up, she reported a relief of palpitation with a reduced PVC burden of 2.8%, without neurological sequelae.

5 Discussion

AIS during radiofrequency ablation procedure were often reported in those atrial fibrillation patients with high risk of thromboembolism. On the other hand, AIS during radiofrequency ablation of PVC patients was rarely reported.⁴ To our knowledge, this is the first case report on AIS during catheter ablation of PVC. AIS during radiofrequency ablation may be associated with char formation at the ablation tip. However, in our reported case, upon the patient's manifestation of the neurological symptoms, no charring was identified on the tip of the withdrawn ablation catheter. Therefore, AIS might not have been associated with charring in this case. The reasonable and speculative source of the embolus was the tissue debris caused by the ablation or catheter manipulation. Histopathological examination of a retrieved embolus would be very helpful for identifying the precise etiology and pathogenesis of this AIS. However, emergency cerebral arteriography and interventions was refused. Nevertheless, considering that the neurological symptoms were developed about 40 seconds after the retrograde transaortic manipulation (at that time, reinforcement ablation was not performed), it was reasonable to associate the AIS with the retrograde transaortic manipulation. Therefore, this is the first case report that AIS was associated with retrograde transaortic manipulation due to the high contact force, but not due to the char formation.

Retrograde transaortic catheter manipulation is a widely used and first-line access route for mapping and ablation of ventricular arrhythmias arising from the left ventricle.¹ Generally, retrograde transaortic approach was safe.^{1,3} However, as presented in this case, the retrograde transaortic manipulation could potentially result in AIS. The excessive contact force during the aortic valve crossing by the ablation catheter could potentially lead to dislodgement of unstable atherosclerotic plaques, which was frequently found in those patients with uncontrolled hypercholesterolemia. The dislodged debris could lead to thromboembolism, if the debris was occluded in an important artery, such as the anomalous left vertebral artery indicated in this specific case. Therefore, cautious the retrograde transaortic manipulation should be performed by limiting the contact force as low as possible.

In clinical practice, AIS encountered during catheter ablation may often have specific neurological symptoms. However, greater attention should be given to those patients with nonspecific neurological symptoms, such as dizziness, vertigo, and limb ataxia. Radiological examinations should be performed for those patients with

sudden onset and agnogenic neurological symptoms during catheter ablation. For the patient in this case, examinations confirmed the diagnosis of AIS (the left cerebellar infarction), which may be a result of the occlusion of the anomalous left vertebral artery by dislodged debris caused by the retrograde transaortic catheter manipulation. Appropriate treatments were administered for this patient to relieve her neurological symptoms after the confirmed diagnosis. Fortunately, her symptoms were relieved after the appropriate treatments and encountered no neurological sequelae during the follow up. Therefore, the vigilance is crucial to evaluate the risk of stroke and to give the appropriate treatments, especially in patients with nonspecific neurological symptoms.

In conclusion, this report highlighted that AIS could be encountered in some patients resulting from repeated retrograde transaortic manipulation with excessive contact force.

AUTHOR CONTRIBUTIONS

Juan Xu: visualization; writing—original draft. Shuang Wu: Data curation, Validation. Xiaofeng Lu: Resources. Shi Peng: Formal analysis. Jun Li: Investigation, **Supervision**. Shaowen Liu: **Formal analysis, Supervision**. Songwen Chen: Supervision , writing-review and editing.

CONFLICT OF INTEREST STATEMENT

None of the authors have financial disclosures relevant to this manuscript.

CONSENT

Written informed consent was obtained from the patient to publish this report.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

Figure Legends:

Figure 1. The PVC morphology and its target. **A.** The 12 leads ECG showed the PVC morphology, which indicated its origin of left ventricular anterior papillary muscle. **B.** The earliest activation site of the PVC was located at the left ventricular anterior papillary muscle (31ms ahead the surface QRS wave).

Figure 2 . The last retrograde transaortic manipulation. After several attempts, the mapping catheter was finally introduced into the left ventricle. Noted that the excessive contact force was encountered during the retrograde transaortic manipulation (A-D).

Figure 3. The cervical computed tomography angiography. Noted that the anomaly left vertebral artery is directly originated from the aortic arch (red arrow).

Figure 4. Acute left cerebellar infarction. Cranial magnetic resonance imaging (T1W1, T1W2 and DWI) confirmed acute left cerebellar infarction.

supplementary video. The excessive contact force and the retrograde transaortic manipulation. After several attempts, the mapping catheter was finally introduced into the left ventricle. The excessive contact force was encountered during the retrograde transaortic manipulation from 12 seconds to 16 seconds of the video.

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