Case report article

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Permanent pacemaker implantation after atrial flutter ablation

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Abstract

Catheter ablation (CA) for typical atrial flutter (AFL) is well-established and has a high success rate and adequate safety. Sinus node dysfunction (SND) can occasionally develop after the termination of long-term, persistent AFL through ablation. Since sinus node function cannot be evaluated during AFL, the preoperative prediction of underlying SND remains unexplored. In such cases, symptomatic patients with long sinus pause on ECG can require pacemaker implantation. We report a case of a 63-year-old female patient with a three-year history of atrial fibrillation and flutter, presenting with dizziness and lightheadedness. Following radiofrequency catheter ablation, her symptoms persisted. A 24-hour Holter electrocardiogram recorded atrial fibrillation with maximum sinus pause of 7.51 seconds. A permanent pacemaker was implanted, resulting in significant symptom remission. This case highlights the need for further research into identifying predictors of SND in patients undergoing catheter ablation for persistent AFL, to guide preoperative assessment and improve clinical outcomes.

Keywords: atrial fibrillation, atrial flutter, sinus node dysfunction, pacemaker, catheter ablation

1. BACKGROUND

Catheter ablation (CA) of the cavotricuspid isthmus (CTI) is a well-established treatment for typical atrial flutter (AFL), yielding success rates above 90% [1]. However, sinus node dysfunction (SND) may develop in approximately 8–11% of patients following CA, as AFL termination can reveal previously suppressed or pre-existing SND [2]. Recent studies indicate that risk factors, such as prolonged AFL duration, atrial enlargement, and sinus node remodeling, are predictive of post-ablation SND, highlighting the need for preoperative risk assessments [3] Although pacemaker implantation often alleviates symptoms in patients with persistent SND, the preoperative identification of patients at risk remains challenging, especially making decision to do both of procedures (catheter ablation and pacemaker implantation) for the patient.

2. CASE REPORT

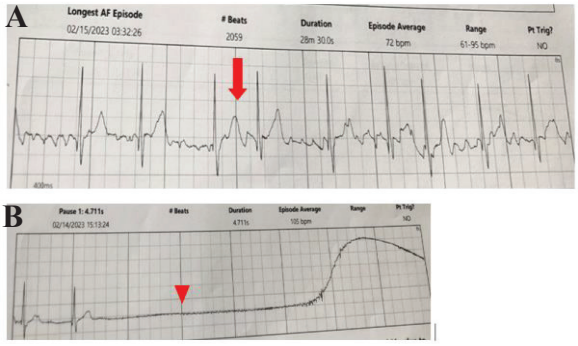
A 63-year-old female patient was admitted to the hospital for dizziness and vertigo. For over 3 years, the patient has been experiencing symptoms such as palpitations, chest pounding, chest pain, dyspnea, and notably, prolonged episodes of dizziness and vertigo. The patient had sought medical attention at multiple centers and was diagnosed with atrial fibrillation, managed with medical treatment (Diltiazem, Rivaroxaban), but her symptoms did not improve.

Two weeks before hospitalization, the patient underwent a 7-day Holter monitor (Cardea Solo S300) recording, revealing

images of atrial fibrillation/flutter accompanied by prolonged pauses exceeding 2 seconds, with the longest pause lasting 4.71 seconds (Table 1 and Figure 1A, 1B).

Table 1. Results of 7-day Holter monitor

Start time: 09:58 on February 9, 2023. End time: 08:06 on February 16, 2023 Duration of monitoring: 6 days 22 hours 8 minutes, data analysis rate: 91.3% Electrocardiogram recorded and analyzed by the Cardea SOLO S300 system
Analysis results: • Sinus rhythm predominant: sinus rhythm (91.2%); atrial fibrillation/flutter (8.8%). • Rates: sinus rhythm 66 (39-189) beats per minute; atrial flutter 104 (61-184) beats per minute. • Atrial flutter: 466 episodes (8.8%), total duration: 13 hours 13 minutes. • Episodes of asystole: 6 episodes in sinus rhythm, longest pause 4.71 seconds; 1 episode in atrial flutter, longest pause 2.56 seconds. • Ventricular tachycardia: 819 episodes, fastest: 160 beats per minute (lasting 2.2 seconds), longest: 126 beats per minute (lasting 1 minute 6.3 seconds). • Atrial ectopic beats: 5.2%; 5265 atrial ectopic beats per day. Single beats: 2.1%; couplets: 0.9%; triplets: 0.5% • Ventricular ectopic beats: 661 ventricular ectopic beats per day (0.6% in sinus rhythm, 0.1% in atrial flutter) • Ventricular flutter: not detected



C ECG at admission showing atrial fibrillation

Figure 1. Holter ECG and surface ECG at the time of admission. Figure A on the 7-day Holter monitor shows the appearance of atrial fibrillation (arrow); Figure B demonstrates a prolonged sinus pause of 4.71 seconds (arrow head) on the 7-day Holter monitor; Figure C is the 12-lead surface ECG.

ECG upon admission, revealing atrial fibrillation (ventricular rate approximately 100 beats per minute) (Figure 1C). Transthoracic echocardiography showed a preserved left ventricular function without regional wall motion abnormalities; no cardiac chambers dilated. Transesophageal echocardiography noted non-dilated left atrium, swirling blood in the left atrium and left atrial appendage, without detecting any thrombi larger than 3 mm in the cardiac chambers. Thyroid function tests (TSH, T3, fT4), renal function tests (urea, creatinine, eGFR), liver enzymes (AST, ALT), and blood electrolytes (sodium, potassium, chloride) were within normal limits. The patient was diagnosed with atrial fibrillation/flutter and scheduled for electrophysiological study and radiofrequency catheter ablation of the atrial flutter. All antiarrhythmic medications were withheld for at least 5 half-lives prior to the ablation procedure.

The patient underwent ablation along the cavo-tricuspid isthmus (CTI) line, with multiple ablations at T:60, P:40W, followed by bidirectional cavo-tricuspid isthmus block confirmation. During the procedure time, rapid atrial fibrillation (frequency of 190 beats per minute) originating from the left atrium was observed. Electrical cardioversion was performed at 200J, restoring sinus rhythm on electrocardiogram at the rate of 70 beats per minute.

Five days later with the catheter ablation, the patient still experienced palpitations, chest tightness, fatigue, and dizziness. The patient continued to receive medical treatment with Amiodarone 200mg for atrial fibrillation treatment. The 12-lead surface electrocardiogram after the ablation showed pattern of atrial fibrillation/flutter (Figure 2A) with a prolonged pause of 1.8 seconds (Figure 2B). The patient underwent 24-hour Holter monitoring (Figure 3) with dominant sinus rhythm, average rate of 68 beats per minute; average ventricular response rate during atrial fibrillation (fastest 160 beats per minute, slowest 31 beats per minute); 2176 episodes of asystole lasting over 2 seconds, with the longest episode lasting 7.56 seconds. At this point, the symptomatic patient was diagnosed with atrial fibrillation, sick sinus syndrome, and performed a permanent pacemaker implantation (one week after the CTI ablation).

Figure 2. 12-lead surface electrocardiogram after the CTI ablation. Panel A shows the residual pattern of the atrial fibrillation/flutter (arrow). Panel B shows a prolonged pause of 1.8 seconds (arrowhead).

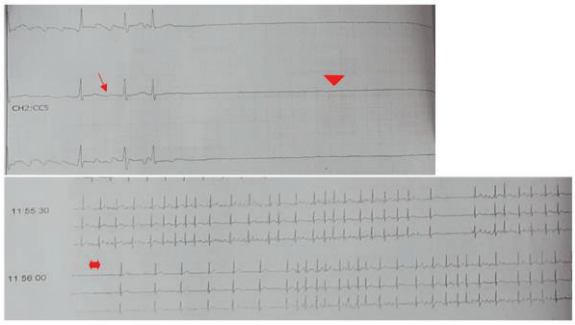


Figure 3. 24-hour Holter monitoring after the ablation. The signs of atrial fibrillation (arrow) and a prolonged sinus pause of 7.56 seconds (arrowhead) were recorded on the Holter. The fast-slow atrial tachycardia was followed by a pause lasting over 3 seconds (double arrow), which was then followed by a slow sinus rhythm.

After the permanent pacemaker was implanted, the patient's symptoms of fatigue, palpitations, and chest pounding significantly got remission. The 12-lead surface electrocardiogram showed regular sinus rhythm at a frequency of approximately 75 beats per minute, with no evidence of atrial fibrillation, atrial flutter, or any sinus pauses (Figure 4). The patient was discharged and re-evaluated after one month, with improved overall health. Occasional palpitations and chest pounding still occurred, but they were brief and did not cause discomfort to the patient as they did before the pacemaker was implanted.

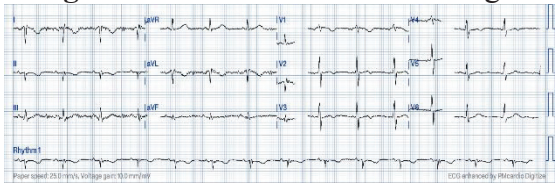


Figure 4. Surface electrocardiogram during follow-up examination (11 days after pacemaker implantation).

3. DISSCUSION

After atrial flutter ablation, the patient underwent a 24-hour Holter monitoring to

document atrial rhythm and evaluate sinus node function. This monitoring revealed episodes of atrial fibrillation/flutter with a flutter cycle length (FCL) of approximately 260 milliseconds, as well as multiple prolonged sinus pauses exceeding 2 seconds, with the longest pause reaching 7.56 seconds. The FCL, or the interval between successive atrial flutter waves, is clinically relevant as studies indicate that a longer FCL (>273 ms) is associated with a higher risk of sinus node dysfunction after ablation of AFL. Additionally, the prolonged sinus pauses observed on Holter monitoring are indicative of sinus node impairment, as pauses over 2 seconds are generally considered pathological and may consider pacemaker implantation. While predicting underlying sinus node dysfunction preoperatively may benefit patients, there is currently no available data on this. The detailed analysis of these findings established the possibility of AFL with concurrent SND, underscoring the need for both rhythm management and potential pacing considerations.

Atrial flutter is a common arrhythmia, the next most frequent condition following atrial fibrillation. These two arrhythmias can coexist and can cause palpitations, chest pounding, reduced exercise tolerance, chest pain, and sometimes no symptoms at all. By reducing the heart rate, it can lead to shortness of breath with exertion, nocturnal dyspnea, pre-syncope, and syncope [4,5]. Sinus node dysfunction, previously known as sick sinus syndrome, is a group of disorders related to conduction and abnormal electrical activity in the sinus node. Sinus node dysfunction can occur at any age, but it is more common in older people. The electrocardiographic manifestation of this disorder includes sinus bradycardia, sinus pauses, atrioventricular block, loss of rate responsiveness, and tachy-brady syndrome. Abnormal atrial rates reduce blood flow to target organs, leading to decreased physiological demand response, especially during periods of stress or exercise. Symptoms resembling atrial fibrillation/flutter include dizziness, fatigue, chest pain, palpitations, dyspnea, and syncope. Therefore, in patients with atrial fibrillation and/or flutter, it is crucial to determine whether this disorder is related to sinus node dysfunction, or it is a chronic disorder with normal sinus node function [5,6].

In our clinical case, the patient was presented with symptoms such as palpitations, chest pounding, chest pain, dyspnea, and dizziness over a prolonged period of 3 years. The patient was diagnosed with atrial fibrillation and was managed medically with anticoagulants and rate control agents at multiple cardiovascular centers, but the symptoms did not improve. It is noteworthy that the symptoms in this patient may occur in both atrial fibrillation/flutter and sinus node dysfunction. Surface electrocardiogram at the time of admission only showed the pattern of atrial fibrillation (Figure 1C); however, during a 7-day Holter monitoring, we observed not only atrial fibrillation/flutter (Figure 1A) but also episodes of sinus pause, including one episode lasting 4.71 seconds, 39 beats per minute for lowest previous sinus heart rate. All these manifestations are predicting with the clinical scenario of possibility of pacemaker implantation during follow-up after AFL ablation.

Atrial flutter can also be a condition of concomitant atrial myopathy along with sinus node dysfunction, complicating the treatment approach. Rate control and antiarrhythmic medications are used to control ventricular response in atrial fibrillation/flutter and to support the maintenance of normal sinus rhythm. However, all rate control drugs, and most antiarrhythmic drugs exacerbate the pre-existing sinoatrial node dysfunction and therefore need to be used with caution in these patients [7]. As a result, in clinical

practice, physicians may have difficulty determining whether atrial fibrillation is a consequence of pre-existing sinoatrial node dysfunction or whether it occurs concurrently with sinoatrial node dysfunction.

Answering this clinical question aims to determine whether the patient should be treated with permanent pacemaker implantation for sinoatrial node dysfunction or with catheter ablation for atrial fibrillation [2]. In the actual progression of the clinical case, the patient underwent catheter ablation and in the following days, the patient still had clinical symptoms, surface electrocardiogram and 24-hour Holter monitoring recorded an increased appearance of sinoatrial node dysfunction with 2176 episodes of sinoatrial pause lasting more than 2 seconds, with the longest episode lasting up to 7.56 seconds (Figure 2,3). There are two explanations for this phenomenon: (1) atrial fibrillation/flutter is a protective mechanism associated with sinoatrial node disease, or (2) prolonged atrial fibrillation/flutter leads to atrial remodeling and sinoatrial node disease. Atrial remodeling is considered a common mechanism for the development of atrial tachyarrhythmia and SND. Importantly, atrial tachyarrhythmia (especially AF and AFL) itself may worsen sinus node function by atrial structural fibrosis, electrical remodeling, and molecular changes. Nerantziz and colleagues also suggest that there may be a risk of damaging the sinoatrial node artery during the catheter ablation of atrial flutter at the CTI site [8]. Limited data are available regarding the incidence and risk factors for pacemaker implantation after CTI-dependent AFL ablation

This patient underwent permanent pacemaker implantation, leading to a more stable clinical progression with symptoms' remission. Post-discharge surface electrocardiogram showed sinus rhythm and no atrial fibrillation/flutter. The patient was further monitored and evaluated using a 24-hour Holter monitor to assess atrial arrhythmias and pacemaker heart rate logs.

According to the 2019 ACC/AHA/HRS guidelines on the management of bradycardia and conduction disorders, if symptoms are caused by sinoatrial node dysfunction, permanent pacemaker implantation is the preferred method to regulate heart rhythm and improve symptoms [9]. Implanting a permanent pacemaker in patients helps physicians use antiarrhythmic drugs and rate control medications at higher doses to improve symptoms and prevent prolonged episodes of atrial fibrillation/flutter due to medication effects.

4. CONCLUSION

From this clinical case, we observed that in the presence of symptomatic atrial fibrillation/flutter, it is crucial to assess the risk of associated sinoatrial node dysfunction by Holter ECG. It is difficult to identify sinus node dysfunction in patients with persistent AFL before the termination of the AFL. Physicians should be aware of the possibility of pacemaker implantation during follow-up after AFL ablation, especially in patients with the relevant risk factors.

REFERENCES

1. Cavotricuspid isthmus ablation by means of very high-power short duration temperature-controlled lesions: acute and mid term outcome. *EP Europace*, Volume 25, Issue Supplement_1, June 2023, euad122.751.
2. Prediction of sinus node dysfunction in patients with persistent atrial flutter using the flutter cycle length. Akinori Sairaku [1], Yukiko Nakano, Noboru Oda, Yuko Makita, Kenta Kajihara, Takehito Tokuyama, Europace 2012 Mar; 14(3):380-7.
3. Permanent Pacemaker Implantations after Catheter Ablation in Patients with

Atrial Fibrillation Associated with Underlying Sinus Node Dysfunction Korean Circ J. 2020 Apr;50(4):346-357.

4. Rodriguez Ziccardi M Goyal A, Maani CV. Atrial Flutter. 2022 Dec 8. Accessed 2024 Jan.
5. Choi S. H., Choi S. L., Lee B. Y., Jeong M.A.Tachycardia-bradycardia syndrome in a patient with atrial fibrillation: a case report. *Korean J Anesthesiol*. Aug 2015;68(4):415-9. doi:10.4097/kjae.2015.68.4.415
6. Hawks M. K., Paul M. L. B., Malu O. O. Sinus Node Dysfunction. *Am Fam Physician*. Aug 1 2021;104(2):179-185.
7. Jackson L. R., 2nd, Rathakrishnan B., Campbell K., et al. Sinus Node Dysfunction and Atrial Fibrillation: A Reversible Phenomenon? *Pacing Clin Electrophysiol*. Apr 2017;40(4):442-450. doi:10.1111/pace.13030
8. Nerantzis C. E., Anninos H., Marianou S. K., Pastromas S. The behavior of three types of large sinus node arteries with regard to the blood supply of the atrial myocardium. *Surg Radiol Anat*. Mar 2021;43(3):311-316. doi:10.1007/s00276-020-02621-5
9. Calkins H. The 2019 ESC Guidelines for the Management of Patients with Supraventricular Tachycardia. *Eur Heart J*. Dec 14 2019;40(47):3812-3813. doi:10.1093/eurheartj/ehz837.