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CASE REPORT
Arrhythmias/Electrophysiology

Radiofrequency catheter ablation for inappropriate sinus tachycardia in a patient with systemic lupus erythematosus: a case report

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Background Systemic lupus erythematosus (SLE) is known to cause inappropriate sinus tachycardia (IST). However, there is limited evidence available with regard to the treatment of IST in this setting. In this article, we report a case of drug refractory IST in a patient with SLE treated with radiofrequency catheter ablation (RFCA) using a non-contact mapping system.

Case summary A 33-year-old woman had been diagnosed with SLE in 2001. She presented with complaints of persistent palpitations for 1 month and persistent sinus tachycardia. She underwent RFCA using a non-contact mapping system for drug refractory IST. The voltage and activation maps did not show obvious differences in the earliest activation site at heart rates (HRs) 90–150 b.p.m. In contrast, the areas of breakout sites were clearly distinguished between those from the normal P-wave zones at HR <140 b.p.m. and those from higher rate sites at HR >140 b.p.m. Radiofrequency catheter ablation was performed in those areas as the target for ablation. Thereafter, the symptoms steadily disappeared and the maximum HR—using 24-h Holter monitoring—decreased from 156 to 120 b.p.m.

Discussion Radiofrequency catheter ablation using a non-contact mapping system was applied to the treatment of drug refractory IST in a patient with SLE. Of note, IST in such patients may be left untreated. This approach may be considered as a first-line therapy option for drug refractory IST in patients with SLE.

Keywords Inappropriate sinus tachycardia • Systemic lupus erythematosus • Non-contact mapping system • Radiofrequency catheter ablation • Case report

Learning points

- Radiofrequency catheter ablation was used for the treatment of drug refractory inappropriate sinus tachycardia (IST) in a patient with systemic lupus erythematosus.
- Radiofrequency catheter ablation using non-contact mapping system for the treatment of IST permits successful ablation, while reducing the risk of sinus node injury.

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Introduction

Inappropriate sinus tachycardia (IST) is defined as: (i) a P-wave axis and morphology during the tachycardia similar to that of the sinus rhythm; (ii) a sinus heart rate (HR) >100 b.p.m. at rest; and (iii) a mean HR >90 b.p.m. via 24-h Holter monitoring.[1]

The autonomic dysfunction and abnormal automaticity of the sinus node involved in IST remain poorly understood.[2–7] Although systemic lupus erythematosus (SLE) is known to cause IST,[8] therapeutic strategies are not well-documented.

Radiofrequency catheter ablation (RFCA) is an acceptable therapy for drug refractory IST.[9–11] Herein, we describe the first application of RFCA using a non-contact mapping system for the treatment of drug refractory IST in a patient with SLE.

Timeline

Dates	Events
2001	Diagnosis of systemic lupus erythematosus.
October 2017	Awareness of persistent palpitations.
29 November 2017	24-h electrocardiography (ECG) monitoring of the sinus rhythm. The minimum, maximum, and mean heart rates (HRs) were 71, 156, and 103 b.p.m., respectively. Total heart beats (THB)/day: 144 721. Echocardiography did not show structural pathology. Laboratory investigations were unremarkable. Diagnosis of inappropriate sinus tachycardia. Administration of a β-blocker or calcium channel blocker was initiated.
10 September 2018	Hospitalization.
11 September 2018	Radiofrequency catheter ablation.
13 September 2018	Discharge without complications.
9 October 2018	Post-operation follow-up (1 month). 24-h ECG monitoring of the sinus rhythm. The minimum, maximum, and mean HR were 60, 129, and 82 b.p.m., respectively. THB/day: 115 245.
13 November 2018	Post-operation follow-up (2 months). 24-h ECG monitoring of the sinus rhythm. The minimum, maximum, and mean HR were 50, 120, and 77 b.p.m., respectively. THB/day: 107 063.
25 March 2019	Post-operation follow-up (6 months). 24-h ECG monitoring of the sinus rhythm. The minimum, maximum, and mean HR were 46, 130, and 78 b.p.m., respectively. THB/day: 107 664.

Case presentation

A 33-year-old woman was diagnosed with SLE in 2001. The patient was treated with prednisolone (initial and maintenance dose: 50 and 15 mg/day, respectively). Polyarthritis pain, Raynaud's sign, and photosensitivity were recognized early in the onset of SLE. After initiation of prednisolone, the SLE symptoms improved. The patient complained of persistent palpitations for 1 month.

Examination showed that she was haemodynamically stable. Surface electrocardiography (ECG) revealed narrow QRS tachycardia with a P-wave of 139 b.p.m. The P-wave axis during tachycardia was similar to that observed during sinus rhythm (*Figure 1A*). Of note, 24-h ECG monitoring showed a minimum, maximum, and mean HR of 71, 156, and 103 b.p.m., respectively. In addition, tachycardia was persistent at rest (*Figure 1B*). Laboratory investigations revealed proteinuria (2.3 g/day) and positivity for anti-DNA antibody. In contrast, there was no evidence of secondary pathological sinus tachycardia (e.g. anaemia, hyperthyroidism, or neurohormonal disease). Physical examination, chest X-ray, and echocardiography did not yield evidence of clinically overt structural and/or organic heart disease. We diagnosed IST on the basis of diagnostic criteria.[1–3] Moreover, bisoprolol (2.5 mg/day), carvedilol (5.0 mg/day), and verapamil (240 mg/day) were administered. However, IST was refractory, and the administration of these agents was discontinued due to the development of adverse effects (i.e. general fatigue, headache, and dizziness).

An electrophysiological evaluation was performed to verify the mechanism of arrhythmia and exclude the presence of other arrhythmias. A multielectrode array catheter (EnSite™ Array, St. Jude Medical, St. Paul, MN, USA) was placed in the right atrium (RA), approximately at the level of the superior vena cava and right atrial junction (*Figure 2*). A 7-Fr quadripolar ablation catheter with a 4-mm-tip electrode (Therapy™, St. Jude Medical, St. Paul, MN, USA) was percutaneously introduced into the RA, while the baseline geometry of the RA was determined.

Surface ECG at rest prior to ablation showed a sinus rhythm of HR 100 b.p.m. (*Figure 3A*). Prior to RFCA, the HR was controlled (90–155 b.p.m.) through the intravenous administration of a β1 antagonist and agonist (*Figure 3B and C*). Moreover, voltage and activation mapping were performed at each HR 90–155 b.p.m. Activation mapping did not show differences in the earliest activation sites (EAS) at HR 90–150 b.p.m. during the intravenous administration of a β1 antagonist and agonist (*Figure 4A and B*). In contrast, the shift to the posteroseptal of breakout sites (BOS) was clearly distinguished between those from the normal P-wave zones at HR <140 b.p.m. and those from higher-rate sites at HR >140 b.p.m. (*Figure 4A*). This finding was in accordance with the appearance of tall P-waves (*Figure 3C*). Radiofrequency catheter ablation for 30–60 s under a pre-set temperature of 50°C and power limit of 30 W was delivered to the target areas of shifted BOS (*Figure 4C*). The ablation catheter potential prior to ablation was not a complete QS pattern, indicating that it was not the EAS (*Figure 4D*). Thereafter, the maximum HR decreased to 120 b.p.m. regardless of the intravenous administration of a β1 agonist (*Figure 3D*). After RFCA, the palpitations were markedly improved. The patient exhibited an uneventful course without evidence of recurrence for ≥6 months.

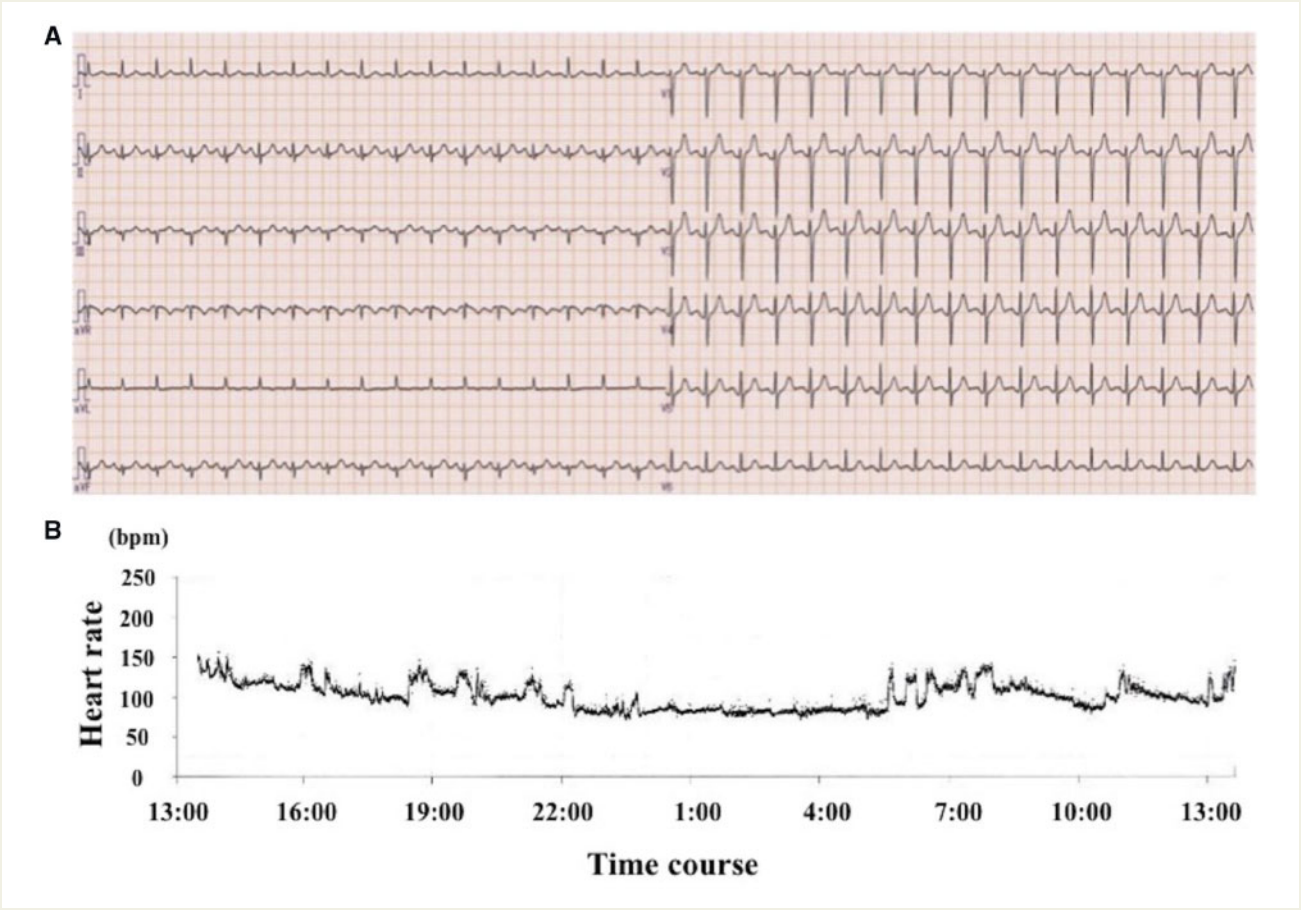

Figure 1 Surface electrocardiography pattern of sinus tachycardia (*A*). Heart rate trend during 24-h electrocardiography monitoring (*B*).

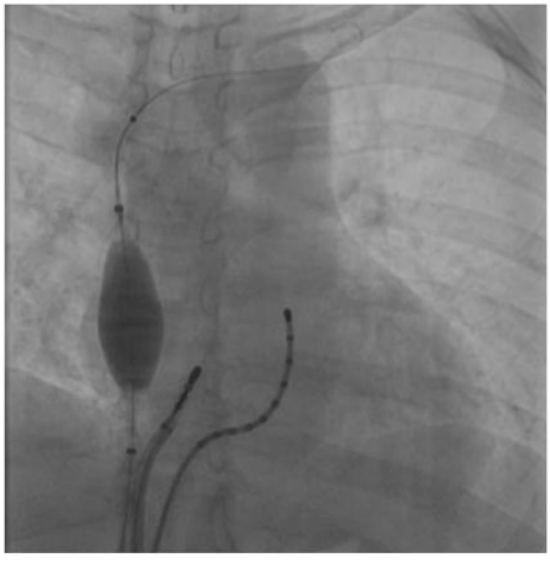

Figure 2 A multielectrode array catheter was placed in the right atrium.

Discussion

This is the first reported application of RFCA for the treatment of IST in a patient with SLE.

Firstly, RFCA was effective in this setting. Currently, the mechanism of IST in SLE remains poorly understood.[12,13] The Systemic Lupus Erythematosus Disease Activity Index (SLEDAI) score is useful for assessing the relationship between the inflammatory activity of SLE and chronic tachycardia (i.e. IST).[13] In this case, the SLEDAI score was 6, indicating that sustained SLE activity may induce IST.

Furthermore, the IST was refractory to pharmacological therapy; thus, we performed RFCA. Informed consent was provided by the patient prior to the procedure. Following RFCA, the clinical status of the patient improved.

Secondly, RFCA using a non-contact mapping system was effective against IST. The non-contact mapping system assists in the rapid, simple, and detailed assessment of sinus node activation, as expressed by the EAS and BOS activation routes per heartbeat.[14] Therefore, it may be more effective against arrhythmias with fluctuating HR (i.e. IST) vs. contact mapping system. This approach clearly determined the BOS at different HR. At HR < 140 b.p.m., the BOS was conducted all around, whereas at HR ≥ 140 b.p.m. it shifted to the posteroseptal

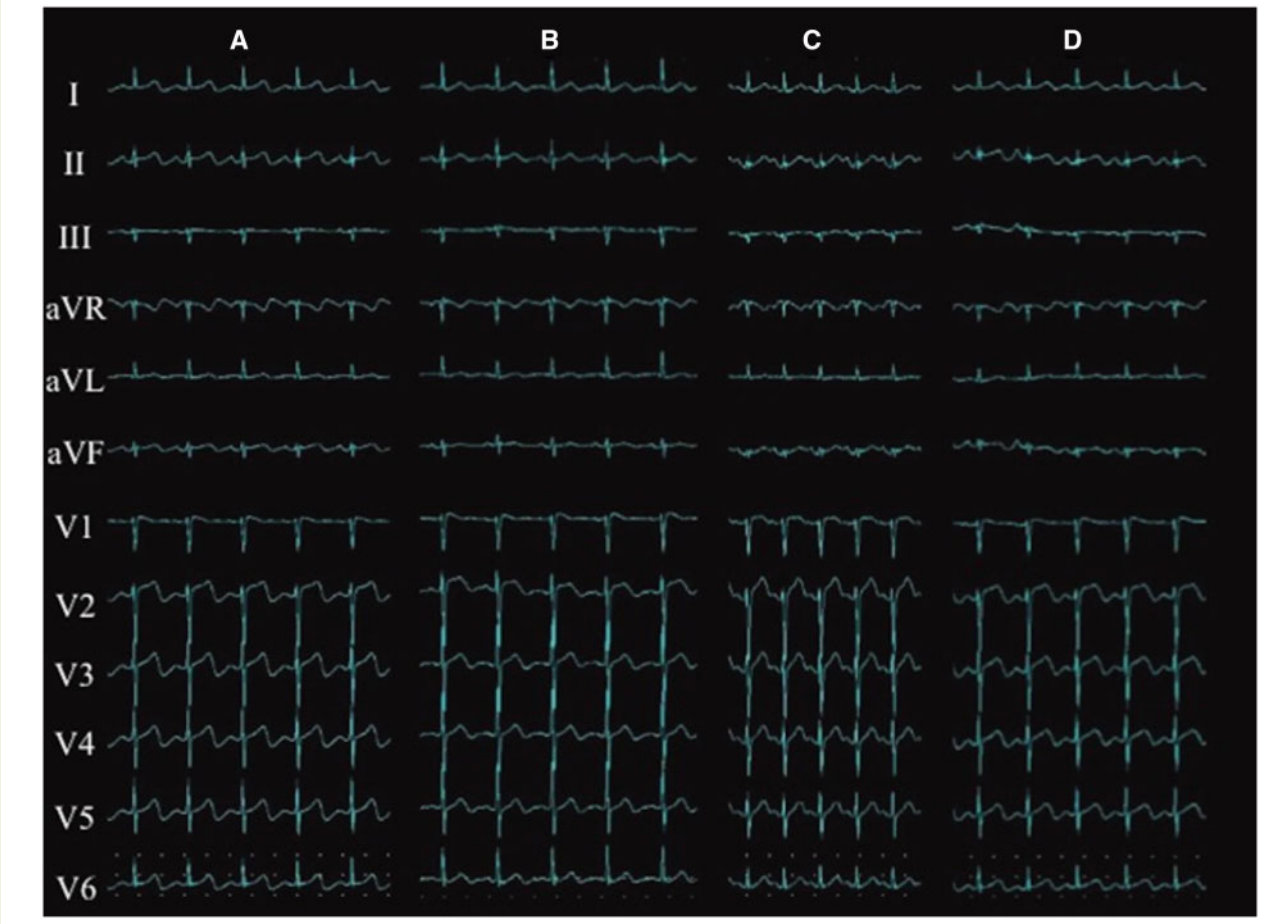

Figure 3 Surface electrocardiography at rest (heart rate = 100 b.p.m.) (*A*). Under intravenous administration of a β1 antagonist (heart rate = 90 b.p.m.) (*B*). Under intravenous administration of a β1 agonist (heart rate = 155 b.p.m.) (*C*). After delivery of radiofrequency energy (heart rate = 120 b.p.m.) (*D*).

site. Consequently, it became possible to perform successful ablation without the risk of injury to the sinus nodal function. In this case, the ablation success site was distant from the EAS. This result was consistent with those of a previous study highlighting that a successful RFCA in IST patients may not take place at the earliest site, but at a distant one (mean: 7 mm) from the EAS.[10] These findings suggest that the aetiology of IST involves the degeneration of the compact node (plus its paranodal areas) and sinoatrial conduction system.

Moreover, autonomic nervous disorder may be involved in the development of IST. Regulation of the autonomic tone induces a shift in the activation site of the sinus node.[9] In this case, RFCA using the Ensite™ mapping system effectively and safely separated the areas of the EAS and BOS (target site of RFCA).

Conclusion

In conclusion, RFCA using a non-contact mapping system was effective for the treatment of drug refractory IST in a patient with SLE. Further studies are warranted to clarify the mechanism of IST and develop therapeutic strategies involving mapping technology for patients with IST.

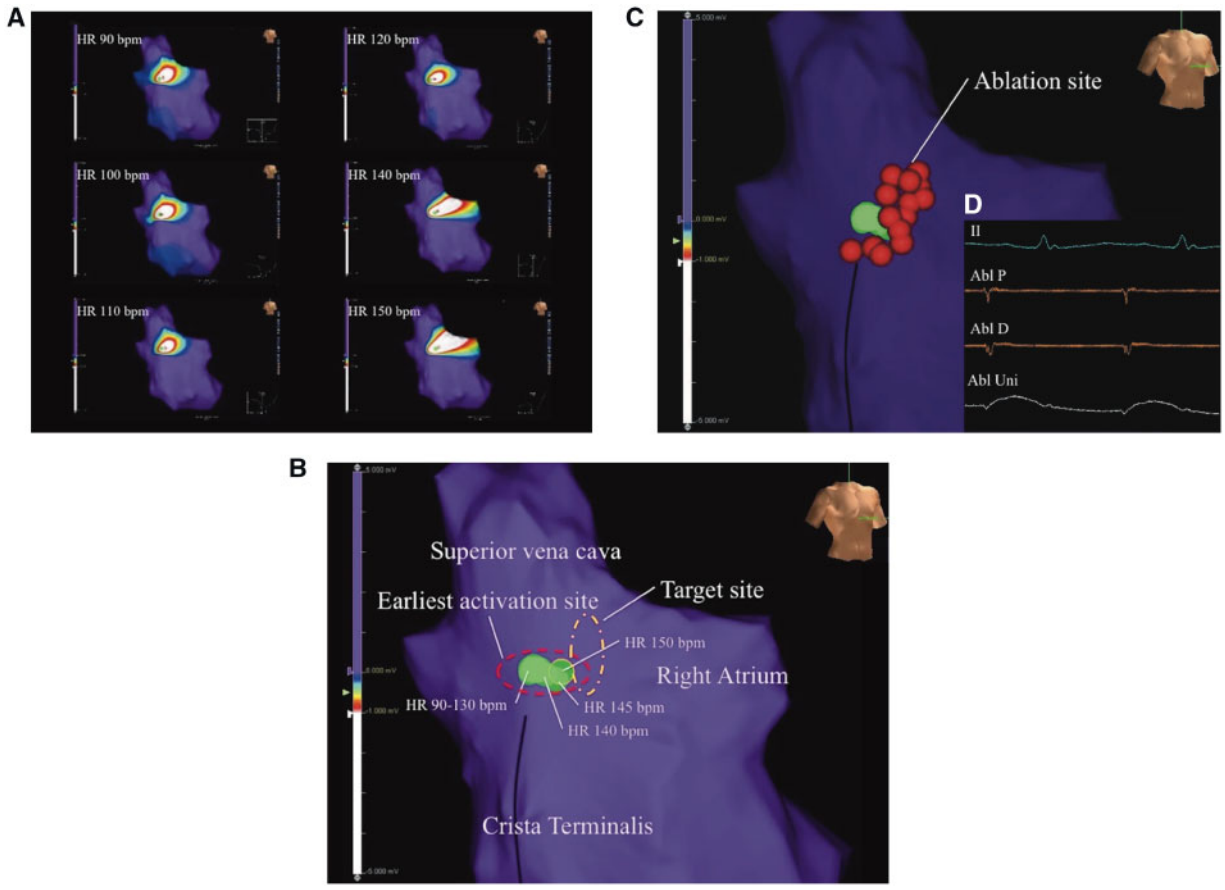

Figure 4 Right anterior oblique view of the EnSite™ activation (*A*) and voltage (*B*) maps showing the right atrium. Green tag with the red circle: the earliest activation site. Yellow circle: target site for ablation (*B*). Red tag: ablation site (*C*). Local electrograms from the ablation catheter in the successful ablation point (*D*). Abl D, ablation catheter distal potential; Abl P, ablation catheter proximal potential; Abl Uni, ablation catheter unipolar potential; HR, heart rate.

Lead author biography

Reisuke Yoshizawa is a graduate of the Teikyo University School of Medicine in 2008. Currently, he is an interventional cardiac electrophysiologist, and Assistant Professor in Division of Cardiology, Department of Internal Medicine, Iwate Medical University, Japan.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: none declared.

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