Intra-atrial reentrant tachycardia originating from the pulmonary vein cuff anastomosis in a lung transplantation patient: Ultra-high-density 3-dimensional mapping

Jae-Sun Uhm, MD, PhD,* Moo Suk Park, MD, PhD,† Boyoung Joung, MD, PhD,* Hui-Nam Pak, MD, PhD, FHRS,* Hyo Chae Paik, MD, PhD,‡ Moon-Hyoung Lee, MD, PhD*

*From the *Division of Cardiology, Severance Hospital, Yonsei University College of Medicine, Seoul, South Korea, †Division of Pulmonology, Severance Hospital, Yonsei University College of Medicine, Seoul, South Korea, and ‡Department of Thoracic and Cardiovascular Surgery, Severance Hospital, Yonsei University College of Medicine, Seoul, South Korea.*

Introduction

In patients who underwent lung transplantation, the cuffs of the pulmonary veins originate from the donor, and therefore, anastomosis lines develop around the pulmonary veins in the left atrium (LA) of lung transplantation recipients.[1] These anastomosis lines have the potential to be an arrhythmogenic substrate.[2] We describe a case wherein ultra-high-density 3-dimensional (3-D) mapping and radiofrequency catheter ablation (RFCA) were used to treat intra-atrial reentrant tachycardia originating from the anastomosis around the pulmonary vein cuff in a bilateral lung transplantation recipient.

Case report

A 62-year-old man visited the outpatient clinic for palpitations. He underwent bilateral lung transplantation for idiopathic pulmonary fibrosis 10 months prior. Electrocardiography revealed atrial tachycardia (AT) (Figure 1). AT and his symptoms persisted despite medical therapy. We performed an electrophysiological study and used a 3-D electroanatomical mapping system (Rhythmia, Boston Scientific, Marlborough, MA) and an Orion catheter (Boston Scientific). AT was sustained and the tachycardia cycle length was 271 ms. After transseptal puncture, pulmonary venography (Figure 2A) and 3-D ultra-high-density mapping were performed. Prolonged high-frequency fragmented signals between the A-A activities were observed along the ridge between the left atrial appendage and left pulmonary veins, which corresponded to the anastomosis line (Figure 2B and C). Three-D activation and propagation maps revealed figure-of-eight intra-atrial macroreentrant tachycardia around the ridge (Figure 3A, Supplementary Video). The slow conduction zone was located in the ridge, which corresponded to the area of the prolonged high-frequency fragmented signals. A voltage map during AT revealed that the low (≤0.5 mV) and borderline (0.5–1.5 mV) voltage zones corresponded to the anastomosis lines (Figure 3B). Linear ablation was

KEY TEACHING POINTS

- Lung transplantation recipients have anastomosis lines around the right and left pulmonary veins in the left atrium.
- The anastomosis lines between the donor's pulmonary vein cuffs and the recipient's left atrium can be an arrhythmogenic substrate.
- An ultra-high-density mapping system is useful for visualizing the critical isthmus of the tachycardia circuit involving the anastomosis lines.

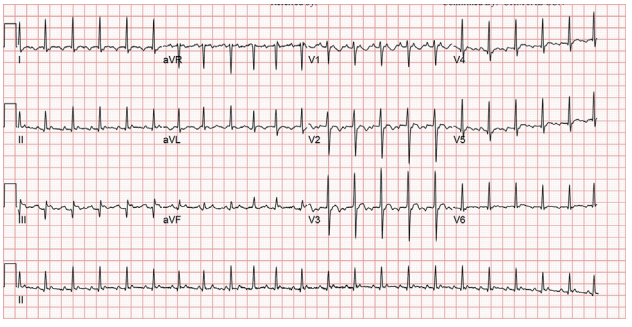

Figure 1 Electrocardiography at the outpatient clinic.

KEYWORDS Atrial tachycardia; Intra-atrial reentrant tachycardia; Lung transplantation; Orion catheter; Rhythmia system; Three-dimensional electroanatomical mapping; Ultra-high-density mapping
(Heart Rhythm Case Reports 2018;4:152–154)

Address reprint requests and correspondence: Dr Moon-Hyoung Lee, Division of Cardiology, Severance Cardiovascular Hospital, Yonsei University College of Medicine, 50-1 Yonsei-ro Seodaemun-gu, Seoul 03722, Korea. E-mail address: mhlee@yuhs.ac.

https://doi.org/10.1016/j.hrcr.2018.01.009

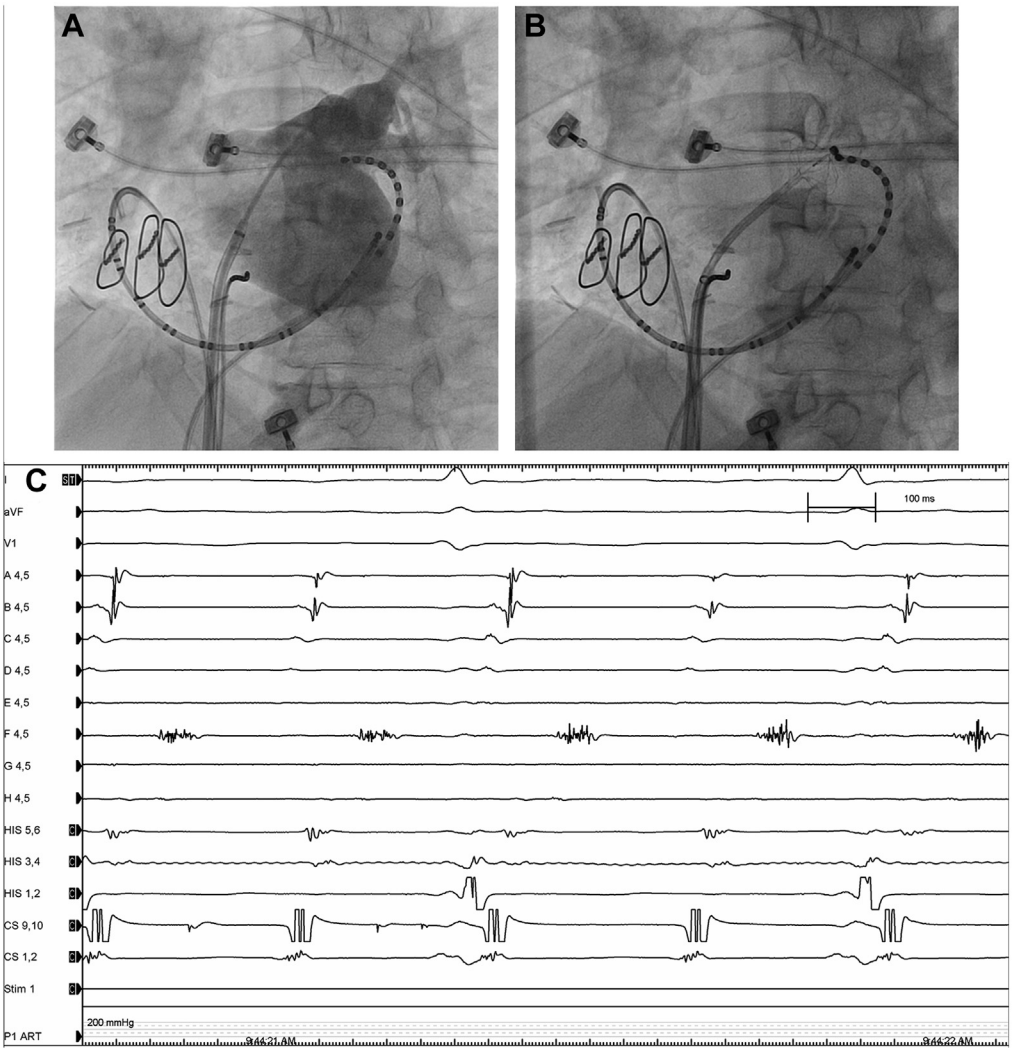

Figure 2 **A:** Left pulmonary venography. **B:** The position of the Orion catheter during the mid-diastolic prolonged fragmented electrogram. **C:** The mid-diastolic prolonged fragmented electrogram recorded with the Orion catheter during atrial tachycardia. The electrograms in A4,5 to H4,5 were recorded from the Orion catheter.

performed along the ridge (Figure 3A). After RFCA, we confirmed that there were no electric signals along the ablation line. AT was not induced by incremental and ramp pacing. Electrical reconnections were observed in the 4 pulmonary veins. AT did not recur in the 6 months following RFCA.

Discussion

As a result of bilateral lung transplantation, anastomosis lines form around the right and left pulmonary veins in the LA of the recipient. The anastomosis lines can have both arrhythmogenic and antiarrhythmogenic effects. In bilateral lung transplantation recipients, the LA is similar to that in patients who underwent the cut-and-sew Cox-maze procedure. Therefore, the long-term prevalence of paroxysmal atrial fibrillation is lower in bilateral lung transplantation recipients than in patients who undergo other thoracic surgeries.[3,4] However, cases of atrial tachyarrhythmias related to anastomosis lines have been reported.[5,6] It can be because inflammatory processes and heterogeneity in conduction properties exist along the anastomosis lines. Furthermore, electrical reconnection of the pulmonary veins was observed in a considerable number of patients who underwent lung transplantation.[7] Several studies have reported prolonged fractionated potentials recorded on the anastomosis lines, as observed in the present case.[2,6] In the present case, the conduction of electrical impulses along the anastomosis line was very slow. As a result, the anastomosis line worked as the critical isthmus of the reentry circuit. A high-density 3-D mapping system was useful for visualization of the critical isthmus in detail.

Conclusion

The anastomosis lines in the LA of lung transplantation recipients can be an arrhythmogenic substrate. An ultra-high-density mapping system is useful for visualization of the

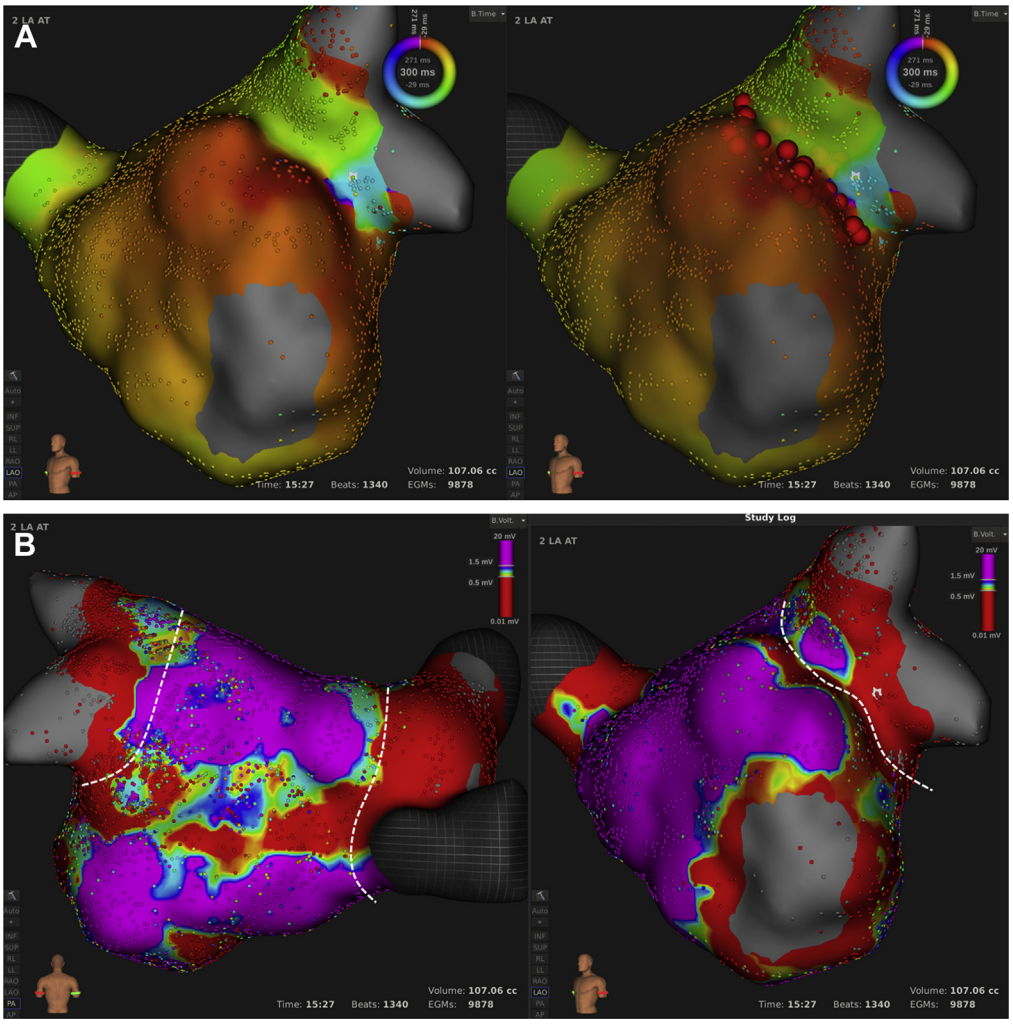

Figure 3 **A:** Ultra-high-density 3-dimensional activation map of the tachycardia shows figure-of-eight intra-atrial reentrant tachycardia with the slow conduction zone at the anastomosis line between the left atrial appendage and the left pulmonary veins. Radiofrequency catheter ablation was performed along the ridge between the left atrial appendage and the left pulmonary veins. The red-filled circles indicate ablation lesions. **B:** Ultra-high-density 3-dimensional voltage map during tachycardia shows the low and borderline voltage along the anastomosis lines (*dotted lines*).

critical isthmus of the tachycardia circuit involving the anastomosis lines.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hrcr.2018.01.009.

References

1. Hayanga JW, D'Cunha J. The surgical technique of bilateral sequential lung transplantation. J Thorac Dis 2014;6:1063–1069.
2. Chaikriangkrai K, Jyothula S, Jhun HY, Chang SM, Graviss EA, Shuraih M, Rami TG, Dave AS, Valderrabano M. Incidence, risk factors, prognosis, and electrophysiological mechanisms of atrial arrhythmias after lung transplantation. JACC Clin Electrophysiol 2015;1:296–305.
3. Lee G, Wu H, Kalman JM, Esmore D, Williams T, Snell G, Kistler PM. Atrial fibrillation following lung transplantation: double but not single lung transplant is associated with long-term freedom from paroxysmal atrial fibrillation. Eur Heart J 2010;31:2774–2782.
4. See VY, Roberts-Thomson KC, Stevenson WG, Camp PC, Koplan BA. Atrial arrhythmias after lung transplantation: epidemiology, mechanisms at electrophysiology study, and outcomes. Circ Arrhythm Electrophysiol 2009;2:504–510.
5. Nazmul M, Munger TM, Powell BD. Atrial tachycardia originating from a donor pulmonary vein in a lung transplant recipient. Circulation 2011;124:1288–1289.
6. Sanam K, Holmes D, Shah D, Foster N. Late atrial tachycardia originating from donor pulmonary vein in a double lung transplant recipient. HeartRhythm Case Rep 2015;1:490–493.
7. Hussein AA, Panchabhai TS, Budev MM, Tarakji K, Barakat AF, Saliba W, Lindsay B, Wazni OM. Atrial fibrillation and pulmonary vein electrical conduction recovery after full surgical resection and anastomosis of the pulmonary veins; insight from follow-up and ablation procedures in lung transplant recipients. JACC Clin Electrophysiol 2017;3:559–567.