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Rapid firing

The inferior displacement of the His bundle and fast pathway in a patient with common type atrioventricular nodal tachycardia: Three-dimensional computed tomography analysis

Kunihiko Kiuchi, MD, FHRS[a,*], Koji Fukuzawa, MD[a], Mori Shumpei, MD[b], Tatsuya Nishii, MD[c]

[a] Section of Arrhythmia, Division of Cardiovascular Medicine, Department of Internal Medicine, Kobe University Graduate School of Medicine, 7-5-2 Kusunoki-chou chuou-ku, Kobe, Hyogo, Japan
[b] Division of Cardiovascular Medicine, Department of Internal Medicine, Kobe University Graduate School of Medicine, 7-5-2 Kusunoki-chou chuou-ku, Kobe, Hyogo, Japan
[c] Department of Radiology, Kobe University Graduate School of Medicine, 7-5-2 Kusunoki-chou chuou-ku, Kobe, Hyogo, Japan

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ABSTRACT

A 66-year-old woman with palpitations was referred to our center for catheter ablation due to drug-refractory, common type atrioventricular nodal tachycardia (AVNRT). A selective slow pathway ablation was attempted. A fast junctional rhythm with transient ventriculoatrial block followed by transient prolongation of the A–H interval occurred immediately after the radiofrequency (RF) application at the coronary sinus ostium (CSOS) level. To assess the location of the fast pathway and His bundle, we sought to visualize the anatomy of the triangle of Koch (TOK) by three-dimensional computed tomography (CT).

1. Discussion

The minimum His potential could be recorded near a site at the CSOS level (Fig. 1A, 3D yellow tags). The distance between the maximum and minimum His recording sites was measured as 21 mm. The distance between the minimum His recording site and ablation site was only 6 mm. Furthermore, the NavX system could demonstrate the activation map of the His potential and an St-H interval map of the TOK (Fig. 1). The St-H interval was shorter in the middle portion of the TOK than in the superior portion (56 ms vs. 96 ms). The His potential at the inferior portion of the CSOS preceded that at the apex of the TOK by 15 ms. This indicated that the His bundle as well as the fast pathway could be dislocated. The 3D blue tag indicates the successful ablation site without ventriculoatrial block, which was close to those with ventriculoatrial block (Fig. 1A). Compared to the unsuccessful ablation sites with and without VA block, the successful ablation site was located at a ventricular site (Fig. 1A, bottom panel).

To avoid injury to the fast pathway, the exact location of the His bundle and fast pathway should be confirmed. Tanaka et al. reported that the dislocated fast pathway was frequently and uniformly observed among various forms of AVNRT, and was probably caused by inferior displacement of the His bundle [1]. Notably, no dislocated fast pathway at the CS roof level has been documented in patients with common AVNRT [2]. We previously reported that the fast pathway was inferiorly dislocated by >10 mm toward the His bundle in one-third of patients with AVNRT and appeared to be positioned deep at atrial sites. In the majority of patients with a dislocated fast pathway, the distance between the maximum and minimum His recording sites is <20 mm [3]. Considering the close electrical vicinity to the His recording site, the initial RF ablation application at the slow pathway should have been performed at a more ventricular annular site in the current case.

To determine the mechanism of the inferiorly dislocated His bundle and fast pathway, we investigated the anatomy of the TOK using a workstation (Ziostation ver. 2.1.7.1., Ziosoft Inc., Tokyo, Japan). Fig. 2 shows the true anatomy of the TOK and surrounding organs. In the current case, the TOK was likely to have been compressed by the aortic root and dilated CSOS. The distance between the proximal His-bundle area and CSOS was reported to be negatively correlated with patient age [4]. An elongation of the aorta is considered an age-associated change [5]. Particularly, aortic elongation could cause an inferior displacement of the His bundle and fast pathways. These findings strongly indicate that the slow pathway could be located close to the fast pathway in

* Corresponding author. Fax: +81 78 382 5859.
E-mail address: kunihikokiuchi@yahoo.co.jp (K. Kiuchi).

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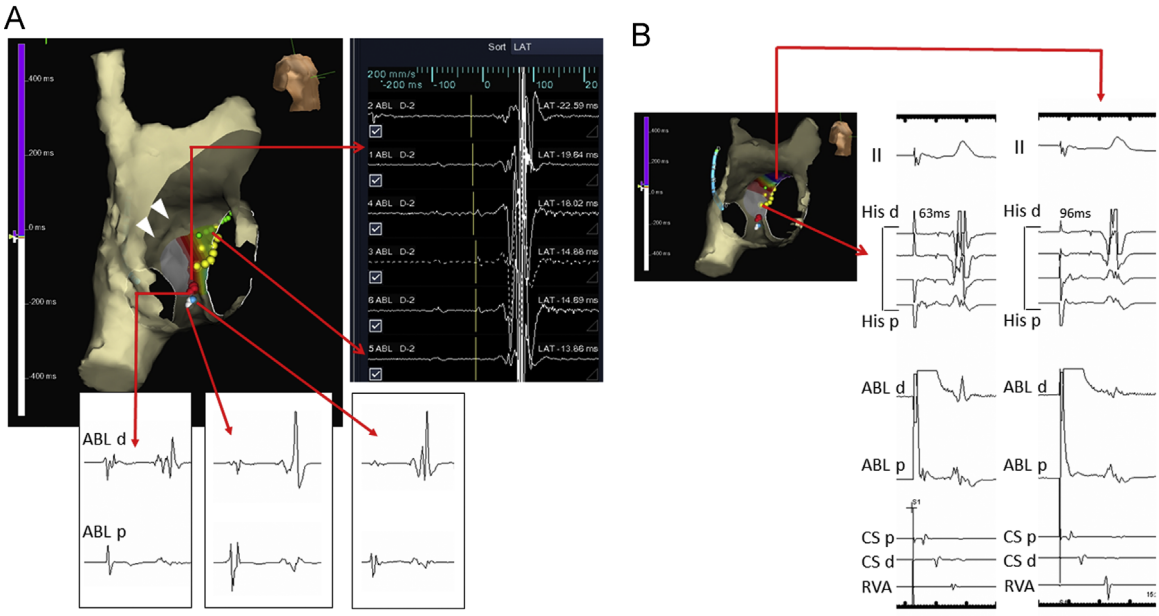

Fig. 1. A: Activation map of the His potential in the TOK using the NavX system. The His potential is annotated at each site (the right panel). The endoscopic view in the RAO direction. The white arrowheads indicate the tendon of Todaro. The small 3D green tags indicate the His potential recording sites, which were recorded by the His catheter. The small yellow tag indicates the maximum His potential recording site. The normal 3D yellow tags indicate the dislocated His potential recording sites, which were recorded by the ablation catheter. The 3D red and white tags indicate the unsuccessful ablation sites with or without ventriculoatrial block, respectively. The 3D blue tag indicates the successful ablation site. NavX demonstrated the activation of the His potential. The successful ablation site was located at a ventricular site, where a small atrial electrogram was recorded (the bottom panel). B: St-His interval map of the TOK using the NavX system. The St-His interval at the middle portion of the superior portion of the TOK were 56 ms and 96 ms, respectively.

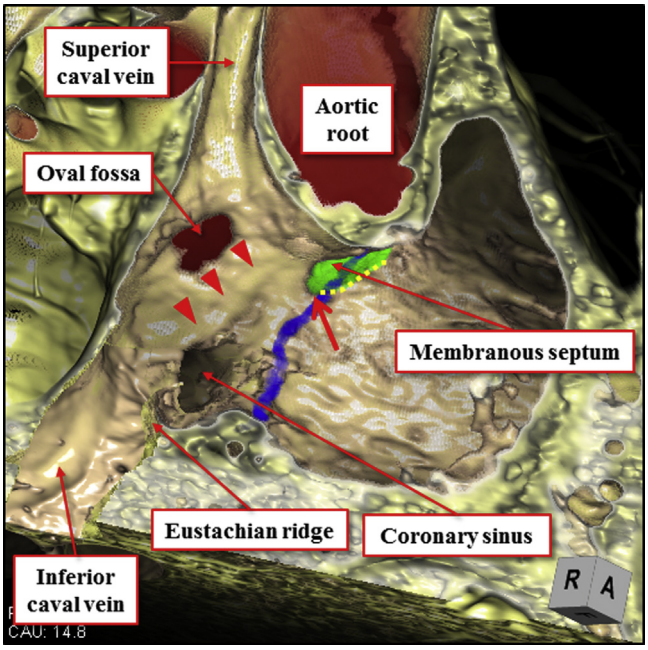

Fig. 2. The three-dimensional reconstructed true anatomy of the TOK and surrounding organs. The red arrowheads indicate the tendon of Todaro. The green object indicates the membranous septum. The red arrow indicates the atrioventricular node in the majority of patients. The dotted yellow line indicates the bottom of the membranous septum. TOK = triangle of Koch, CSOS = coronary sinus ostium.

elderly patients. We recommend an anatomical assessment by CT in more elderly patients with a rotated or compressed heart indicated by the chest Xp or echocardiography. Although a 3D mapping system was not always necessary for the slow pathway ablation, the 3D mapping system allowed us to recognize the following landmarks: the maximal His potential recording site, CSOS, and most ventricular site along the tricuspid annulus and the precise location of the fast pathway, which could result in avoiding any unexpected atrioventricular block.

This case highlighted the relationship between the displacement of the His bundle and true anatomy of the TOK and surrounding organs. To avoid any unexpected fast pathway injury, visualization of the His potential recording sites and a detailed anatomical assessment of the TOK and surrounding organs could be useful.

Disclosures

None.

Conflict of interest

All authors declare no conflict of interest related to this study.

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