Stored Intracardiac Electrograms Reveal Patients With Sick Sinus Syndrome Frequently Develop Atrioventricular Block

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Sick sinus syndrome (SSS) is common but poorly understood and the only treatment is implantation of a pacemaker.^{1,2} In patients with SSS, AAI pacing mode has been recommended as a physiological pacemaker system. However, retrospective analysis has shown that some patients with SSS develop high-grade atrioventricular block (AVB) and need a pacemaker mode change from AAI to ventricular or dual-chamber pacing.^{3–6} Therefore, in the 1980s dual-chamber pacing instead of a single chamber atrial pacing (AAI) was recommended in patients with SSS. Brandt et al reported high-grade AVB occurred in 8.5% (1.8% per year) and its incidence was greater in patients with complete bundle-branch block or bifascicular block than in patients without such disturbances (35% vs. 6%),⁷ suggesting increased risk of subsequent AVB.

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On the other hand, Rosenqvist and Obel reviewed data from 28 studies, showing that a median annual incidence of high-grade AVB was 0.6% among patients with atrial pacing for SSS.⁸ Andersen et al⁹ performed a prospective study to evaluate the AV conduction and the risk of developing AVB during long-term follow-up (mean 5.5 ± 2.4 years) of patients with SSS. There was no change in AV conduction and only a few patients developed high-grade AVB (0.6% per year). However, the presence of bundle-branch block was associated with such a risk. Those results indicated that patients with SSS have a low risk of developing high-grade AVB (0.6–1.8% per year) and dual-chamber pacing was recommended as the primary choice especially for patients with complete bundle-branch block or bifascicular block at the time of implantation.

In the previous studies, the incidents of AVB included asymptomatic episodes detected on a few Holter ECG recordings or only symptomatic episodes such as dizziness or syncope. Therefore, the real number of AVB episodes during the entire follow-up period in the patients with SSS has not been evaluated. In recent years, new pacing modes have been developed, SafeR™ (SORIN Group CRM SAS, Clamart, France) or managed ventricular pacing (MVP; Medtronic, Minneapolis, MN, USA), which were designed to combine the advantages of AAI with the safety of DDD mode.^{10,11} These pacing modes decrease the frequency of ventricular pacing compared with DDD mode. SafeR mode can automatically detect and store the intracardiac electrograms (EGM) of AVB episodes during the entire follow-up period.

Figure. Photomicrograph of an atrophic atrioventricular (AV) node with marked fatty infiltration (elastica van Gieson, $\times 6.6$). This patient had a Wenckebach-type 2nd degree AV block (3:1–4:1 AV block) above the His bundle induced by atrial pacing at 90 beats/min. CFB, central fibrous body; IAS, interatrial septum; N, AV node; RA, right atrium. (Reproduced with permission from Chida K, et al.¹⁴)

In this issue of the Journal, Hosoda et al¹² analyze AVB episodes based on the stored EGM in a cardiovascular implantable electronic device mounting the SafeR mode, and determine the occurrence rate and risk factors for advanced AVB in patients with SSS. In their study, the mean percentage of ven-

The opinions expressed in this article are not necessarily those of the editors or of the Japanese Circulation Society.

Received April 20, 2015; accepted April 20, 2015; released online May 1, 2015

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ISSN-1346-9843 doi:10.1253/circj.CJ-15-0446

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tricular pacing was only $2.5 \pm 8.1\%$, which was low enough to detect most of the AVB events. The stored EMGs were carefully reviewed by physicians and 73 of 377 EGMs (19.4%) were determined as advanced AVB episodes. Advanced AVB occurred in 9 of 50 patients (18%), and the occurrence rate of advanced AVB was 11.7% per year, which was much higher than in previous studies (0.6–1.8% per year). In addition, multivariate analysis revealed that β -blocker use was an independent risk factor for advanced AVB. However, the occurrence rate of advanced AVB in patients without β -blockers was 7.8% per year, which was also higher than in previous reports. Thus, the authors conclude that patients with SSS have an increased risk of advanced AVB irrespective of β -blocker treatment, and suggest the use of a dual-chamber pacemaker rather than a single-chamber atrial pacemaker. Although bundle-branch block and the Wenckebach block rate were not associated with advanced AVB in their analysis, previous reports suggested that the presence of bundle-branch block or lower Wenckebach block rate (<120 beats/min) were high risks of the development of AVB.^{7,9}

Previous histological examination revealed widespread fibrosis in the AV conduction system of patients with SSS.¹³ Chida et al¹⁴ studied the histopathological findings of the AV conduction system in 14 elderly patients treated with pacemakers for SSS. The patients who had a Wenckebach block point <130 beats/min showed excessive fatty infiltration around the atrionodal junction area and into the atrophic AV node (Figure). Most of the remaining cases also had an atrophic AVN. The results from Hosoda et al¹² agree with histopathological studies that suggested sinus node dysfunction is often the clinically apparent manifestation of a widespread degenerative process in the cardiac conduction system.

In conclusion, it is important to be reminded of an increased risk of high-grade AVB in patients with SSS, especially the elderly or β -blocker users.

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