JACC: CLINICAL ELECTROPHYSIOLOGY
VOL. ■, NO. ■, 2017

ISSN 2405-500X/$36.00
PUBLISHED BY ELSEVIER
http://dx.doi.org/10.1016/j.jacep.2017.01.022

Atrial Ganglionated Plexus Modification

A Novel Approach to Treat Symptomatic Sinus Bradycardia

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ABSTRACT

OBJECTIVES This study sought to determine if anatomic atrial ganglionated plexus (GP) ablation leads to long-term sinus rate (SR) increase and improves quality of life in patients with symptomatic sinus bradycardia (SB).

BACKGROUND Atrial GP ablation has been demonstrated to increase SR in our previous study. Atrial GP ablation may also be effective in treating patients with symptomatic SB.

METHODS Sixty-two patients with symptomatic SB were recruited: Group A included patients <50 years of age (n = 40); Group B included patients ≥50 years of age (n = 22). All patients underwent anatomic ablation of the main atrial GP, and 24-h Holter monitoring and quality-of-life assessment were performed during 1 year of follow-up. Quality of life was accessed by the Medical Outcomes Study Short-Form 36 Health Survey.

RESULTS Although SR markedly increased in all patients after GP ablation, the increase was significantly greater in patients <50 years of age than in patients ≥50 years of age (19.3 ± 9.9 beats/min vs. 10.8 ± 5.4 beats/min; p = 0.001). The right anterior GP and the GP at the junction of the aorta and superior vena cava made the greatest contributions to SR increase among all GP. The mean and minimal SR increased significantly after ablation and remained elevated for 12 months only in Group A patients. Although symptoms and quality of life improved in all patients, 5 of the 8 domains of the Medical Outcomes Study Short-Form 36 Health Survey did not show obvious improvements in patients of Group B at 12 months.

CONCLUSIONS Anatomic atrial GP ablation effectively increased SR and improved quality of life in patients <50 years of age with symptomatic SB. (J Am Coll Cardiol EP 2017;■:■–■) © 2017 by the American College of Cardiology Foundation.

Sinus bradycardia (SB) is a common clinical problem and serves as a potential risk of cardiovascular events. Although both European and American guidelines recommend cardiac pacing for severely symptomatic SB patients (1,2), younger patients may have to undergo multiple generator exchanges as well as lead revision, extraction, or replacement, exposing them to potential serious complications such as infection. Unfortunately, the mechanism underlying symptomatic SB in younger patients remains unclear. Our preliminary study showed that atrial ganglionated plexus (GP) ablation significantly increased sinus rate (SR) and improved symptoms in 11 patients (mean age 45.9 yrs) with symptomatic SB (3), suggesting that abnormal autonomic activity may play a role in the genesis of symptomatic SB. Thus, ablation of the major atrial GP potentially may serve as an alternative approach to treat patients with symptomatic SB. This prospective study therefore investigated the long-term effects (12 months) of autonomic denervation by ablation of the major atrial GP in patients with symptomatic SB.

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This research was supported by National Natural Science Foundation of China Grants (Grant No: 81400246) and China Postdoctoral Science Foundation Grant (Grant No: 2015M571570). The funder has designed this study and decided to publish this manuscript. The authors have reported that they have no relationships relevant to the contents of this paper to disclose. Drs. Qin and Zhang contributed equally to this work.

Manuscript received August 26, 2016; revised manuscript received January 2, 2017, accepted January 12, 2017.

ABBREVIATIONS AND ACRONYMS

Ao-SVC = aorta-superior vena cava

ANS = autonomic nervous system

GP = ganglionated plexus

HFS = high-frequency stimulation

HR = heart rate

HRV = heart rate variability

LIGP = left inferior ganglionated plexus

LSGP = left superior ganglionated plexus

PVI = pulmonary vein ablation

RAGP = right superior ganglionated plexus

RIGP = right inferior ganglionic plexus

SB = sinus bradycardia

METHODS

This study protocol was approved by the Institutional Ethics Committee at the Shanghai Chest Hospital and was conducted in compliance with the protocol and in accordance with standard institutional operating procedures. Patients who met all the inclusion criteria and were willing to participate were enrolled after providing written informed consent.

STUDY PATIENTS. Sixty-two consecutive patients with symptomatic SB (dizziness, fatigue, and palpitation) at Shanghai Chest Hospital Affiliated to Shanghai Jiaotong University were prospectively enrolled. Patients were excluded if they had structural heart disease, with any atrial or ventricular arrhythmia, drug-induced SB, sinus pause >2.0 s, positive atropine test, corrected sinus node recovery time (cSNRT) >525 ms, or a history of ablation procedures to treat atrial tachyarrhythmias. A positive atropine test was defined as SR <90 beats/min within 20 min, junctional rhythm, or sinus pause after intravenous administration of 0.03 mg/kg atropine. Therefore, the study population included only patients with symptomatic SB who did not meet the criteria for pacemaker implantation. Because the incidence of sick sinus syndrome has been reported to be about 3-fold higher in subjects 55 to 64 years of age (0.10% to 0.37%) than in those 45 to 54 yrs of age (0.06% to 0.12%) (4), sick sinus syndrome and other pathological conductive disorders are associated with increasing age and ablation would be ineffective for these patients. Furthermore, GP ablation showed greater effects in patients <50 years of age than in older patients in our previous study (3). Based on these observations, patients with class I indications for a pacemaker were strictly excluded. Group A (patients <50 yrs of age) and Group B (patients >50 yrs of age) were pre-specified in this study. All patients provided written informed consent for the electrophysiological study and ablation.

ELECTROPHYSIOLOGICAL STUDY AND ABLATION PROCEDURE. Specific anatomic ablation of the 4 major left atrial GP and aorta-superior vena cava (Ao-SVC) GP was performed as described (3). Briefly, catheter ablation was performed under the guidance of an electroanatomic mapping system (CARTO, Biosense Webster, Diamond Bar, California). After completed the electroanatomic mapping of the left atrium was complete and pulmonary vein (PV) ostia identified, presumed GP clusters were ablated 1 to 2 cm outside the PV-left atrium junctions at the following sites: the left superolateral area (left superior GP [LSGP]), the left inferoposterior area (left inferior GP [LIGP]), the right superoanterior area (right anterior GP [RAGP]), the right inferoposterior area (right inferior GP [RIGP]), and the Ao-SVC fat pad (Ao-SVC GP), and in that sequence (**Figure 1**) (3,5,6).

Radiofrequency (RF) power output was up to 40 W, at 43°C, with 20- to 30-s duration for each lesion and saline infusion rate of 20 to 25 ml/min. The endpoint was ablation of atrial electrical activity (peak-to-peak bipolar electrogram <0.1 mV), or elimination of vagal response at the sites where vagal responses were elicited by RF applications. A positive vagal response was defined as a >20% decrease in heart rate (HR) during SR or atrioventricular conduction block.

FOLLOW-UP. After the ablation procedure, patients were hospitalized for at least 3 days, with cardiac rhythm continuously monitored for the first 48 h. Outpatient visits and 24-h Holter monitoring were scheduled at 3, 6, and 12 months and every 6 months thereafter. The mean HR and HR variability (HRV) were analyzed by 24-h Holter monitoring before the procedure and 1 week and 3, 6 and 12 months after ablation. Autonomic modulation was assessed by frequency-domain HRV analysis with commercially available software (MemCalc/CHIRAM, GMS, Tokyo, Japan). Frequency-domain analysis was performed by a fast Fourier transformation of the NN intervals. The low frequency (LF) (range 0.04 to 0.15 Hz), high frequency (HF) (range 0.15 to 0.40 Hz), and LF-HF ratio were calculated by frequency-domain analysis.

The Medical Outcomes Study Short-Form 36 Health Survey (SF-36) was used to assess quality of life (QoL) at baseline and 12 months after ablation (7). The self-administration mode was strictly followed for QoL surveys. The SF-36 assesses 8 specific QoL domains, namely physical functioning, role limitations due to physical health, bodily pain, general health, vitality, social functioning, role limitations due to emotional problem, and mental health. For each subscale, scores were transformed to a scale ranging from 0 to 100, with lower scores representing a lower QoL.

Each patient subjectively assessed his or her SB-related symptom, including dizziness, fatigue, and palpitation, on a score of 1 to 10 points (mild to severe). The total SB-related symptom score for each patient was calculated as the sum of all scores for individual symptoms.