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Clinical and Electrophysiologic Characteristics Before and After Radiofrequency Ablation of Sustained Slow Atrioventricular Nodal Pathway Conduction

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ABSTRACT

OBJECTIVES This study examined the clinical and electrocardiographic characteristics and electrophysiologic determinants of sustained slow pathway conduction (SSPC) during sinus rhythm.

BACKGROUND SSPC during sinus rhythm in presence of dual atrioventricular (AV) nodal pathways has not been thoroughly studied.

METHODS We studied 30 consecutive patients (19 men), whose median age was 31 years (interquartile range: 22 to 48 years); their electrocardiograms revealed 2 different PR intervals during nearly identical sinus rates. We measured the short and long PR intervals and their differences and examined the electrophysiologic determinants of SSPC during slow pathway (SP) ablation in 12 patients.

RESULTS Among the 30 patients, 21 (70%) complained of major symptoms. The short and long PR intervals measured 202 ± 42 ms and 472 ± 110 ms, respectively, and their mean difference measured 270 ± 101 ms. During electrophysiologic studies, dual AV nodal and SSPC were observed in all patients. A markedly prolonged refractory period (593 ± 116 ms) and retrograde conduction block over the fast pathway (FP) were observed over a range of sinus cycle lengths (CLs). Ablation of the SP in 11 patients promoted FP conduction and shortened its effective refractory period from 593 ± 116 ms to 288 ± 90 ms. Over a median follow-up of 2 years (interquartile range: 1 to 3 years), all patients remained asymptomatic and without recurrences of SSPC or AV block.

CONCLUSIONS Two distinct PR intervals during sinus rhythm indicated the presence of dual AV nodal pathways. SSPC was promoted by a markedly impaired bidirectional conduction over the FP at critical sinus CL. SP ablation safely and effectively eliminated SSPC in symptomatic patients. (J Am Coll Cardiol EP 2016;■:■–■)

Intermittent sustained slow pathway conduction (SSPC) during sinus rhythm on the surface electrocardiogram is rare (1). It has been typically observed during rapid atrial pacing in patients presenting with inducible atrioventricular (AV) nodal reentrant tachycardia (2–4), although the first intracardiac documentation of SSPC during sinus rhythm was recorded in a patient who presented with a paroxysmal non-reentrant supraventricular tachycardia (5). The present study describes the clinical

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ABBREVIATIONS AND ACRONYMS

AV = atrioventricular

CL = cycle length

ERP = effective refractory period

FP = fast pathway

SP = slow pathway

SSPC = sustained slow pathway conduction

VA = ventriculoatrial

manifestations and electrocardiographic observations recorded in 30 patients who presented with SSPC during sinus rhythm. We also studied the electrophysiologic determinants of SSPC during sinus rhythm and the effects of slow pathway (SP) ablation on fast pathway (FP) conduction in 12 symptomatic patients who underwent selective radiofrequency catheter ablation of the SP.

METHODS

Between 1998 and 2014, we studied 30 consecutive patients (19 men) whose median age was 31 years (interquartile range: 22 to 48 years) and who presented with short and long PR intervals during nearly identical sinus rates, in the absence of structural heart disease and cardioactive medication that influenced AV nodal conduction. All patients underwent detailed cardiac investigations, including history, physical examination, transthoracic echocardiography, 24-h ambulatory electrocardiogram, exercise treadmill testing, and, if needed, isoproterenol infusion test.

All authors had full access to the data, take responsibility for their integrity, and have read and approved this paper as written. Our institutional review board reviewed and approved the protocol of this study, which was conducted in accordance with institutional policies, national legal requirements, and the revised Declaration of Helsinki.

ELECTROCARDIOGRAPHIC OBSERVATIONS AND MEASUREMENTS. Stable, short and long PR intervals during sinus rhythm were initially documented by 12-lead electrocardiograms in 13 patients and by 24-h ambulatory electrocardiograms in 17 patients. The measurements included the short and long PR intervals, their difference (Δ), and their corresponding sinus rates after the long PR interval had remained stable for ≥30 s. The appearance and disappearance of the long PR interval on the 24-h ambulatory electrocardiogram were analyzed in 28 patients.

ELECTROPHYSIOLOGIC STUDIES AND CATHETER ABLATION. Electrophysiologic studies and radiofrequency catheter ablation of the SP were performed in 12 patients (40%) who complained of prominent symptoms and requested a curative procedure. The indications to proceed with ablation of the SP were firmly ascertained by an unequivocal correlation between the symptoms reported by the patients and the periodic and sudden prolongation of the PR interval, which was confirmed by 24-h ambulatory electrocardiographic monitoring or by remote telemonitoring.

The electrophysiologic studies were performed in the post-absorptive and nonsedated state after a signed informed consent was obtained from each patient. Quadripolar, 4-F electrode catheters (St. Jude Medical, St. Paul, Minnesota) were introduced percutaneously from the left femoral vein and positioned in the high right atrium, the His bundle region, and at the right ventricular apex. A 6-F decapolar electrode catheter (St. Jude Medical) was advanced from the left subclavian vein into the coronary sinus. Surface electrocardiographic leads I, aVF, and V_1, and all intracardiac electrograms were continuously recorded and stored on a computer-based digital amplifier/recorder (PrukaCardioLab IT System, GE Healthcare, Milwaukee, Wisconsin). Bipolar electrograms were recorded at a bandpass between 30 and 500 Hz. Stimuli, which were 2 ms in duration, were delivered at twice the end-diastolic threshold by a programmable digital stimulator (Bloom DTU 215, Fisher Medical Technologies, Denver, Colorado). Anterograde and retrograde AV nodal conduction was ascertained by incremental pacing and by the extrastimulation technique. The conduction properties and refractory periods, as defined previously (6), were measured, and AV nodal reentrant supraventricular tachycardia was diagnosed by standard criteria (7).

For the ablation procedures, a 7-F, large-tip, 4-mm long, deflectable, quadripolar electrode catheter, with 2-mm interelectrode distance (Bard Electrophysiology, Lowell, Massachusetts) was introduced percutaneously from the right femoral vein and advanced to the right atrium. Radiofrequency energy was delivered as a continuous, modulated, sinusoidal waveform at 500 kHz in unipolar mode, between the distal tip of the ablation catheter and a large, posterior skin patch electrode, using a radiofrequency energy generator (Stockert EP Shuttle, Stockert, Freiburg, Germany). The energy was delivered in steps to ablate the SP from the right posterior and inferior aspect of the interatrial septum (8). Radiofrequency energy was delivered at least twice at 50 W, for 50 s, with the temperature limited to 50°C during SSPC, if possible. An ablation attempt was classified as successful when SSPC or anterograde dual AV node conduction was eliminated.

LONG-TERM FOLLOW-UP. The 12 patients who underwent SP ablation were followed in our ambulatory department at 1 month after discharge and every 6 months thereafter. They were interviewed, and 12-lead and 24-h ambulatory electrocardiograms were