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Incidence of Pulmonary Vein Stenosis After Radiofrequency Catheter Ablation of Atrial Fibrillation

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ABSTRACT

OBJECTIVES The study aimed to determine incidence of pulmonary vein stenosis (PVS) and evaluate PVS-related symptoms.

BACKGROUND The real-life incidence of PVS after radiofrequency catheter ablation (RFCA) of atrial fibrillation (AF) is unknown.

METHODS All patients who underwent RFCA of AF from 2005 to 2016 with routine pre- and post-ablation screening by magnetic resonance imaging or computed tomography were included. Primary ablation strategy was PV antrum isolation alone in all patients. PVS, defined as a significant reduction in the superoinferior or anteroposterior PV diameter, was classified as mild (30% to 50%), moderate (50% to 70%), or severe (>70%).

RESULTS Sufficient quality imaging of the PV anatomy before ablation and during follow-up (mean 6 ± 4 months) was performed in 976 patients (76.4% men, 59.1% paroxysmal AF). Of these patients, 306 (31.4%) showed mild stenosis, 42 (4.3%) revealed moderate stenosis, and 7 (0.7%) had a severe stenosis in at least 1 PV. Incidence of PVS fluctuated over the past decade. All severe PVS cases were likely caused by ablations being performed inside the PVs. Only 1 (0.1%) patient reported PVS-related symptoms of severe dyspnea during follow-up. Computed tomography revealed a subtotal occlusion of the left inferior PV and a severe stenosis of the left superior PV, requiring stenting.

CONCLUSIONS Although mild PVS was frequently observed after RFCA in this large cohort, incidence of severe PVS was <1% and incidence of symptomatic PVS necessitating intervention was negligible. Based on these findings, it seems appropriate to only screen for PVS in patients with suggestive symptoms. (J Am Coll Cardiol EP 2017;■:■–■) © 2017 by the American College of Cardiology Foundation.

Pulmonary vein stenosis (PVS) is a well-known complication of radiofrequency catheter ablation (RFCA) of atrial fibrillation (AF). It is defined as a reduction of a PV diameter and is likely caused by a vascular response to RF energy application leading to replacement of necrotic myocardium by collagen (1,2). The clinical presentation of PVS, normally appearing 3 to 6 months after RFCA, varies from asymptomatic in the majority of patients to occasional symptoms of severe dyspnea, cough, chest pain, and hemoptysis (3,4). During follow-up, PVS can be detected by computed tomography (CT), magnetic resonance imaging (MRI), or transoesophageal echocardiography (TEE) (5–8). Treatment of severe PVS depends on the symptoms, and varies from no treatment to balloon dilatation or stenting (3). If such interventions fail, severe PVS may even necessitate lobectomy (9).

Although PVS is a feared complication, it is not clearly defined and its true incidence remains unknown (10). Among the studies of AF ablations reviewed for the 2012 expert consensus statement,

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ABBREVIATIONS AND ACRONYMS

AF = atrial fibrillation

AP = anteroposterior

CTA = computed tomography angiography

LA = left atrium

LAA = left atrial appendage

MRI = magnetic resonance imaging

PV = pulmonary vein

PVAI = pulmonary vein antrum isolation

PVS = pulmonary vein stenosis

RFCA = radiofrequency catheter ablation

SI = superoinferior

TEE = transoesophageal echocardiography

PVS was reported in <10% of studies (1). In studies that did report PVS, various imaging modalities and definitions for PVS were used and the reported incidence varied widely. Incidence up to 42% was shown in an earlier study (11). In contrast, incidence of only 0.5% was reported in a large systematic review on complications of RFCA (12). Yet, many of the studies included in this review only screened for PVS in case of symptoms suspected to be related to PVS. Because moderate and even severe PVS can remain asymptomatic (3), true incidence is likely to be underestimated (10).

In this study we report a large single-center cohort of patients who were routinely screened for PVS after RFCA of AF. Goals of this study were to determine incidence of PVS and assess PVS-related symptoms. Changes in incidence of PVS over the past decade were analyzed.

METHODS

PATIENT POPULATION. This study was approved by the local ethics committee. All consecutive patients with symptomatic, drug-refractory, or drug-intolerant AF who underwent first PV antrum isolation (PVAI) in the University Medical Center Utrecht over an 11-year period from January 2005 to January 2016 were analyzed. As part of standard clinical care, all patients routinely underwent pre-ablation imaging of the left atrium (LA) and PV anatomy and post-ablation imaging mostly after 4 to 6 months (range 3 to 12 months) to screen for PVS. The main reason for this wide range is that if a redo ablation procedure was scheduled, post-ablation imaging was performed prior to this procedure.

Patients who did not undergo imaging of the PV anatomy before or after ablation (e.g., due to claustrophobia or refusal of the control scan) or those in whom PV diameters could not be accurately measured due to insufficient scan quality were excluded. Baseline patient characteristics were prospectively collected and comprised sex, age, AF type, history of AF (years since AF was diagnosed), cardiovascular risk factors, structural heart disease, CHA_2DS_2-VASc (congestive heart failure, hypertension, age ≥75 years, diabetes mellitus, prior stroke or transient ischemic attack or thromboembolism, vascular disease, age 65 to 74 years, sex category) score, and LA size measured on echocardiography.

IMAGING PROTOCOLS BEFORE ABLATION AND DURING FOLLOW-UP. From 2005 to 2011, patients underwent gadolinium-enhanced MRI of the heart ≤6 months before and around 6 months after PVAI. Our MRI protocol has been described previously (13). In short, a 1.5-T MRI system (Philips Healthcare, Best, the Netherlands) was used to obtain a MR angiogram with single breath-hold 3-dimensional fast spoiled gradient echo imaging in coronal view. Scan parameters were as follows: repetition time = 4 ms, echo time = 1 ms, radiofrequency flip angle 35°, field of view 400 mm, matrix size 272 × 173, slice thickness 3 mm, and gap + slice 1.5 mm. As MRI could be planned up to 1 month before PVAI, all these patients underwent TEE just prior to the procedure to rule out LA and LA appendage (LAA) thrombus.

From 2011 onward, an electrocardiography-gated cardiac CT angiography (CTA) was performed ≤7 days prior to and around 6 months after ablation. Our CTA protocol has been described before (14,15). In short, CTA was performed using a 256-slice CT system (Philips Healthcare). The scan parameters were as follows: collimation 128 × 0.625 mm, tube voltage 80 to 120 kV, tube current 195 to 210 mAs, rotation time 0.27 s. Images were reconstructed with a slice thickness of 0.9 mm and a reconstruction increment of 0.45 mm. TEE was only performed if LA or LAA thrombus could not be ruled out by CT. In the transition period of MRI to CT imaging follow-up imaging was performed with the same imaging modality as the initial scan.

PV ANATOMY AND DIAMETERS. Source images were transferred to a commercially available workstation (Vitrea 2, Vital images or Intellispace, Philips Healthcare) for 3-dimensional reconstructed images of the LA, LAA, and PVs and measurement of PV diameters. The number and anatomy of PVs and presence of common trunks were assessed in all patients. A common trunk was defined as a superior and inferior PV that have joined before entering the LA. Both superoinferior (SI) and anteroposterior (AP) diameters were measured of the PVs at the level of the ostium and the common trunks (**Figure 1**). During follow-up, PV diameters were measured in the same views and on identical locations using the same software as in the initial scan.

CLASSIFICATION OF PVS. In the 2012 Heart Rhythm Society/European Heart Rhythm Association/European Cardiac Arrhythmia Society Expert Consensus Statement, PVS is defined as a reduction of a PV diameter and classified as mild (<50%), moderate (50% to 70%), and severe (>70% diameter reduction) (1). We classified mild stenosis as a reduction of 30% to 50% and moderate and severe stenosis according to the Consensus Statement.

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