

# Anatomical variation of pulmonary venous ostium and its relationship with atrial arrhythmia in the Saudi population



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**Purpose:** To assess the anatomical variation of the ostial pattern of pulmonary veins observed on coronary computed tomography (CT) angiogram and to estimate the relationship of atrial arrhythmia with similar ostial variants in the Saudi population.

**Materials and methods:** Thin-section (0.625 mm) contrast enhanced CT scans of 151 consecutive patients obtained over a span of a two-year period (January 2009–January 2011) for the diagnosis of ischemic heart disease, aortic regurgitation, infective endocarditis, aortic aneurysm, fibrosing mediastinitis, and pericardial defect. The retrospective study was focused on the identification of the number of venous ostia on either side of the left atrium and the drainage patterns of pulmonary veins. The frequency of each pattern was tabulated, and significance of their relationship with atrial arrhythmias was assessed with the  $\chi^2$  and Fisher's exact tests.

**Results:** Out of 151 patients analyzed, 26 patients (17.2%) had anatomical variation of the pulmonary venous ostia. Atrial arrhythmia was recorded in 16 of 26 (61.5%) patients ( $p = 0.000$ ). The association of higher anatomical variation of pulmonary venous ostia was recorded as higher ( $p = 0.034$ ) in the female group ( $n = 15$ , 57.7%).

**Conclusion:** The association between anatomically varied venous ostia and atrial arrhythmia was significant ( $p = 0.000$ ) with a significantly higher anatomical variation of pulmonary venous ostia in the female Saudi population ( $p = 0.034$ ).

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**Keywords:** Pulmonary venous ostium, Computed tomography, Atrial arrhythmia

## Introduction

Variation of pulmonary venous ostial anatomy is touted as one of the harbingers of atrial arrhythmogenic foci [1–4]. Radiofrequency ablation

is a well-accepted procedure for treating patients with atrial arrhythmia. Pre-procedure understanding of pulmonary venous anatomy and their relationship to the left atrial wall is of paramount importance for precise mapping and disconnection

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of these electrical stimuli. Despite popular belief in the rarity of anatomical variations of pulmonary venous ostial anatomy, several recent publications have highlighted the relationship of such a variability and a higher incidence of atrial arrhythmia. In a review of intracardiac echocardiographic guided radiofrequency ablation, Mangrum et al. reported a higher incidence of anatomical variation of pulmonary vein in 36% cases with an increased association of ectopic beats [5]. With the advent of high tech imaging such as magnetic resonance imaging (MRI) and multidetector computed tomography (MDCT), non-invasive diagnosis of the variation of pulmonary venous ostial anatomy is currently the preferred choice over invasive conventional angiography. This is due to the high resolution images of MRI and MDCT with relatively less or no use of contrast media.

MDCT has been used in several recent series for non-invasive evaluation of pulmonary venous anatomy with a higher degree of accuracy [6–8].

We retrospectively evaluated the incidence of variability of the anatomy of pulmonary venous ostium in a Saudi cohort referred for computed tomography angiography (CTA), and correlated the variability of the pulmonary vein ostial opening with the prevalence of atrial arrhythmia.

## Materials and methods

Between January 2009 and January 2011, 151 Saudi patients underwent coronary CTA with Toshiba Aquilion 64 Slice CT Scanner. The male:female ratio was 91:60 with a mean age of 50.1 ( $\pm 10.6$ ) years (Table 1). The majority of referred

Table 1. Total demography of 151 patients undergone coronary CT angiography.

Variable	n (%) or Mean (SD)
<i>Gender</i>	
Male	91(60.2%)
Female	60(39.7%)
Age	50.1 ( $\pm 10.6$ )
<i>Number of pulmonary veins in right</i>	
Two	130 (86.0%)
Three	21 (13.9%)
<i>Number of pulmonary veins in left</i>	
One	2 (1.3%)
Two	145 (96.0%)
Three	4 (2.6%)
<i>Status of veins in either left or right side</i>	
Normal (two veins on either side)	125 (82.7%)
Abnormal (more or less than two on either side)	26 (17.2%)
<i>Atrial arrhythmia</i>	
No	135 (89.4%)
Yes	16 (10.6%)

patients were Saudis while non Saudi patients were excluded from the study ( $n = 16$ ). This project and the waiver of consent were approved by the departmental scientific committee. The research center in our institution approved this retrospective study. Patients were referred for cardiac MDCT examinations with 64 slice CT in order to exclude ischemic heart disease ( $n = 140$ ), aortic regurgitation ( $n = 3$ ), infective endocarditis ( $n = 3$ ), aortic aneurysm ( $n = 3$ ), fibrosing mediastinitis ( $n = 1$ ) and pericardial defect ( $n = 1$ ).

Two blinded radiologists reviewed the CT studies on a TeraRecon workstation with the ability to display 2D orthogonal and three-dimensional images. The intra atrial anatomy of venous ostium was also evaluated with 3D hollow view volume rendering image to look for a number of ostial openings into the left atrium. The variation of pulmonary venous ostial anatomy was classified into two main groups depending on the side of entry into the left atrium. In each group, the number of pulmonary venous ostium was recorded, and those with more or less than two in each side were grouped as anatomical variations. The group of patients with anatomical variations of pulmonary venous ostium was also investigated for evidence of atrial arrhythmia in the medical records.

## Statistical methods

The association between atrial arrhythmias and variations of pulmonary venous ostial anatomy were determined by using Fisher's exact test, which was also used to find the relationship between the variation of pulmonary vein ostium and the gender of the cohort.

## Result

The detailed demography of patients included in the study, along with statistical analysis is enumerated in Tables 1 and 2. The mean age of men was 49.9 years ( $\pm 11.1$ ) and mean age of women was 51.2 years ( $\pm 8.4$ ). Coronary narrowing was established in 23 patients out of 140 referred for ruling out of ischemic heart disease.

The reviewed chart confirmed presence of atrial arrhythmia in 16 of 26 (61.5 %) patients with abnormal anatomical variation of pulmonary vein. Of 16 patients with atrial arrhythmia, 11 had paroxysmal atrial fibrillation (Fig. 1); two had chronic atrial fibrillation and sinus tachycardia; and one had atrial flutter. The diagnosis was based upon the findings of electrocardiogram, Holter and/or Loop ECG. Four of 26 patients with anatomical

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