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Original Research Article

Comprehensive assessment of morphology and severity of atrial septal defects in adults by CT

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ABSTRACT

Background: Cardiac CT is an excellent tool for evaluating the anatomy of a secundum atrial septal defect (ASD). However, a comprehensive assessment of its usefulness, including measurement of the pulmonary to systemic blood flow ratio in secundum ASD patients, has not been performed.

Objective: Therefore, this study was designed to evaluate the usefulness of CT for assessing the hemodynamics of secundum ASD in adults compared with transesophageal echocardiography (TEE), transthoracic echocardiography, and invasive catheterization.

Methods: Fifty adult patients with secundum ASD were enrolled. Cardiac CT scans (128-slice multidetector CT instrument) were acquired. These were followed by 2-dimensional reconstruction of the secundum ASDs to determine the defect size, the rim length between the outer edge of the defect, and the pulmonary to systemic blood flow (Qp/Qs) ratio.

Results: The maximum sizes of the secundum ASDs derived from CT and TEE studies were comparable (21.2 ± 8.0 vs 20.0 ± 7.3 mm; $P = .41$; $r = 0.960$; $P < .001$). The rim lengths for the aortic, mitral, and tricuspid valves; the inferior vena cava; and posterior atrium were also comparable between CT and TEE measurements. The mean Qp/Qs ratio that was derived from CT measurements was comparable with that found by invasive catheterization (2.3 ± 0.7 vs 2.3 ± 0.8; $P = .73$; $r = 0.786$; $P < .001$).

Conclusion: Cardiac CT is feasible for assessing pathology and the severity of secundum ASD in adults.

Conflict of interest: The authors report no conflicts of interest.

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1. Introduction

A secundum atrial septum defect (ASD) is a common type of congenital heart malformation. Currently, transcatheter closure is used as the first-line treatment for ASD repair because it is minimally invasive and has a high success rate, a low rate of complications, and an excellent long-term outcome.[1–3] For transcatheter ASD closure to be successful, morphologic information, including the location and size of the defect, its rim lengths, and the value of the pulmonary to systemic blood flow ratio (Qp/Qs), is essential.

To evaluate these various features, echocardiography has served as the primary diagnostic modality.[4] Transthoracic echocardiography (TTE) is a noninvasive procedure but has a limited echocardiographic window. Transesophageal echocardiography (TEE), an invasive technique, provides better resolution compared with TTE. However, occasionally TEE is difficult to perform, especially when patients have esophageal blockage or the probe cannot be easily inserted. Conversely, cardiac CT has an excellent spatial and temporal resolution, and recent studies have reported the utility of cardiac CT for evaluating ASD.[5,6] Cardiac CT is used to evaluate coronary artery stenosis and anatomic malformations that complicate ASD repair. Therefore, cardiac CT provides additional anatomic information concerning ASD and can be an alternative and complementary modality of echocardiography in certain situations.

However, there has been no comprehensive assessment of the measures used to evaluate the status of ASD, including the Qp/Qs ratio, using cardiac CT. Therefore, this study aimed to evaluate the usefulness of cardiac CT for adult patients with secundum ASD compared with TEE, TTE, and invasive cardiac catheterization.

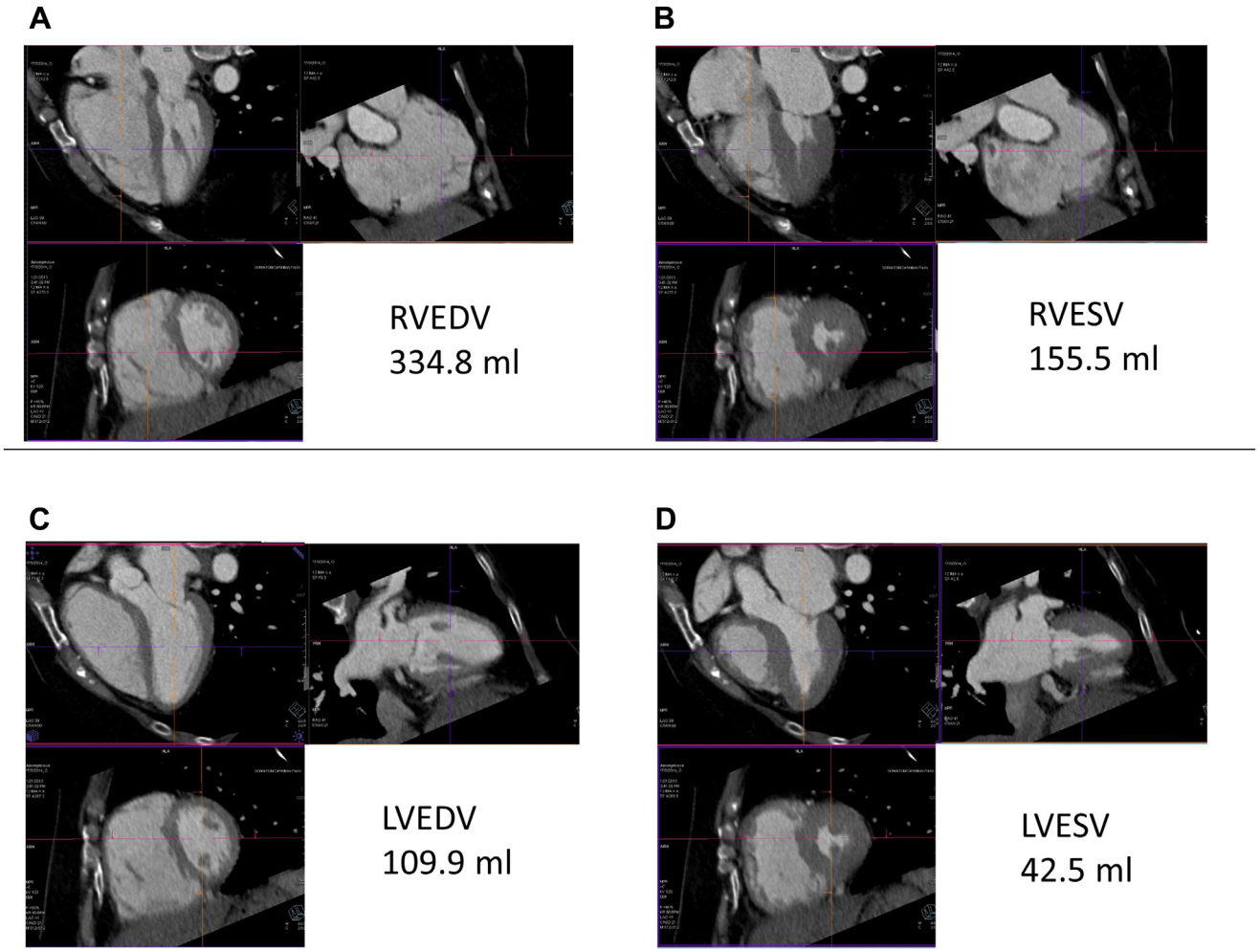

Fig. 1 – A representative example of right and left ventricular volumes. In each panel, the left superior image is shown as a transverse CT image. The left inferior images are shown along the short axis and the right superior images are shown along the long axis. (A) Right ventricular (RV) volume analysis in the diastolic phase. (B) RV volume analysis in the systolic phase. (C) Left-ventricular volume analysis in the diastolic phase. (D) Left-ventricular volume analysis in the systolic phase. This case shows 334.8 mL as the end-diastolic volume of RV and 155.5 mL as the end-systolic volume of RV, and the Qp values are calculated as 179.3 mL × heart rate beats/min. In the same way, this case shows 109.9 mL as the end-diastolic volume of LV and 42.5 mL as the end-systolic volume of LV, and the Qs values are calculated as 67.4 mL × heart rate beats/min. Finally the Qp/Qs ratio could be calculated as 2.66 (179.3 mL × heart rate beats/min/67.4 mL × heart rate beats/min).