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ECG-Gated High Resolution CT Evaluation of a Ruptured Non-Coronary Sinus of Valsalva Aneurysm Draining into the Right Atrium: A Case Report

Case Report

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Abstract

Background: Rupture of a sinus of Valsalva aneurysm (SOVA) is an uncommon but potentially life-threatening condition requiring prompt diagnosis and surgical intervention. While echocardiography is often used as an initial screening modality, computed tomography (CT) provides superior anatomical delineation and is invaluable for surgical planning.

Case Presentation: A 41-year-old female presented with rapidly progressive dyspnea and orthopnea with features of cardiac decompensation. ECG-gated CT aortography revealed a focal aneurysmal dilatation of the non-coronary sinus of Valsalva with a rupture tract communicating into the right atrium. The aneurysmal sac was seen protruding into the right atrium with indentation of the adjacent tricuspid valve leaflet. Associated right-sided chamber dilatation and signs of pulmonary hypertension were noted. The patient subsequently underwent surgical repair, and intraoperative findings correlated with CT imaging.

Conclusion: ECG-gated CT angiography provides precise localization of the rupture site, delineation of the fistulous tract, and assessment of valvular involvement, thereby playing a crucial role in preoperative planning of ruptured sinus of Valsalva aneurysms.

Keywords: Ruptured Sinus of Valsalva aneurysm; ECG-gated CT; CT angiography; Aortic root; Pulmonary hypertension

Introduction

Sinus of Valsalva aneurysm (SOVA) is a rare cardiac abnormality that may be congenital or acquired. These aneurysms arise due to weakness at the junction between the aortic media and the annulus fibrosus. Although many remain asymptomatic, rupture of the aneurysm can result in an acute left-to-right shunt, leading to congestive cardiac failure, pulmonary hypertension, or cardiogenic shock [1-3].

The right coronary sinus is most commonly involved, followed by the non-coronary sinus [1,3]. Rupture into right-sided cardiac chambers is the typical pattern [2,4].

Transthoracic echocardiography is frequently used as a screening tool; however, CT angiography provides superior spatial resolution and allows accurate delineation of the rupture site, fistulous tract, and associated structural abnormalities. This detailed anatomical information is essential for surgical planning [4,5].

We report a case of a ruptured non-coronary sinus of Valsalva aneurysm draining into the right atrium, initially diagnosed on ECG-gated CT angiography and confirmed at surgery.

Case Report

A 41-year-old female with no known comorbidities presented

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with progressive shortness of breath over a period of two months, which had worsened significantly over the preceding two to three weeks. She also reported orthopnea, palpitations, intermittent chest discomfort, nausea, vomiting, bilateral lower limb edema, and episodes of hypotension.

She was initially treated elsewhere for unstable angina with acute left ventricular failure and cardiogenic shock and received inotropic and vasodilator support. Despite initial improvement, she developed recurrent dyspnea and was found to have pulmonary hypertension, ascites, and anemia during further evaluation.

On admission, her pulse rate was 78 beats per minute, blood pressure was 186/68 mmHg, respiratory rate was 24 breaths per minute, and oxygen saturation was 97% on room air. Cardiac auscultation revealed a pansystolic murmur.

Coronary angiography was performed via the right femoral approach and demonstrated normal coronary arteries. In view of persistent symptoms and suspected structural cardiac pathology, the patient was referred for CT aortography.

CT Technique

ECG-gated contrast-enhanced CT aortography was performed on a dual-source dual-energy 128-slice CT scanner (Siemens Somatom Drive). A retrospective ECG-gated acquisition was used. Intravenous administration of 100 mL of non-ionic iodinated contrast was performed, followed by thin-section image reconstruction. Multiplanar reformations, maximum intensity projections, and volume-rendered images were generated for detailed anatomical assessment.

Imaging Findings

CT angiography demonstrated a focal aneurysmal dilatation arising from the non-coronary sinus of Valsalva, measuring approximately 18 × 14 mm. A well-defined rupture defect measuring approximately 12.5 × 11.4 mm was identified in the wall of the aneurysmal sac. Through this defect, contrast was seen directly opacifying the right atrium, confirming the presence of a fistulous communication.

The aneurysmal sac was noted to protrude into the right atrium, producing indentation of the adjacent tricuspid valve leaflet. There was significant dilatation of the right atrium and inferior vena cava, with associated hepatic venous congestion. The main pulmonary artery was dilated, measuring approximately 3.9 cm, suggestive of pulmonary hypertension. Mild pericardial effusion and cardiomegaly were also present.

The right and left coronary sinuses were unremarkable. The coronary arteries, thoracic aorta, and abdominal aorta were within normal limits.

Surgical Correlation

The patient subsequently underwent surgical repair. Intraoperative findings confirmed a ruptured sinus of Valsalva aneurysm opening into the right atrium. The aneurysmal sac was identified and excised. The sinus defect was repaired using a Dacron patch, and tricuspid valve repair was also performed. The postoperative course was uneventful, and the patient remained hemodynamically stable.

Postoperative Course and Follow-Up

The patient was shifted to the intensive care unit following surgery and remained hemodynamically stable. Inotropic support was gradually tapered, and she was extubated on the second postoperative day. Postoperative echocardiography demonstrated satisfactory repair with no residual shunt across the sinus defect and preserved left ventricular systolic function (LVEF approximately 55%). The patient had an uneventful recovery and was discharged in stable condition with advice for routine cardiothoracic follow-up.

Discussion

Sinus of Valsalva aneurysm (SOVA) is an uncommon abnormality of the aortic root characterized by focal dilatation of one of the aortic sinuses. The condition most frequently results from congenital deficiency of elastic and muscular tissue at the junction between the aortic media and annulus fibrosus [1,3]. Acquired causes such as infective endocarditis, trauma, or degenerative changes are less common but have also been described [5,6]. Progressive weakening of the sinus wall may eventually culminate in rupture, producing a pathological communication between the aorta and an adjacent cardiac chamber.

The right coronary sinus is most commonly involved, followed by the non-coronary sinus, while left sinus involvement is rare [1,3]. Patterns of rupture reflect anatomical proximity. The right coronary sinus most often ruptures into the right ventricle, whereas aneurysms arising from the non-coronary sinus typically communicate with the right atrium [1,2,4]. Our case demonstrated a ruptured non-coronary sinus aneurysm draining into the right atrium, which corresponds to the recognized distribution patterns reported in the literature.

Clinical manifestations depend on the size of the defect and the rapidity of shunt formation. Small unruptured aneurysms may remain asymptomatic, whereas rupture commonly produces an acute left-to-right shunt leading to dyspnea, volume overload, and signs of heart failure [2,7]. Chronic shunting may result in progressive right atrial enlargement, pulmonary hypertension, and secondary valvular dysfunction. In the present patient, right atrial dilatation, inferior

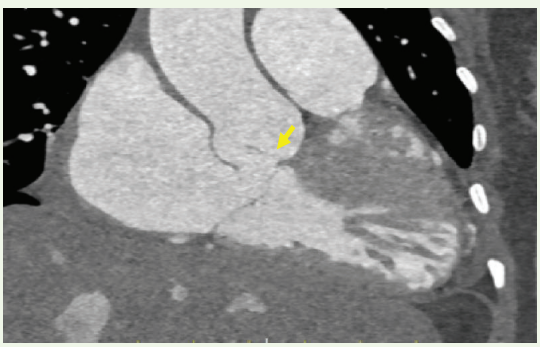

Figure 1: Coronal multiplanar reformatted CT image demonstrating the fistulous tract extending from the non-coronary sinus into the right atrium (arrow).

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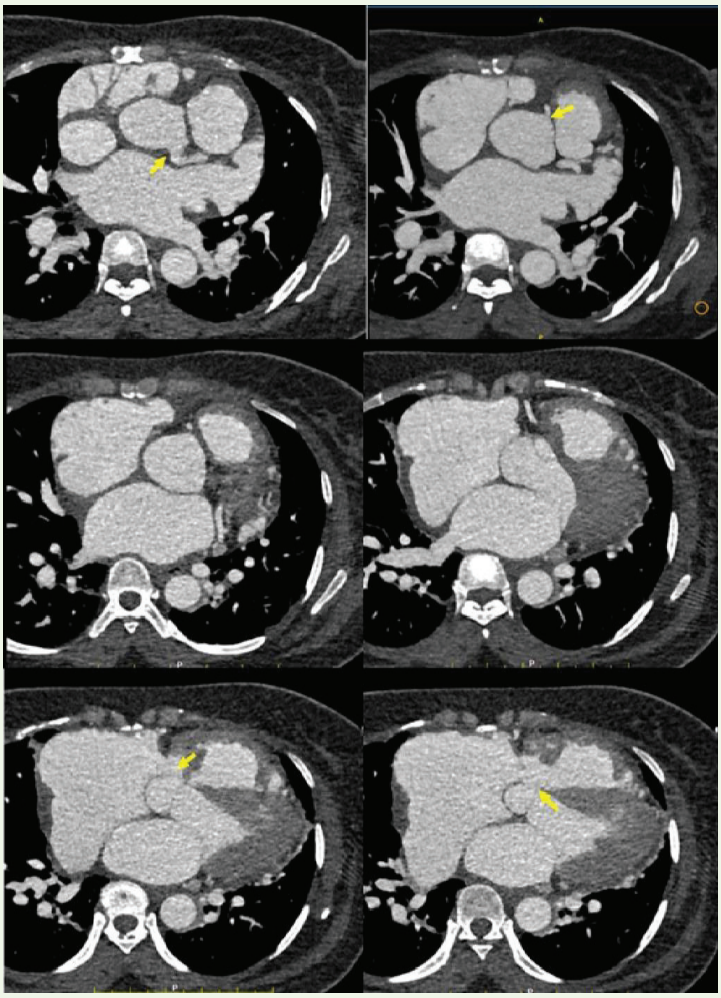

Figure 2: Serial axial ECG-gated contrast-enhanced CT images obtained in craniocaudal sequence through the aortic root. The superior sections demonstrate the right coronary ostium and left coronary ostium arising normally from their respective coronary sinuses (arrows). The inferior sections show focal aneurysmal dilatation of the non-coronary sinus with protrusion.

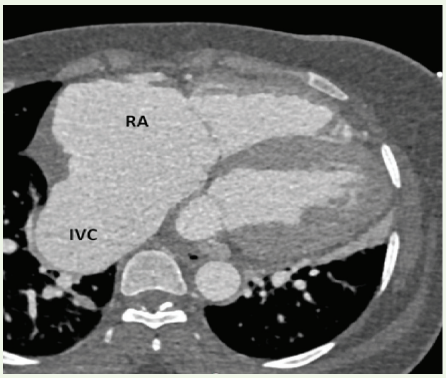

Figure 3: Axial ECG-gated contrast-enhanced CT image at the level of the cardiac base demonstrating marked dilatation of the right atrium (RA) and enlarged inferior vena cava (IVC), consistent with right-sided volume overload.

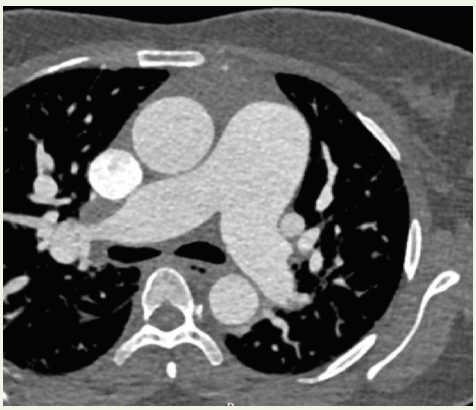

Figure 4: Axial contrast-enhanced CT image at the level of the pulmonary artery bifurcation demonstrating dilatation of the main pulmonary artery, suggestive of pulmonary hypertension.

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vena cava enlargement, and pulmonary arterial dilatation were evident on CT, reflecting significant hemodynamic impact.

Imaging is central to diagnosis and therapeutic planning. Transthoracic echocardiography is often the first-line investigation because it can demonstrate abnormal flow jets and chamber enlargement. However, acoustic window limitations and complex anatomy may hinder precise localization of the rupture site [4,5]. Cross-sectional imaging provides a more comprehensive anatomical assessment.

Multidetector CT angiography, particularly when ECG-gated, enables high spatial resolution evaluation of the aortic root, aneurysmal sac, and fistulous tract [4,8,10]. ECG gating minimizes motion artifact and allows accurate delineation of the aortic root and coronary origins, which is crucial in preoperative planning.

Cross-sectional imaging not only defines the rupture site but also assesses coronary ostial involvement, chamber enlargement, pulmonary arterial changes, and associated congenital anomalies [11]. Such evaluation is essential because coronary compromise or concomitant structural abnormalities may alter surgical strategy. In our case, CT clearly demonstrated a focal rupture defect within the non-coronary sinus, direct opacification of the right atrium, indentation of the tricuspid valve leaflet, and preserved coronary ostia. The ability to visualize these relationships in multiple planes provided a precise anatomical roadmap prior to surgery.

Complications of SOVA include aortic regurgitation, arrhythmias, endocarditis, progressive pulmonary hypertension, and, in severe cases, cardiogenic shock [2,5]. Long-term surgical outcomes are generally favorable when timely repair is performed [2,7]. Accurate preoperative anatomical definition has been shown to contribute to optimal surgical results [4,5].

This case underscores the diagnostic strength of ECG-gated CT angiography in ruptured SOVA. While echocardiography remains indispensable for functional assessment, CT offers superior depiction of the rupture tract, spatial relationships, and associated structural changes. Such detailed anatomical information is particularly valuable when surgical repair is contemplated.

Conclusion

ECG-gated dual-source CT angiography plays a crucial role in the evaluation of ruptured sinus of Valsalva aneurysms by precisely delineating the rupture site, fistulous communication, and associated valvular involvement, thereby facilitating optimal surgical planning. This detailed anatomical information is invaluable for preoperative planning and surgical decision-making.

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