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Ruptured Aneurysm of Valsalva Sinus with Pseudoaneurysm and Intratumoral Thrombus: A Rare Case Report

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Abstract

The rupture of a sinus of Valsalva aneurysm (SVA) is a rare occurrence in cardiovascular medicine; however, it often severely compromises patients' physiological functions and poses a life-threatening risk when it occurs [1]. Pseudoaneurysm of the sinus of Valsalva (SVpA) more frequently affects men [2]. However, we report a case of sinus of Valsalva pseudoaneurysm with thrombosis: a 30-year-old female, who experienced no physical discomfort in her daily life, accidentally discovered a ruptured aneurysm of the Valsalva sinus at the non-coronary sinus during a physical examination. The aneurysm had formed a large pseudoaneurysm, measuring 6.3 × 6.0 cm, located in the right atrioventricular sulcus. This pseudoaneurysm exerted significant pressure on the right atrium, and much of it had been filled with thrombus.

Keywords

Sinus of Valsalva Pseudoaneurysm, Atypical Symptoms, Transesophageal Echocardiography, Thrombus, Case Report

Introduction

SVA is typically asymptomatic unless it ruptures, at which point it can lead to serious complications. These complications typically involve acute hemodynamic changes, which are commonly manifested as sudden chest pain, dyspnea, a continuous murmur, and heart failure [3]. Most of the pseudoaneurysms after SVA rupture reported in the existing literature break into the cardiac cavity, forming a left-to-right shunt; however, it is extremely rare to see cases that are "completely located outside the heart, with huge thrombus filling, no shunt, and long-term asymptomatic." At present, only a few such cases have been reported, and they lack systematic description [4]. We report such a morphologic subtype that has not been formally classified. Its diagnostic clues, perioperative risks, and special surgical strategies can provide a new cognitive framework for the existing literature.

Case Presentation

A 30-year-old asymptomatic female patient found a cardiac mass during a physical examination in a local hospital. No special examination or treatment was performed; the patient sought medical attention at our hospital.

Case Report

The physical examination in our hospital found that the patient's cardiac boundary was enlarged; transthoracic echocardiogram revealed a tumor-like structure in the right atrioventricular groove. The tumor was connected to the non-coronary sinus and measured approximately 5.7 × 5 cm in size. The inner diameter of the communication port measured 0.7 cm, and there was bidirectional low-speed blood flow at the communication port, accompanied by intraluminal thrombus formation, and the blood flow of the tricuspid valve was accelerated. The patient was diagnosed with a sinus of Valsalva pseudoaneurysm with thrombosis. The contrast-enhanced CT revealed an enlarged heart, dilation and rightward protrusion of the aortic valve in the non-coronary sinus region, compression of the right atrium, and a sinus pseudoaneurysm with thrombus formation (**Fig-1**).

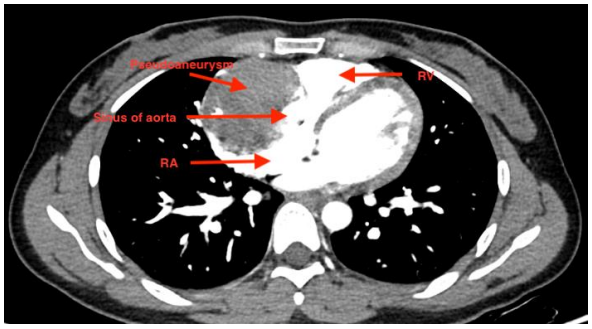

Fig-1: Thrombus-Filled Sinus of Valsalva Pseudoaneurysm on CT Imaging

Contrast-enhanced CT reveals a 6 × 5 cm thrombus-filled pseudoaneurysm originating from the non-coronary sinus, compressing the right atrium. No significant blood flow signal was detected within the tumor.

Cardiac magnetic resonance imaging revealed outward bulging of the ascending aorta, lacking a sinus area, with a cross-sectional area of approximately 6.3 × 6.0 cm. The right atrium was significantly compressed and deformed, with a small amount of contrast agent filling the aneurysm cavity. She was scheduled to undergo sinus aneurysm resection and aortic sinus reconstruction surgery.

We examined the heart using an adult transesophageal echocardiography (TEE) probe to confirm the location of the fistula and blood flow in the tumor by an experienced and skillful sonographer. In the mid-esophageal aortic valve short-axis view, TEE confirmed that the fistula was located in the non-coronary sinus valve, and the blood flow was limited to the junction of the fistula (**Fig-2A**). The size of the aneurysm was measured in this section (**Fig-2B**).

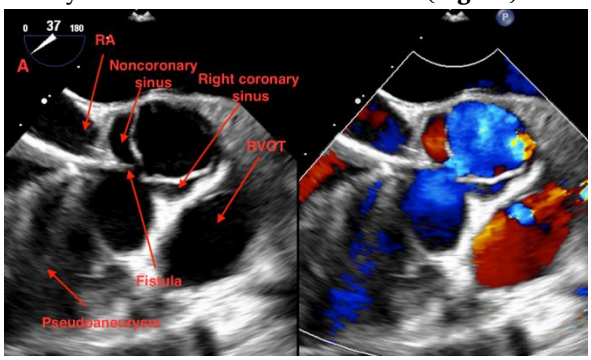

Fig-2A: TEE Revealing Fistula at Non-Coronary Sinus with Thrombus-Filled Pseudoaneurysm

The fistula was located in the non-coronary sinus valve, and blood flow was limited to the junction of the fistula. The right cardiac system is significantly compressed, and most of the pseudoaneurysms are filled with thrombus. There is no significant acceleration of blood flow in the right ventricular outflow tract.

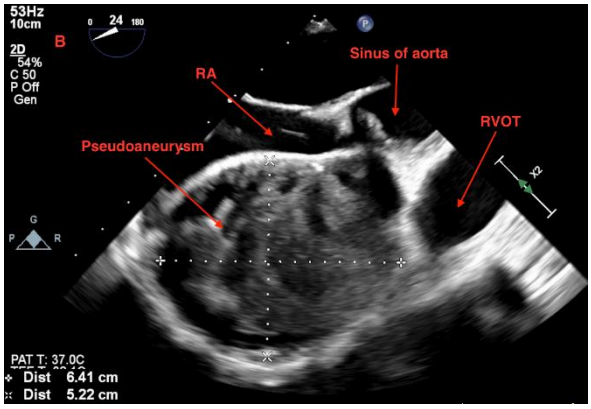

Fig-2B: Measurement and Morphology of the Pseudoaneurysm on TEE Imaging

The size of the pseudoaneurysm was measured in this section. The tumor exhibits uneven internal characteristics and significantly compresses the right cardiac system.

During the surgery, the patient underwent a routine midline thoracotomy, with the ascending aorta and the superior and inferior vena cava cannulated to establish extracorporeal circulation. After the infusion of cardioplegic solution, the heart ceased to beat smoothly. Upon incising the ascending aorta and the tumor wall, a large amount of thrombus was observed within the tumor. After removing the thrombus, the neck of the tumor was exposed, repaired with a pericardial patch, and the sinus rupture was closed. Finally, the patient was safely sent to the intensive care unit for postoperative recovery.

Four days' post-operation, the contrast-enhanced CT revealed a 4.9 × 4.2 cm aneurysm remnant at the right atrioventricular groove (**Fig-3**). Echocardiography revealed no significant blood flow communication between the aneurysm cavity and the aortic sinus, and the anterior flow of the tricuspid valve was unobstructed. The patient was transferred to the local hospital for rehabilitation treatment on the fifth day after the operation.

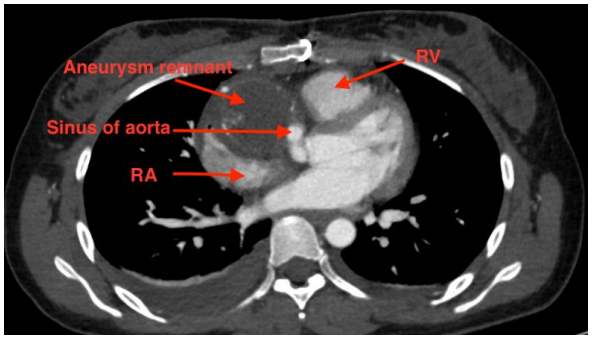

Fig-3: Postoperative CT Showing Residual Aneurysm and Reduced Right Heart Compression

The contrast-enhanced CT reveals a 4.9 × 4.2 cm aneurysm remnant located at the right atrioventricular groove. The tumor exhibits relatively uniform internal characteristics, and the compression on the right heart system has diminished compared to preoperative levels.

Discussion

The typical mode of SVA rupture involves the tumor body breaking into the low-pressure cardiac cavity, which immediately produces an acute left-to-right shunt, presenting as a continuous murmur and acute right heart failure. Conversely, this case demonstrated an expansion of extraversion, resulting in a completely extracardiac thrombotic pseudoaneurysm. This caused hemodynamic disorders through mechanical compression, rather than through a shunt.

For this rare phenotype, only a few reports have described similar non-shunt, external-pressure pseudoaneurysms; however, these reports did not systematically elaborate on strategies for perioperative thrombus management, coronary artery protection, and bundle risk prevention [5-7]. Therefore, this case not only expands the morphological spectrum of SVA after rupture, but also provides the first relatively complete perioperative scheme for the diagnosis and treatment of this subtype.

The fundamental pathophysiology of this case differs from the classic acute left-to-right shunt that occurs following sinus of Valsalva aneurysm rupture [8,9]. Instead, a space-occupying thrombotic pseudoaneurysm predominates: the thrombus and residual blood within the sac expand in unison, directly compressing the right atrium and atrioventricular groove, impeding right atrial inflow, and progressively elevating central venous pressure.

Stagnant flow or intraoperative manipulation can dislodge a thrombus, precipitating pulmonary or systemic embolism; continued pressure and wall thinning may lead to sudden rupture with acute cardiac tamponade; and chronic restriction of right atrial and right ventricular (RV) preload can ultimately progress to irreversible right heart failure [10].

The pseudoaneurysm is located deep within the right atrioventricular sulcus. The actual operation presents three major technical challenges. The right coronary trunk runs close to the tumor wall, and any separation operation may lead to acute ischemia; we routinely define the anatomic relationship before the operation and formulate the bypass grafting plan in advance [11,12].

The tumor is adjacent to the atrioventricular node and bundle, posing a high risk of damage to the conduction system [13]. Intraoperative hypothermic cardioplegia perfusion and real-time monitoring of conduction function can significantly reduce the incidence of permanent atrioventricular block.

To prevent thrombosis resulting from thrombus fragmentation, we have designed a dual-incision pathway that connects the aortic root and the right atrium. This procedure allows for the meticulous and complete removal of the thrombus from the capsule cavity under direct vision, thereby preventing fragmentation that could lead to embolism [14,15]. Additionally, the redundant capsule wall tissue is completely removed to alleviate right atrial compression [16].

Perioperative management is centered around three integrated steps:

1. Preventing thromboembolism by limiting cardiac manipulation prior to cardiopulmonary bypass, ensuring proximal aortic control following cross-clamping, and conducting en-bloc thrombectomy via combined aortic and right atrial incisions with immediate suction to prevent fragmentation [17];
2. Right-heart protection employs a restrictive volume strategy to optimize RV preload, reduces pulmonary vascular resistance as necessary, and involves the infusion of milrinone to enhance RV contractility [16];
3. Early postoperative surveillance involves serial ECGs to monitor for ST-T changes and conduction blocks, as well as transthoracic echocardiography to assess right atrial geometry, tricuspid valve function, and any residual shunt [18].

Conclusion

This report characterizes a distinct "sinus of Valsalva pseudoaneurysm with thrombosis" phenotype, extracardiac and compressive, without intracardiac shunt. Complete thrombectomy and pericardial patch repair via a combined aortic–right atrial approach safely relieved obstruction and prevented embolism. Prospective case series are now warranted to define the optimal timing and long-term outcomes for this rare variant.

Conflict of Interest

The authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

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