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Case Report

Percutaneous Closure of Sinus of Valsalva Rupture into the Right Ventricule in a Pediatric Patient: A Case Report

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Abstract

This case report details a rare instance of an 8-year-old boy with a large sinus of Valsalva rupture in the right ventricle, who underwent successful percutaneous closure. The rarity of this condition in pediatric patients, coupled with the innovative approach to treatment, makes this a significant contribution to pediatric cardiology. The success of procedure highlights the potential of minimally invasive techniques in the management of complex cardiac abnormalities in children.

Introduction

The Valsalva sinus, an anatomical feature of the aorta, plays a crucial role in cardiac function. Its rupture, particularly into cardiac chambers such as the right ventricle, is a rare and life- threatening event. This condition is rarely observed in pediatric patients, making its diagnosis and management particularly challenging.

In adults, sinus of Valsalva ruptures are often associated with congenital weaknesses exacerbated by factors such as hypertension or trauma.

However, in children, these ruptures are primarily congenital and can present unique clinical challenges due to the patient's age and heart size. The traditional approach to repair this anomaly has been open-heart surgery, which, while effective, poses significant risks and requires a longer recovery period.

This report presents a unique case of an 8- year-old boy who presented symptoms of heart failure and was subsequently diagnosed with a large sinus of Valsalva rupture in the right ventricle. The decision to opt for a percutaneous closure procedure was driven by the desire to minimize surgical trauma and facilitate quicker recovery.

Case Presentation

The patient, an 8-year-old boy with no significant medical history, presented to the pediatric cardiology unit with symptoms of fatigue, shortness of breath, and palpitations.

Diagnostic Assessment

Echocardiography revealed

1-Enlargement of right Ventricle (RV): The echocardiogram showed an enlarged right ventricle. This was characterized by an increase in the dimensions of the RV cavity, which exceeded the normal range for the patient's age and body size. dilatation was likely a result of increased volume load due to shunting from the left side of the heart. The RV walls appeared to be under increased stress, as indicated by their hypertrophic appearance. However, the function of the right ventricle was preserved, with no significant decrease in the ejection fraction or tricuspid annular plane systolic excursion (TAPSE).

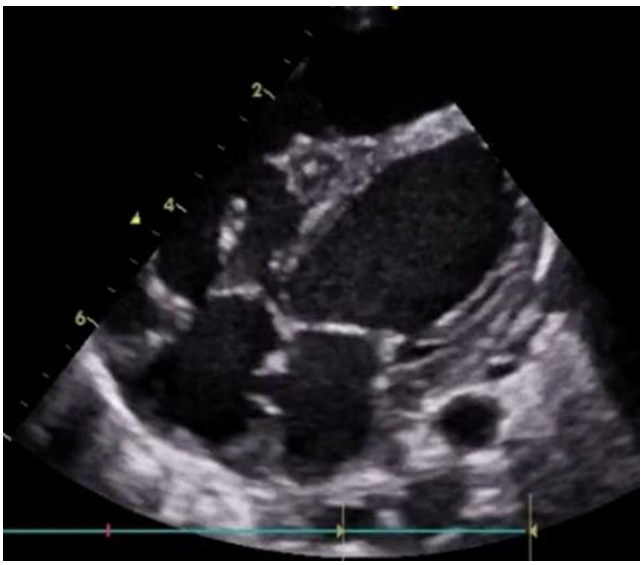

Figure 1: Transthoracic echocardiography showing enlargement right and left ventricula

Dilation of the Left Ventricle (LV): The left ventricle also showed signs of enlargement. This dilatation was likely compensatory in nature, a response to the increased volume load from the right ventricle. The size of the LV cavity was above the normal limits for the patient's age. Despite this enlargement left ventricular systolic function was maintained, with normal ejection fraction and wall motion.

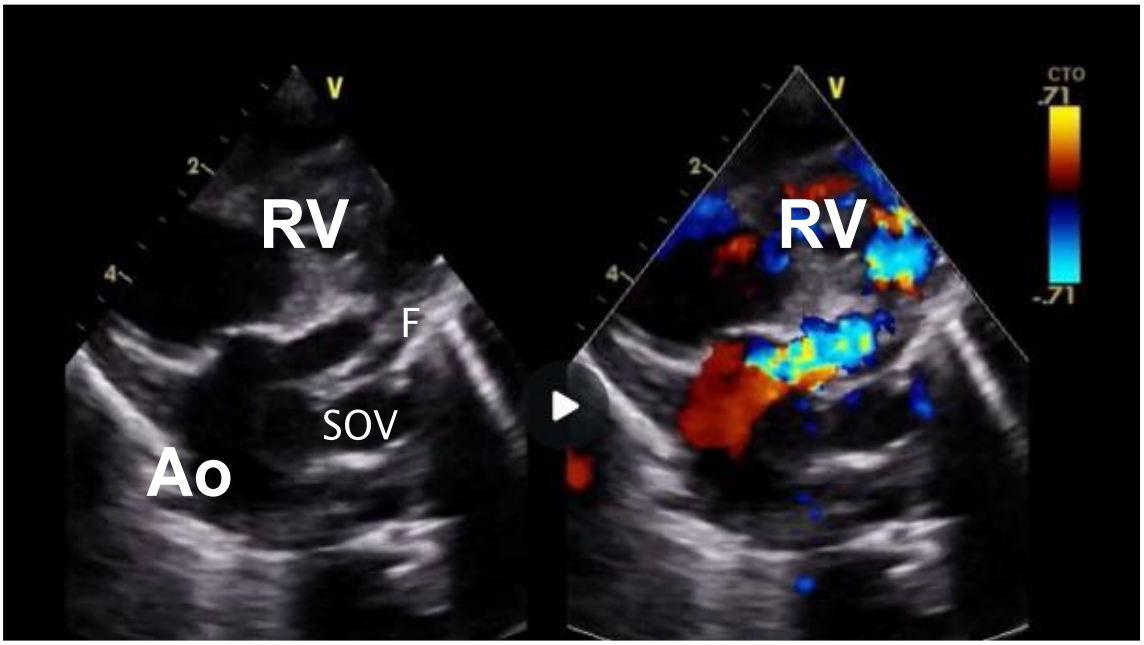

Figure 2: Transthoracic echocardiography showing a dilated left sinus of valsalva (SOV) (F) in the right ventricule (RV)

Fistula Characteristics: A critical finding on the echocardiogram was the presence of a 7 mm diameter fistula that connects; the sinus of Valsalva to the right ventricle. This fistula, or rupture, was found to originate in the right coronary sinus, a less common site of such anomalies. The size of the fistula (7 mm in diameter) was considerably large, especially considering the age of patient and the size of heart. This large fistula was the primary cause of the shunt between the aorta and the right ventricle, leading to volume overload in the ventricles.

Color Doppler flow patterns: The use of color Doppler echocardiography provided additional insights. It demonstrated turbulent flow through the fistula into the right ventricle, confirming the left-to-right shunt. The flow pattern suggested a high jet flowing into the right ventricle, which contributed to RV and LV enlargement.

Additional Findings: There were no signs of aortic valve regurgitation, which can sometimes accompany sinus valve ruptures. The atria were of normal size, and there was no evidence of intracardiac thrombi or other structural heart diseases.

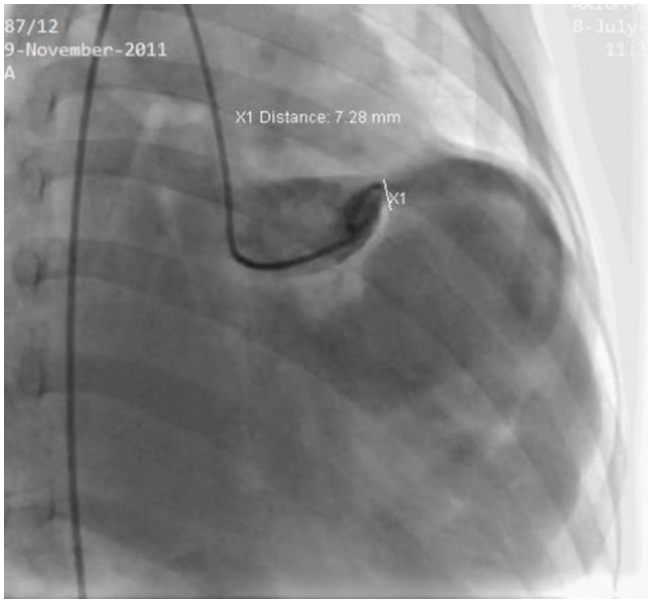

Figure 3: Angiography Detailed anatomical confirmation of the sinus of the valsalva and showing the contrast going inside the right ventricule through a large fistula of 7 mm in diameter

Angiography

The angiographic findings provided essential information for the diagnosis and planning of the percutaneous closure procedure. Here is a detailed description of the angiographic findings:

- *Location and Origin of the Rupture:* Angiography revealed that the rupture originated from in the right coronary sinus of the Valsalva. This was observed as a distinct outpouching or aneurysmal dilation communicating with the right ventricle. The precise point of rupture was clearly visualized, confirming the echocardiographic findings.
- *Size and Shape of the Fistula:* The fistula measured approximately 7 mm in diameter, which is considered large, especially in a pediatric patient. The shape of the fistula was somewhat irregular, with a wider opening at the sinus of Valsalva and a narrower tract leading into the right ventricle, indicative of the directional pressure gradient from the aorta to the ventricle.
- *Shunt Visualization:* The angiogram demonstrated a prominent left-to-right shunt. This was evidenced by the contrast medium injected into the aorta that preferentially flows through the fistula to the right ventricle, rather than following the normal aortic route. The flow pattern suggested that a significant volume of blood was pushed consistent with the observed ventricular enlargement.

In general, the angiographic findings were instrumental in providing a complete visualization of the sinus of the Valsalva sinus rupture, its hemodynamic impact, and the structural integrity of the surrounding cardiac anatomy. These findings guided the decision-making process for percutaneous closure, confirming the suitability of the approach and aiding in the planning of the procedure.

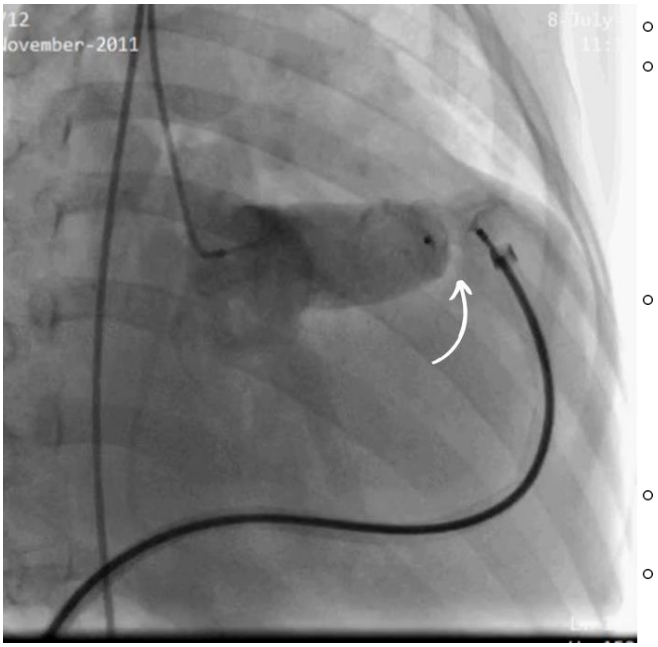

Figure 4: Angiography Detailed anatomical confirmation of the rupture of the sinus of valsalva and showing the contrast going inside the dissected interventriculare septum

Closure procedure

Percutaneous closure of a large sinus of Valsalva rupture in the right ventricle using a retrograde approach and deployment of a Patent Ductus Arteriosus (PDA) occluder device involves a series of meticulous and precise steps. In the case of the 6-year-old boy, the procedure was performed using a 10/12 mm occluder device, deployed retrogradely from the femoral vein. Here is a detailed description of the procedure:

Pre-Procedure Preparation

Patient preparation: The child was admitted to the catheterization laboratory, and general anesthesia was administered for optimal procedural control and patient comfort.

Access Site Preparation: The right femoral vein was chosen as the access site. The area was sterilized and draped in a standard aseptic manner.

Vascular Access and Catheter Placement

Vascular Access: Percutaneous access to the right femoral vein was obtained using a standard Seldinger technique.

Guiding Catheter Placement: A guiding catheter was advanced through the femoral vein into the right atrium, and then into the right ventricle, under fluoroscopic guidance.

Diagnostic Angiography

Right Ventricular Angiography: To confirm the location and size of the fistula, contrast was injected into the right ventricle, and angiographic images were obtained.

Measurements: Exact measurements of the fistula size and surrounding structures were taken to ensure the appropriate sizing of the occluder device.

Deployment of the Occluder Device Occluder Device Selection: Based on the measurements, a 10/12 mm PDA occluder device was selected. This device is typically used to close PDAs but is also effective for other similar cardiac defects.

Advancing the Occluder: The occluder device was loaded onto a delivery cable and introduced through the guiding catheter.

Positioning the Occluder: Under fluoroscopic guidance, the device was carefully advanced retrogradely across the fistula from the right ventricle toward the aorta.

Deployment: Once in position, the device was deployed. The first part of the device opened on the aortic side of the fistula, and the second part opened within the right ventricle, effectively sandwiching the fistula between the two parts of the device.

Confirmation of Position and Effectiveness: After deployment, angiography and echocardiography were performed to confirm the correct position of the occluder and to ensure that it effectively sealed the fistula without obstructing adjacent structures, such as coronary arteries or valves.

Post-Deployment Assessment and Closure

Assessing Hemodynamics: Hemodynamic measurements were taken to assess changes in heart pressures post-closure.

Withdrawal of equipment: Following successful deployment and confirmation of the device's position, the catheter and other equipment were carefully withdrawn.

Closure of the access site: The puncture site of the femoral vein was closed using standard techniques, with careful attention to hemostasis.

Post-Procedure Care

Recovery Monitoring: The patient was closely monitored in a recovery area. Cardiac function was continuously assessed, and pain management was provided as needed.

Follow-up

- Echocardiography is performed within 24 hours to confirm device's position of the device and assess the status of the false aneurysm.
- Periodic imaging follow-up usually echocardiography or CT angiography, is scheduled to monitor the long-term position of the device and the status of the aneurysm.

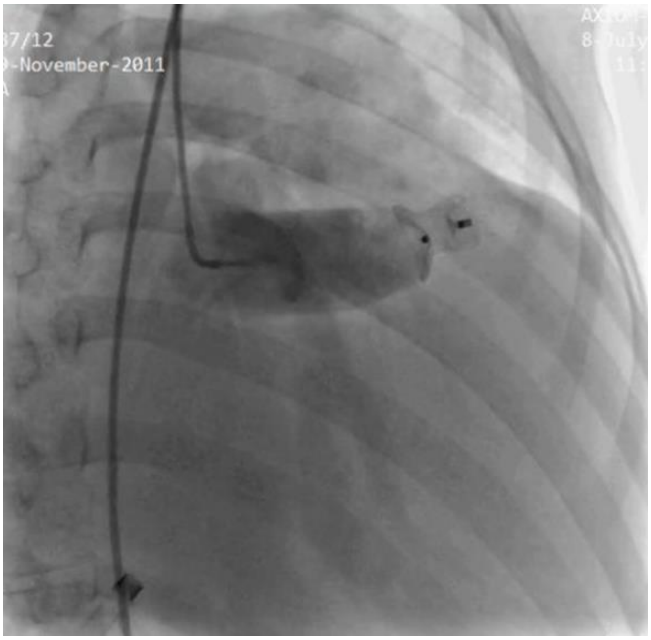

Figure 5: Final angiography with complete occlusion of the communicating orifice

Discussion

Rarity and Significance of the Condition

- *Uncommon Presentation of the condition in Pediatrics:* Valsalva sinus ruptures are rare, especially in pediatric patients. This case provides valuable on the presentation, diagnosis, and management of this rare condition in children.
- *Etiology:* The case had a clear etiological factor such as congenital heart disease or trauma, making it an idiopathic presentation, which is rare in pediatric Valsalva sinus ruptures.

Diagnostic Challenges

- *Echocardiography and angiography:* The use of echocardiography and angiography was crucial in this case. These imaging modalities provided detailed information on the size and location of the rupture, the extent of the shunting, and the impact on cardiac function.
- *Symptoms:* The child's symptoms of heart failure were indicative of the significant hemodynamic burden caused by the rupture. Early recognition and accurate diagnosis were the key to successful management.

Therapeutic Approach

Percutaneous closure: The choice of percutaneous closure over open heart surgery represented a less invasive approach, reducing the risks associated with surgery and potentially leading to a faster recovery.

Device Selection: The use of a PDA occluder device, typically used to close patent ductus arteriosus, in the closure of the sinus of Valsalva rupture, is a testament to the versatility and adaptability of existing cardiac devices. The selection of a 10/12 mm device was based on precise measurements of the fistula, ensuring effective closure.

Procedural Success and Outcomes

- *Technical Success:* The successful deployment of the occluder device and the immediate sealing of the fistula without complications were significant achievements. This underscores the feasibility of this technique in similar cases.
- *Post-procedure recovery:* The patient's uneventful recovery and improvement in cardiac function post-procedure are encouraging. They highlight the benefits of minimally invasive approaches in pediatric cardiology.

Implications for Pediatric Cardiology

- *Advancing Techniques:* This case illustrates the advances in interventional cardiology that allow for the effective treatment of complex conditions in pediatric patients.

Future research and development

- The success of this procedure calls for further research into the use of various closure devices for different congenital heart defects and the long-term outcomes of such interventions.

Conclusion

This case is a notable example of the successful management of a sinus of Valsalva rupture in a pediatric patient using a percutaneous approach. It demonstrates the importance of accurate diagnosis, the effectiveness of minimally invasive techniques, and the adaptability of interventional tools in pediatric cardiology. The favorable outcome for this young patient opens doors for further exploration and application of such techniques in similar cases, potentially altering the standard of care for complex cardiac anomalies in children.

Conflict of Interest

There was no conflict of interest

Data Availability

Data would be available upon reasonable request

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