Case Report
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Migration of a Right Ventricular Outflow Tract Stent Causing Incomplete Cardioplegic Arrest: Stent Gone Astray!

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Abstract

Right ventricular outflow tract (RVOT) stenting is an established palliative option in tetralogy of Fallot (TOF) when surgical repair poses a high-risk. We report a rare, life-threatening complication in a 4-year-old child with TOF, a hypoplastic pulmonary annulus, and multiple comorbidities that precluded primary corrective surgery. RVOT stenting was therefore planned. During catheterization, the stent embolized, necessitating emergency surgical retrieval. Intraoperatively, the stent was seen lodged across the aortic valve, preventing complete leaflet coaptation, and causing the cardioplegia to leak into the left ventricle. This resulted in an incomplete cardioplegic arrest. Real-time transesophageal echocardiography (TEE) identified the mechanism of cardioplegia failure, delineated the stent position, guided its repositioning, and facilitated successful cardioplegia delivery and definitive surgical repair. This case emphasizes meticulous anatomical evaluation and highlights the indispensable role of intraoperative TEE in high-risk RVOT stenting.

Keywords: Tetrology of Fallot, echocardiography, endovascular procedures/stents, except pci, aortic valve insufficiency, cardiovascular and thoracic anaesthesia

Main Points

- Right ventricular outflow tract (RVOT) stent migration can result in critical intracardiac complications, including aortic valve impingement, leading to ineffective cardioplegia delivery and incomplete cardioplegic arrest.
- Intraoperative transesophageal echocardiography is pivotal for real-time localization of embolized stents, detection of functional valvular compromise, and guidance for immediate corrective surgical strategies.
- Meticulous pre-procedural anatomical assessment and stent selection, combined with coordinated multidisciplinary perioperative management, are essential to mitigate life-threatening complications in high-risk tetralogy of Fallot patients undergoing RVOT stenting.

Introduction

Tetralogy of Fallot (TOF) is the most common cyanotic congenital heart disease and typically necessitates early surgical repair to correct the ventricular septal defect (VSD) and relieve right ventricular outflow tract (RVOT) obstruction.[1] In high-risk patients such as those with multiple comorbidities, poor nutritional status, neurological insults, or coagulopathy definitive surgical correction may be deferred.[2] In such cases, RVOT stenting has emerged as an effective strategy to relieve infundibular and pulmonary valve obstruction, thereby promoting anterograde pulsatile pulmonary blood flow and improving oxygen saturation.

The increasing popularity of RVOT stenting is driven by additional benefits, including reduced cyanosis, improved pulmonary artery development and better weight gain weight gain, ultimately favouring future complete repair. Although effective, it carries potential risks, including procedural failure, stent dislodgement or migration, stent malposition leading to tricuspid

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valve regurgitation, vascular injury during stent retrieval, and ventricular arrhythmias.[2]

We report a rare, life-threatening complication of RVOT stenting in a child with TOF and significant comorbidities: the stent migrated through a large VSD with a portion impinging on the aortic valve. During surgery, transesophageal echocardiography (TEE) revealed that incomplete closure of the aortic valve allowed cardioplegia to leak into the ventricle, preventing complete cardioplegic arrest. This case offers critical learning points regarding perioperative vigilance, the utility of TEE, and multidisciplinary planning in complex congenital interventions.

Case Presentation

A 4-year-old male (13 kg) with central cyanosis and recurrent hypercyanotic spells presented with respiratory distress and high-grade fever. TTE and CT showed a large subaortic VSD (1.5 cm) with 50% aortic override; a small ASD; right ventricular hypertrophy; a hypoplastic pulmonary annulus (8 mm); and small pulmonary arteries (MPA 9.6 mm, Z −2.56; LPA 3.5 mm, Z −4.8; RPA 12 mm, Z +1.79). Severe valvular and infundibular pulmonary stenosis (peak gradient 49 mmHg) along with aorto-pulmonary collaterals (largest 2.2 cm) were noted.

Past medical history included thalamic and occipital infarcts with hemorrhagic transformation; right-sided weakness; bilateral cortical blindness; seizures; left subclavian artery thrombosis requiring digital amputations; and warfarin therapy complicated by coagulopathy.

In June 2025, he developed worsening tachypnea and hypoxemia (SpO_2 70%). Chest radiography showed recurrent left pleural effusion that was adenosine deaminase-positive, for which antitubercular therapy was started. Despite escalation of respiratory support to high-flow nasal cannula (40 L min^{-1}, FiO_2 100%), he required intubation and vasopressor support (phenylephrine 1 µg kg^{-1} min, noradrenaline 0.1 µg kg^{-1} min). Given refractory hypoxia, comorbidities, and poor surgical candidacy, RVOT stenting was planned for the patient.

In the catheterization lab, an 8.0×37 mm cobalt-chromium stent (Myra™ BMS) was implanted via right femoral venous access (Figure 1), but it embolized into the right ventricle and could not be retrieved percutaneously. A temporary pacing lead was placed, and the child was transferred for emergency surgery after obtaining written informed consent (Figure 2).

Intraoperatively, real-time TEE was instrumental in localizing the embolized stent and monitoring its movement and course (Figures 3 and 4). We observed that the stent had migrated further ahead and was found impinging on the aortic valve (Video 1-3). Incomplete valve closure led to cardioplegia leakage into the ventricle, thereby compromising cardiac quiescence, as cardiac electrical activity resumed

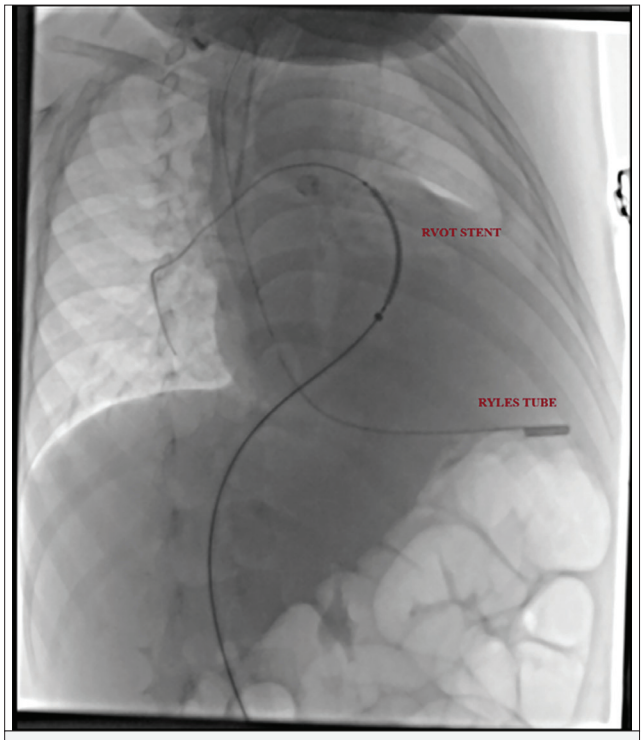


Figure 1. Angiogram just before RVOT stent deployment.

RVOT, right ventricular outflow tract.

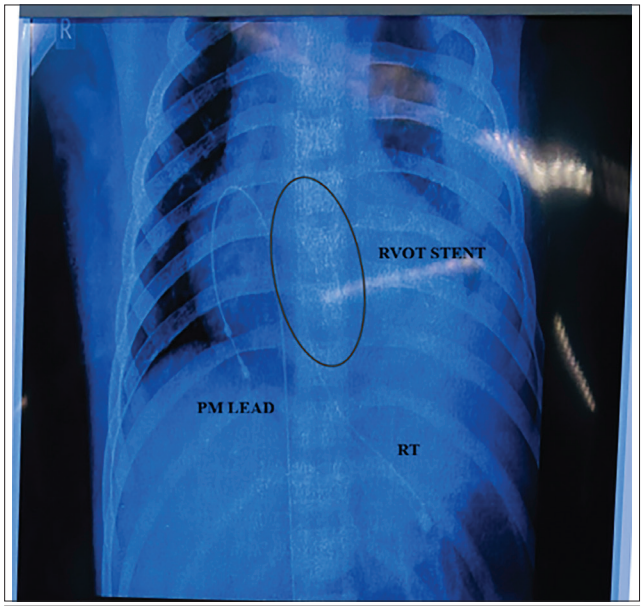


Figure 2. X-ray chest AP view showing a massive left sided pleural effusion, Ryle's tube and pacemaker lead *in situ*. Embolised RVOT stent can be seen (black circle).

PM Lead, pacemaker lead; RT, ryles tube; RVOT, right ventricular outflow tract.

shortly after cardioplegic administration (Video 4). To address this, the stent was manually repositioned away from the aortic valve by the surgeon, allowing successful re-administration of aortic root cardioplegia and achieving complete diastolic arrest, thereby facilitating safe surgical retrieval of the RVOT stent and intracardiac repair (Figure 5). Definitive repair included VSD closure, pericardial transannular patch, and PTFE monocusp pulmonary valve reconstruction. Postoperatively, TEE showed moderate pulmonary regurgitation with a gradient across pulmonary valve of 25 mmHg. The patient was transferred to the ICU, on mechanical ventilation with VVI pacing (120/min) on inotropes (adrenaline 0.125 µg kg^{-1} min, noradrenaline 0.025 µg kg^{-1} min, dobutamine 10 µg kg^{-1} min).

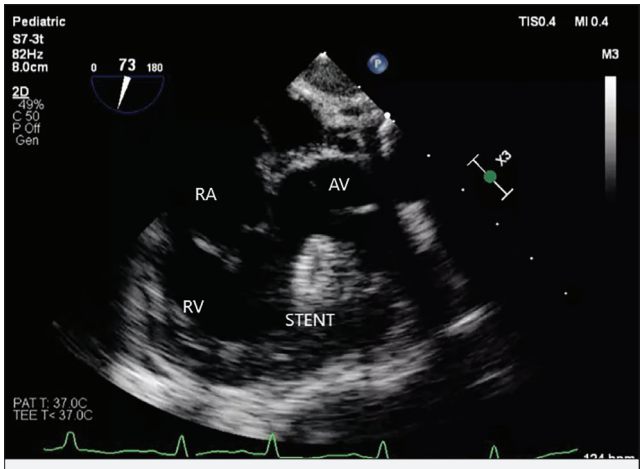


Figure 3. TEE midesophageal RV inflow outflow view demonstrating the position of the embolised RVOT device seen in the RV just below the Subaortic VSD.

AV, aortic valve; RA, right atrium; RV, right ventricle; RVOT, right ventricular outflow tract; TEE, transesophageal echocardiography; VSD, ventricular septal defect.

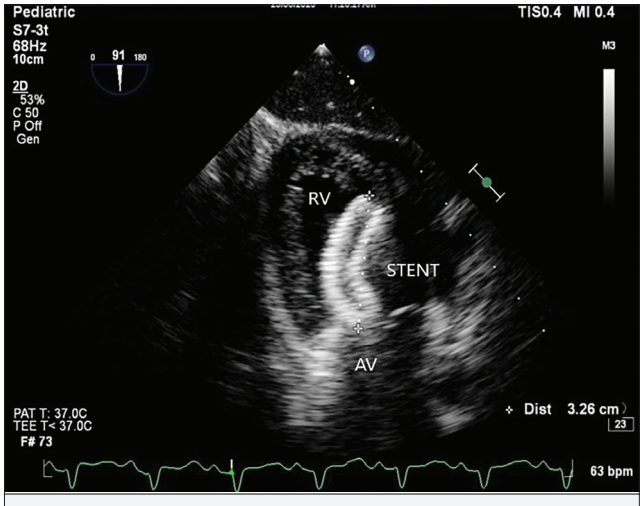


Figure 4. TEE transgastric right ventricular inflow view showing RVOT stent lodged at the subaortic VSD impinging on the RCC of the aortic valve.

AV, aortic valve; RCC, right coronary cusp; RV, right ventricle; RVOT, right ventricular outflow tract; TEE, transesophageal echocardiography; VSD, ventricular septal defect.

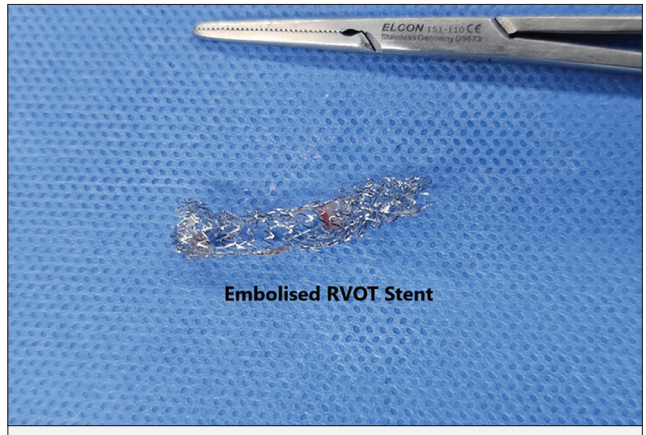


Figure 5. Surgically retrieved RVOT stent.

RVOT, right ventricle outflow tract.

Discussion

Management of severely cyanotic TOF patients with unfavorable anatomy and markedly reduced pulmonary blood flow remains controversial. While complete primary surgical repair is ideal, it is not feasible in many patients due to low weight or challenging anatomy. In addition, the modified Blalock-Taussig shunt carries a high perioperative risk and numerous potential complications.[2]

RVOT stenting has emerged as a significant palliative intervention for select patients with TOF who are not ideal candidates for immediate surgical repair due to anatomical complexities or clinical instability.[3] In infants or children with hypoplastic pulmonary arteries, cyanotic spells, or multisystem involvement, RVOT stenting can alleviate cyanotic spells and promote pulmonary artery growth before definitive surgery.[3]

Despite its advantages, the procedure carries inherent risks. Stent migration is a known, albeit rare, complication that can have serious consequences.[4] When this occurs, it can result in systemic embolization, obstruction of the aortic valve, or complications requiring subsequent surgical retrieval.[5] Furthermore, most RVOT stents cannot be crimped back after deployment, making percutaneous retrieval impossible.[6]

In our patient, the stent impinged on the aortic valve leaflets, preventing them from closing completely. Consequently, the cardioplegia administered during aortic cross-clamping leaked into the ventricle, resulting in inadequate cardioplegic arrest and posing significant intraoperative risk. This complication was particularly critical given the child's hemodynamic instability and fragile preoperative state.

Intraoperatively, real-time TEE played a crucial role. It enabled the team to identify the exact location of the embolized stent, to monitor stent migration in real time, and assess the functional impairment of the aortic valve. TEE also revealed cardioplegia leakage, prompting timely intervention during which the stent was repositioned away from the valve, permitting successful re-dosing of cardioplegia and achievement of complete diastolic arrest.

To the best of our knowledge, only one previous case has reported RVOT stent impingement on the aortic valve, resulting in aortic regurgitation during follow-up. In that instance, the presence of a subarterial VSD and a hypoplastic pulmonary valve further increased the risk of aortic valve injury.[6] This emphasises the importance of meticulous selection of stent length to minimise such complications.[3]

From a cardiac anaesthesia perspective, the case presented multiple perioperative challenges. The patient had a complex medical history including prior seizures, cortical blindness, warfarin-induced coagulopathy, and arterial thrombosis requiring digital amputation. These comorbidities increased the risk of bleeding, altered cerebral perfusion thresholds, and necessitated cautious anaesthetic planning. In general, cyanotic congenital heart disease is associated with an increased bleeding tendency owing to subtle coagulation defects.[7] During induction, careful titration of agents was necessary to prevent a drop in systemic vascular resistance, which could exacerbate right-to-left shunting.

Taken together, these considerations highlight not only the technical complexities of RVOT stenting in anatomically challenging settings but also the importance of individualized perioperative planning.

Conclusion

Stent migration during RVOT stenting in TOF can result in serious complications such as aortic valve obstruction. In this case, intraoperative TEE proved indispensable for real-time assessment and surgical guidance. The experience reinforces the need for vigilant imaging and collaborative perioperative strategies in managing complex congenital cardiac procedures.

Ethics

Informed Consent: An informed consent was obtained from the parents of the patient for publication of clinical details and images, with the understanding that anonymity will be maintained as far as possible.

Footnotes

Authorship Contributions: Surgical and Medical Practices - A.K.J., K.G., T.M., J.K.K., P.P.; Concept - A.K.J., K.G., T.M.; Design - T.M., J.K.K.; Data Collection and/or Processing - J.K.K., P.P.; Analysis and/or Interpretation - T.M., J.K.K., P.P.; Literature Search - A.K.J.; Writing - A.K.J., K.G., T.M., P.P.

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Declaration on the Use of Artificial Intelligence (AI): No artificial intelligence tools were used in the preparation of this manuscript.

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Video 1: https://youtu.be/6SSu9F-6uaU

Video 2: https://youtu.be/Us5Mudl61to

Video 3: https://youtu.be/pL6noadxRBU

Video 4: https://youtu.be/K2luhi2hKDc