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Case Report Open Access

# Multiple Detector Computed Tomography Scans Imaging of an Early Polytetrafluorethylene Patch Aneurysm after Tetralogy of Fallot Repair

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**Abstract**

Postoperative aneurysms of the right ventricle after correction of Tetralogy of Fallot are usually the consequence of a long standing pulmonary regurgitation or distal pulmonary obstruction. They occur more frequently in patients where a transannular incision has been initially applied. The aneurysm formation is usually slow with progressive dilatation of the anterior free wall of the right ventricle. We report a very early and unusual postoperative polytetrafluorethylene (PTFE) patch aneurysm accidentally discovered in the sixth postoperative week during the prolonged hospital stay due to a postoperative cerebral stroke. The dilatation of the right ventricular outflow tract could not be completely outlined by ultrasound, and Multiple Detector Computed Tomography scan (MDCT) gave an excellent insight to the anatomy of the aneurysm and provided the cardiac surgeon with necessary information. The patch had not been previously resterilized or damaged in any way. The explanted patch was not infected. PTFE aneurysms have been observed and studied for decades and were mostly related to PTFE grafts in vascular surgery. Creep or "cold flow" theories have been proposed to explain gradual stretching of the material, one of them including wall tensions dependent on the pressure and radius parameters.

## Introduction

Postoperative right ventricular (RV) aneurysm is usually a late complication after correction of Tetralogy of Fallot (TOF), seen mostly in adolescents or young adults due to a residual obstruction or free pulmonary regurgitation [1]. Nevertheless, reported aneurysms were true aneurysms of the anterior right ventricular muscular wall or autologous pericardial patch. To our knowledge, an early PTFE aneurysm has not been reported so far in pediatric cardiac surgery. We report our imaging and treatment choices in a case of an early postoperative RVOT aneurysm consisting entirely of PTFE thick walled patch diagnosed by MDCT and the final result after aneurysm resection [2].

## Case Report

A 20 month old girl was admitted as an emergency to our institution in a hypercyanotic spell. A palliation by a right sided 4 mm modified Blalock Taussig shunt (MBTS) was performed elsewhere. Heart ultrasound and cardiac catheterization demonstrated a barely patent shunt, pinhole opening of a tricuspid pulmonary valve and severe stenosis of the left pulmonary artery with marked hypoperfusion of the left lung. There was minimal anterograde flow in the RVOT due to muscular obstruction. Basic neurological examination on admission was normal. An urgent operation was performed confirming the anatomy of TOF, an adequate sized pulmonary annulus with a tricuspid stenotic pulmonary valve, a long and narrow RVOT and a hypoplastic left pulmonary artery. The ventricular septal defect (VSD) closure and a pulmonary valve commissurotomy was performed, with a transatrial and transpulmonary relief of the RVOTO and extensive autologous pericardium reconstruction of the left pulmonary artery. The initial postoperative pressure in the right ventricle was suprasystemic. Additional resection of the RVOT was performed through a small ventriculotomy and a 0.6mm PTFE patch used for reconstruction of the right ventricle. The postoperative pressure in the RV was now subsystemic which was considered acceptable considering the distal obstruction in the left pulmonary artery. The postoperative course was uneventful; she was extubated on the 1st postoperative day. The cardiac ultrasound showed a widely open RVOT, mild to moderate pulmonary regurgitation and a vast difference in sizes of the branch pulmonary arteries. On the 5th postoperative day she developed a right sided hemiparesis. Nuclear magnetic imaging (NMR) angiography of the brain demonstrated a total occlusion of the left internal carotid artery, multiple cortical infarctions and old thalamic ischaemic lesions. Protocol anticoagulation therapy with fraxiparine was commenced. Six weeks post cerebral stroke, the control laboratory results showed newly elevated levels of D-dimers. The new NMR screening of the CNS was negative. The chest X-ray was inconclusive (Figure 1). The cardiac ECHO demonstrated an unusual dilatation of the RVOT (Figure 2). There was a suspicious thrombus in the right atrium and inferior vena cava. The thrombophilia screening was negative. The cardiac catheterisation was ruled out because of the possible thrombus mobilisation, and a MDCT scan (Toshiba Aquilion) was chosen over the NMR because of the expected accuracy of the vascular and prosthetic structures [4]. The scan demonstrated a 39 mm × 39 mm right ventricular globular formation communicating with the RV cavity through an opening of 10 mm, with a clear distinction between

the PTFE patch and the ventricular muscle. The formation was positioned lateral to the left sternocostal joints (Figure 2).

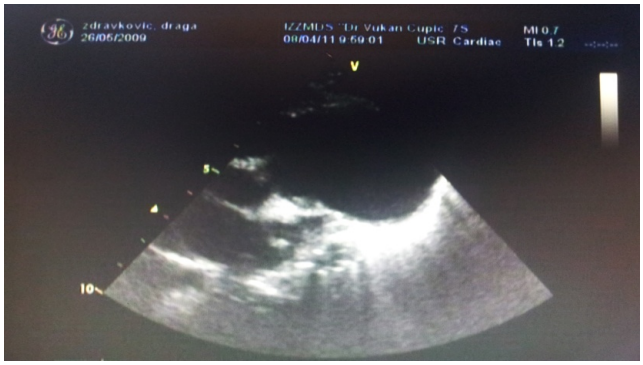


**Figure 1:** Postoperative ECHO demonstrating a huge postoperative dilatation of the RVOT

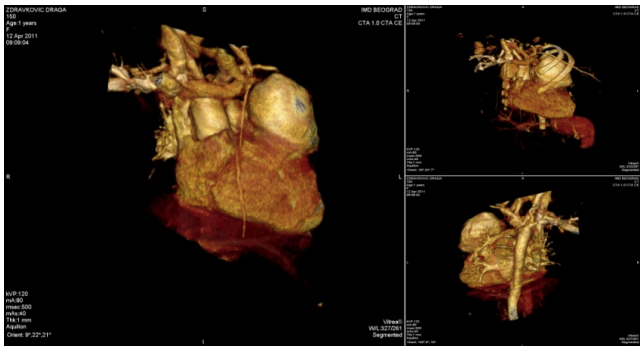

**Figure 2:** MDCT scan of the postoperative right ventricular PTFE aneurysm

The re-operation was done immediately. The intraoperative findings showed a globular formation which was partially embedded against the left sternal border and ribs. After full mobilization on cardiopulmonary bypass, the formation was found to consist of a thinned PTFE patch and a narrow strip of thinned myocardial wall to which the patch was previously sutured. The RV itself was grossly dilated but with no intracavital obstruction (Figure 3). The annulus and the pulmonary valve were preserved and competent and the intrapericardial course of the left pulmonary artery narrowed but patent. As the wall of globular formation consisted completely of a stretched PTFE patch it could not be characterized as a pseudoaneurysm, but a true aneurysm of the RVOT patch. After complete resection of the aneurysm, the two free right ventricular walls were approximated and sutured (Figure 3). The histopathology and microbiology results confirmed a sterile and thinned prosthetic material (0.25 mm versus initial 0.6 mm). The postoperative ultrasound and MDCT clearly demonstrated the reconstructed right ventricular cavity. The patient recovered uneventfully and was discharged from the hospital, but although known to be alive did not show again for follow up.

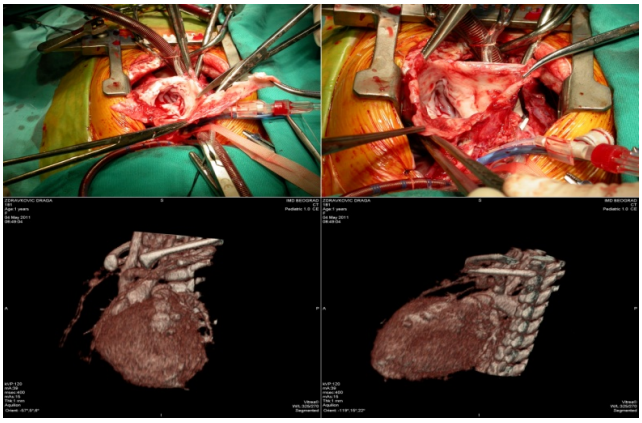

**Figure 3:** Intraoperative findings and the postoperative MDCT scan showing an excised aneurysm and reconstructed right ventricle

## Discussion

Aneurysmatic dilatation of the RVOT is a known late complication post TOF repair. It should not be mistaken with pseudoaneuysms [3,5]. Various materials can be used for reconstruction of the RV free wall, autologous pericardium being the most frequent. In this unusual case, a thick walled 0.6 mm PTFE patch was chosen because of expected postoperative residual obstruction on the level of the distal intrapulmonary hypoplastic left pulmonary artery. Although the final postoperative pressure gradient across the reconstructed left pulmonary artery was not excessive, it was obviously sufficient to dilate the PTFE patch and create an aneurysm. The patch was not previously sterilized or physically manipulated in any way. There was no infection related to this case.

PTFE aneurysms have been observed and studied for decades and were mostly related to PTFE grafts in vascular surgery [6]. Creep or "cold flow" theories have been proposed to explain gradual stretching of the material, one of them including wall tensions dependent on the pressure and radius parameters [7]. The crucial physical property of PTFE is its yield strength known to be 23 MPa. Yield strength is defined as the stress at which a material begins to deform plastically. The material will deform elastically returning to its original shape when the applied stress is removed. Once the yield point is passed the deformation will be permanent and non-reversible. Remaining pieces of PTFE were routinely discarded postoperatively. There is no clear explanation for this unique and early aneurysm in this case obviously caused by rapid stretching exceeding its yield force.

In conclusion, early PTFE prosthetic patch aneurisms can occur and MDCT scans provide the best visualization of prosthetic material and its relation to cardiac and vascular anatomy.

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