

A Quadricuspid Aortic Valve in a Patient with Neurofibromatosis Type 1

James Coulston, Joyce Thekkudan, Mohamed F. Ibrahim

Department of Cardiothoracic Surgery, University Hospital of Wales, Heath Park, Cardiff, UK

Quadricuspid aortic valve is a rare cardiovascular abnormality. Herein is described the case of a male patient with neurofibromatosis type 1 (NF1) who was found to have a quadricuspid aortic valve causing severe aortic regurgitation. Although congenital cardiac malformations have been described in patients

with NF1, to the best of the present authors' knowledge this is the first time that a quadricuspid valve in a patient with neurofibromatosis has been described.

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Case report

A 70-year-old male patient was admitted to the University Hospital of Wales, Cardiff, with angina. He was known to have neurofibromatosis, and was noted to have multiple fibromas and café au lait spots. Aside from this, he had no significant past medical history, excluding his angina. He was an ex-smoker and a hypertensive but with no other risk factors for coronary disease. The patient had Canadian Cardiovascular Society grade 3 angina and NYHA grade 2 dyspnea. He had a raised troponin T level, and was treated for acute coronary syndrome.

As such, the patient underwent an inpatient angiography that revealed triple-vessel disease with significant obtuse marginal 1 disease and an occluded left anterior descending artery. His pre-surgery work-up revealed normal spirometry and no evidence of carotid disease. Transthoracic echocardiography (TTE) indicated a normal left ventricular size, function and wall thickness. Echocardiography showed the patient to have thickened aortic leaflets, which were opening well. He had mild to moderate aortic regurgitation, mild mitral regurgitation, and a trace of tricuspid regurgitation. The pulmonary valve was reported to be normal. The aortic root area was shown (by TTE) to be 8.6 cm².

The patient was assessed by the cardiothoracic surgeons and consented to coronary artery bypass grafting with a modified euroSCORE of 6%.

Surgical procedure

The patient was anaesthetized and brought to the operating room. After harvesting of the arterial and venous conduits, he was cannulated via the ascending aorta and two-point venous cannulation. An aortic root cannula was inserted and the aorta cross-clamped. Cold antegrade blood cardioplegia was introduced via the aortic root cannula.

At this point the heart continued to beat and began to distend, and the degree of aortic incompetence was felt to be more than the mild to moderate AR found on TTE; thus, an aortotomy was performed.

The patient was found to have annular dilatation of the aortic root with a quadricuspid aortic valve. The valve leaflets were not all of uniform size, with a small (accessory) leaflet situated between the right and the non-coronary cusp of the valve. The left coronary leaflet was found to be prolapsing.

The coronary arteries were cannulated directly for the administration of cold cardioplegia. The surgeon then performed arterial bypass using the internal mammary artery to the left anterior descending and the saphenous vein conduits to OM1 and the right coronary artery. A 23-mm biological (Carpenter-Edwards) aortic valve was then inserted using an everting suture technique. The aortotomy was closed and the patient brought off bypass, with no complications.

The patient had a good postoperative period and was discharged from hospital after eight days. The findings of the operation were fully explained to him and his family.

Address for correspondence:
Department of Cardiothoracic Surgery, University Hospital of
Wales, Heath Park, Cardiff CF14 4XW, UK
e-mail: jamescoulston@hotmail.com

Discussion

The finding of a quadricuspid valve is a rare occurrence, the incidence of this congenital malformation being cited as between 0.0003 and 0.043% (1). It is generally well recognized that the majority of these cases are discovered either at autopsy or during surgery for aortic valve replacement. In this case, TTE did not illustrate the four aortic cusps and, although the regurgitation was identified, the aortic leaflets were thought to be interacting well.

In 1973, Hurwitz and Roberts studied a series of quadricuspid valves and produced a classification based on the size of the aortic leaflets (2). These authors showed that valves with unequal size cusps, as in the present case, are more likely to exhibit regurgitation.

The presence of four leaflets of varied sizes changes the biomechanics of the valve and causes an increased amount of mechanical stress on the valve. Also, the leaflets - due to their variation in size - commonly do not adhere together as well as if there were three normal equally sized aortic leaflets. These two factors can mean that there is a fault in the competence of the valve in diastole, causing regurgitation (3). The presence of active regurgitation on an abnormal valve, along with the production of abnormal flow and mechanical stresses, can cause severe symptomatic aortic regurgitation, as reported previously (1,4). In both of these reports, and also in the present patient, the regurgitation could be attributed directly to the presence of a prolapsing valve leaflet, often the smaller hypoplastic leaflet. Viewing the regurgitation in these quadricuspid valves as a progressive process with the initial congenital abnormality and the progressing abnormal stresses provides some explanation as to the reason why these isolated lesions are asymptomatic during childhood. Clearly, the effect of mounting mechanical stress, along with aortic root dilation as the patient ages, means that symptoms will only manifest themselves in later life.

Quadricuspid valves can occur in either of the semilunar valves and, in the majority of cases, as isolated abnormalities. An autopsy series of semi-lunar valves showed that the ratio of quadricuspid pulmonary valve to quadricuspid aortic valve was 5:1 (5). Various associated cardiac abnormalities have been described in association with a quadricuspid valve, including displaced coronary ostia, patent ductus arteriosus, and ventricular septal defect (3,4). However, the majority of these valves appear to occur as a single congenital cardiac abnormality.

The present patient had neurofibromatosis type 1 (NF1), an autosomal dominant condition which can be associated with a range of cardiovascular manifestations, including hypertension, though it is characterized by its cutaneous malformations, namely café au lait spots, neurofibromas and lenti. The condition has an incidence of 1 in 3500 newborns. Research into

patients with this condition has shown there to be an increased prevalence of certain cardiac structural abnormalities, including pulmonary stenosis, coarctation of the aorta and ventricular septal defects (6-8). Echocardiographic studies of patients with NF1 have shown that there is a high prevalence of cardiac abnormalities (27%). Moreover, the range of such abnormalities in NF1 is wide, and this is thought to be related to the heterogeneity of NF1 itself (8). The majority of lesions were not regarded as severe, however.

Research into the embryological etiology of these malformations indicates a presence of the neurofibromatosis gene influencing the formation of endocardial cushions. The presence of NF1 genes causes hyperproliferation of the endocardial cushion and a lack of apoptosis (9). The origin of isolated quadricuspid valve is thought to be related to abnormalities in the process of truncal septation (1,3), but it is unclear whether the NF1 genes have any influence on this process.

In conclusion, the present case appears to be the first of a quadricuspid valve in a patient with neurofibromatosis. This was an incidental finding during coronary artery surgery and, due to the significant degree of aortic regurgitation, the valve was replaced.

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