

Mechanical Heart Valve Prosthesis in the Pulmonary Position without Anticoagulation: Case Report

H. Zafer Iscan MD, Mustafa Seren MD, D. Suha Kucukaksu MD, Kemal Bayazit MD

Turkey Yuksek Ihtisas Egitim and Arastirma Hospital, Cardiovascular Surgery Clinic, Ankara, Turkey

A 10-year-old girl underwent tetralogy of Fallot (TOF) repair and subsequent pulmonary valve replacement with a St. Jude Medical mechanical heart valve prosthesis. Valve replacement was necessary due to right heart failure resulting from pulmonary regurgitation occurring three months after TOF repair. At the age of 25 years, when she became pregnant, routine cardiac evaluation indicated that

she had not used oral anticoagulation during the past 15 years. The patient was of rural origin, and of poor socioeconomic status, but is currently in her 15th postoperative year, with neither clinical problems nor any sign of valve failure.

Placement of a valve or valved conduit in the pulmonary circulation during the repair of a congenital heart defect presents a major challenge, but has become an integral part of the surgical treatment of many complex congenital heart lesions (1).

In severely dilated and hypokinetic right ventricles with pulmonary valve dysfunction, the use of a competent prosthetic valve with an expected long life span is preferred. However, this cannot be achieved with the commonly used biological prostheses (porcine or homograft) which may undergo progressive deterioration (2,3), nor with a valved conduit that might require reoperation (1,4,5). Likewise, the use of a mechanical valve has proven unpopular in the right heart (2,6,7). Consequently, the decision of which valve prosthesis is the most likely to provide the greatest durability must be made by the surgeon.

The present case report, though not providing an answer to this problem, warrants inclusion into the relevant literature as the quest continues for a right-sided heart valve replacement in childhood (1-10).

Case report

A 10-year-old girl was diagnosed with tetralogy of Fallot (TOF) in April 1988, and subsequently under-

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went infundibular resection, transannular patch plasty, pulmonary valvulotomy and patch repair of the ventricular septal defect. Postoperatively, the patient developed progressive right heart failure caused by pulmonary regurgitation, and could not be discharged from hospital. She experienced several attacks of syncope, and underwent a second operation three months later, at which time a St. Jude Medical mechanical aortic heart valve (25 mm) was implanted in the pulmonary position, with enlargement of the transannular patch. Postoperatively, she received inotropic support in the intensive care unit and was discharged on the 15th postoperative day.

The patient apparently led a normal life over the next 15 years, without any further clinical follow up examination. At the age of 25 years, she became pregnant and visited the present authors' outpatient clinic for cardiac evaluation. At this time, it was realized that the woman was not receiving any anticoagulation, including warfarin and/or antiplatelet therapy. Her physical examination was within normal limits, and she was in NYHA functional class I-II. Neither were there any signs of right heart failure, congestion, or pretibial edema. All laboratory data and signs of hemostasis were normal, with prothrombin time (PT) 14.3 s (82.1%), PT (INR) 1.21, partial thromboplastin time 44.6 s, fibrinogen 2.07 g/dl, platelet count 231,000/mm³ and hematocrit 36.8%. Transthoracic echocardiography was immediately performed and revealed normal prosthetic heart valve function, with an ejection fraction of 67% and fractional shortening of 35%. The gradient at the prosthetic valve in the pul-

Address for correspondence:

H. Zafer Iscan, Turkey Yuksek Ihtisas Egitim and Arastirma Hospital
Cardiovascular Surgery Clinic
06100-Sihhiye-Ankara
e-mail: zafirustr@yahoo.com/zizitap@hotmail.com

monary position was 38/21 mmHg. Chest radiography was not performed because of the patient's pregnancy, but electrocardiography revealed a normal sinus rhythm.

Discussion

The size of the pediatric heart requires placement of a prosthetic valve with the lowest profile and the largest orifice possible so that it can accommodate the increasing flow requirements as the child grows. Clearly, prosthesis durability is also very important in these young patients, who have a long life expectancy (7).

In children aged under 13 years, pulmonary homografts tend to offer the best choice of conduit. The placement of stents within conduits has generated much enthusiasm over the past three or four years, and may prolong conduit lifespan (1,4). A limited overall supply of the prostheses - particularly in pediatric sizes - as well as increased cost are among the primary disadvantages recognized for homografts. However, despite these limitations the cryopreserved homograft has emerged as the conduit of choice to reconstruct the pulmonary outflow tract when repairing congenital heart defects (4).

Those children who did not receive anticoagulants were significantly less free of thrombotic and thromboembolic events than adults who did receive anticoagulation (8). The present patient had not received any postoperative medical therapy for over 15 years, perhaps simply because of her rural origin and poor socioeconomic background.

In this woman, the gradient at the prosthetic valve in the pulmonary position was 38/21 mmHg. Standard echocardiography may overestimate gradients across bileaflet heart valves, and high values are not necessarily due to valve dysfunction (11). It is assumed that in this patient the gradient across the valve prosthesis may have been due to subvalvular residual obstruction, turbulence, or to paradoxical movement of the right ventricular outflow tract.

The relatively lower pressure and blood velocity on the right side of the circulation allows a build-up of tissue to occur on valves placed in the pulmonary or tricuspid positions. In contrast, a higher left or systemic ventricular pressure results in a more forceful opening and closing of the leaflet, and retards tissue ingrowth into the valve, and this may explain the absence of prosthesis failure on the left side (7). Previous experience has suggested that fewer thromboembolic complications occur in children, and although no specific explanation for this low incidence of valve thrombosis has been offered, it is likely that the relatively higher cardiac output, the faster heart rate, the lack of atrial

arrhythmias and the presence of good ventricular function may all play a role in this respect (7). The data indicate that antiplatelet therapy alone may prevent thromboembolic complications of the St. Jude Medical valve prosthesis in young patients on the left side of the circulation, but this is not the case for the right side. The value of warfarin use is also speculative, as the initiating stage of valve failure in the pulmonary position is tissue ingrowth rather than clot formation (7). The example of the present patient may support this hypothesis.

In a recent literature review, Rosti et al. (2) noted that no complications were reported in patients with a tilting disc valve in the pulmonary position, whereas thrombotic phenomena or valve failure occurred in 35% of children with a St. Jude Medical valve. The low pressure of the right heart most likely allows the deposition of fibrin and formation of microclots, predisposing to the growth of fibrous tissue within the valve annulus and in the hinges, and impairing leaflet movement (2). Reports indicate that, despite adequate anticoagulant therapy, the results of right-sided mechanical heart valve replacement were poor, with rates of thromboembolic complications between 25 and 56%, compared with only 4% for left-sided valves (2). The contributory factors may include frequent ventricular arrhythmias, reduced right ventricular contractility and paradoxical movement of the right ventricular outflow tract. These factors are thought to produce stasis and turbulence in the right ventricular cavity, with resultant thrombus formation (2,6). Sporadic cases like ours may occur, however, mechanical valves on the right side carry a high risk of thromboembolism, and the controversies still remain.

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