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# TREATMENT OPTIONS FOR PULMONARY HOMOGRAFT CONDUIT DYSFUNCTION AFTER ROSS SWITCH PROCEDURE

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**Bicuspid Aortic Valve is the most common type of aortic valve abnormality. The Ross procedure is an attractive option in the treatment of aortic valve disease in infants, children, and young adults.[1] The Ross procedure has been performed with low mortality in children and adolescents with isolated aortic valve disease.[2] Long-term outcomes after the Ross procedure remain uncertain. Although the pulmonary autograft is capable of growth, the pulmonary homograft placed in the right ventricular outflow tract (RVOT) does not grow; thus, reintervention can be expected in one quarter of these patients.[3]**
**Given the progressive homograft stenosis, careful follow-up of these patients is warranted in the second decade after operation. In this article we will discuss the types of RVOT interventions after Ross Procedure and significance of ballon dilatation in pulmonary homograft conduit dysfunction.**

**KEYWORDS:**
**Ross Switch Procedure, Homograft (a graft obtained from an organism of the same species), RVOT (right ventricular outflow tract), autograft.**

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## INTRODUCTION

The autograft procedure was introduced by Donald Ross in 1967.[4] The **Ross procedure** (or **pulmonary autograft**) is a cardiac surgery operation where a diseased aortic valve is replaced with the person's own pulmonary valve. A pulmonary homograft (valve taken from a cadaver) is then used to replace the patient's own pulmonary valve. In comparison with mechanical and homograft valves, anticoagulation is not required and the pulmonary autograft is capable of growth.[5]

Several studies reported satisfactory mid-term and long-term results of the Ross operation.[6-9] Right ventricle to pulmonary artery conduit obstruction is a common postoperative sequelae, requiring intervention. There are different options like stenting, balloon dilatation and replacement available for RVOT interventions depending upon the underlying cause. Here, we will discuss a case of 22 yr of male who underwent balloon dilatation of pulmonary valve after 14 yrs of Ross Switch procedure.

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## CASE REPORT

22 year old male, who had congenital bicuspid aortic valve, underwent ROSS SWITCH PROCEDURE 14 years ago at AFIC. He presented with complaint of exertional dysnea associated with chest pain in out patient department. His clinical examination was insignificant except ejection systolic murmur of 4/6 grade at pulmonary area.

Patient was admitted in Kulsum International Hospital for coronary angiography which showed

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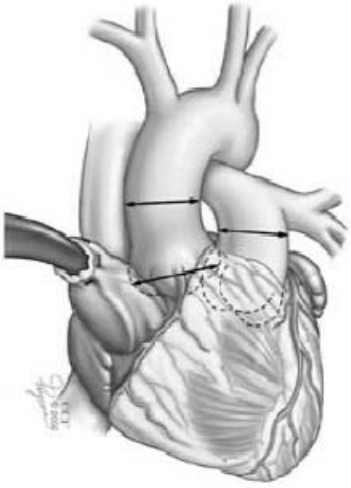
Ross Surgery with Conduit Dysfunction with normal right ventricular function. Valved RV to PA Conduit Replacement was advised. Ballooning of pulmonary Homograft conduit was done by using 12mm*4cm Cordis Balloon . It reduced the gradient across pulmonary valve to 49 mmHg. Post ballooning echocardiography showed satisfactory result with no complication.

## DISCUSSION

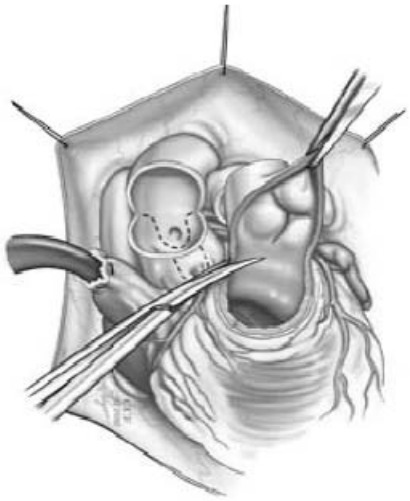
The Ross procedure is named after Dr. Donald Ross - a pioneer in cardiac surgery in the UK - who proposed the procedure in 1962[10] and first performed it in 1967. Here is brief diagrammatic explanation of this procedure.

**Step 1:** Measurement of the aortic and pulmonic valves

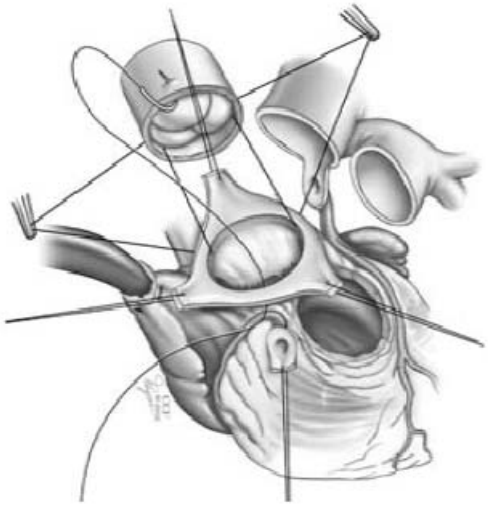


Advantages of this procedure are freedom from thromboembolism without the need for anticoagulation, valve grows as the patient grows (i.e. children), favourable hemodynamics and no foreign material present in the valve. The Ross procedure is usually performed on patients younger than ages 40 to 50 who want to avoid taking long-term anticoagulant medications after surgery. Disadvantage is Single valve disease (aortic) treated with a two valve procedure (aortic and pulmonary).

**Step 2:** The aorta and pulmonary artery are opened and the aortic and pulmonary valves are carefully inspected to determine if the Ross is an appropriate procedure.

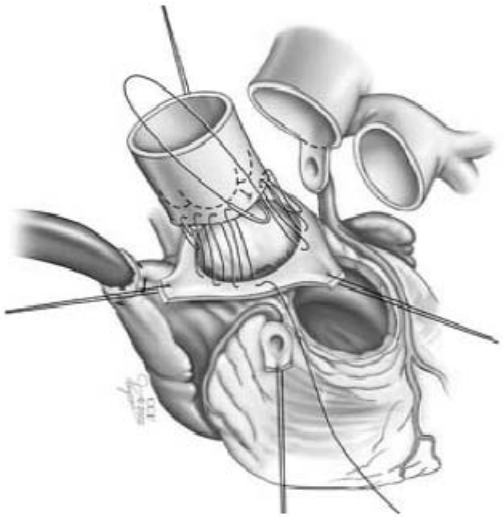


**Step 3:** The diseased aortic valve is removed. Then, the pulmonary valve (autograft) is removed and placed in the aortic position.

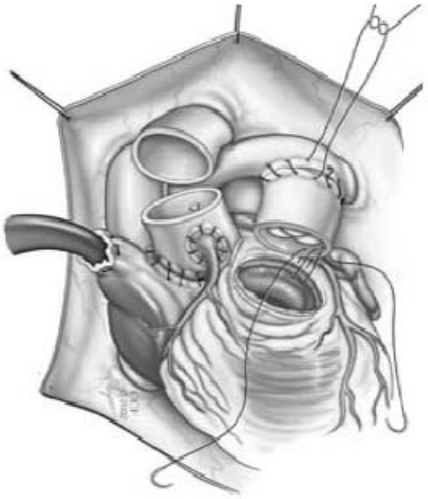


One of the main objections to the Ross procedure is the genesis of pulmonary valve disease in addition to aortic valve disease. Proponents have argued that biological valves implanted in the pulmonary position would be slow to develop dysfunction, and any dysfunction would be well tolerated due to the lower pressures in the right side of the heart. Survival of homografts in the pulmonary position is good (20-year freedom from reoperation of 80%), and

**Step 4:** The autograft in sutured in place and the coronary arteries are re-attached.



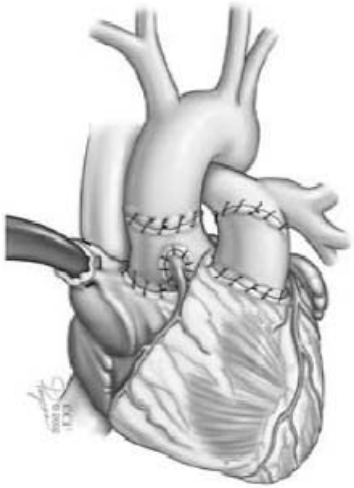
**Step 5:** A pulmonary homograft is attached to the right ventricle outflow tract.



homograft dysfunction is infrequently implicated in the observed morbidity and mortality.[11]

Homografts (aortic or pulmonary) should be the replacement of choice; no other valve performed as well in the pulmonary position. Today, cryopreservation is the method of choice for homograft preservation. Many homograft valves are sterilized with ethylene oxide or irradiation - methods recognized to have deleterious effects on valve performance. The results of the pulmonary autograft procedure are

**Step 6:** The aorta is attached to the autograft and the pulmonary artery is attached to the homograft - the procedure is complete.



likely to be superior with the use of fresh homograft valves.

Other alternatives for the Ross operation are the mechanical prosthesis, bioprosthesis, and homograft with their advantages and disadvantages. Mechanical prostheses are designed to last a lifetime but require lifelong anticoagulation therapy due to their increased thrombogenicity. Even though anticoagulation therapy is relatively safe, it does increase the risk of bleeding complications. For smaller children no artificial valves of adequate size are available and the Ross operation remains the solution of choice. Furthermore, in children or patients who want to live an active lifestyle it is preferable to avoid the use of anticoagulation therapy. And also for women in child-bearing age the mechanical prosthesis has several disadvantages, including not only a higher mortality risk during pregnancy mainly due to valve thrombosis, but also a higher risk of embryopathy with oral anticoagulants. After the Ross operation, patients require no anticoagulation therapy similar to the bioprosthesis and homograft.

Stenosis in RV to PA homografts or conduits occurs in all growing children, although the time from initial placement varies greatly depending on

the age of the child, associated lesions, the state of the distal pulmonary bed, and other factors. The pathophysiology includes mechanical distortion such as kinking or sternal compression, bioprosthetic valve calcification, diffuse intimal hyperplasia and or calcification, homograft shrinkage, or scar formation at anastomotic sites. Most of these causes of obstruction will not respond to dilation alone, but will respond to stenting. Stenosis within the homograft or conduit usually occurs at the RV or PA anastomotic sites if it is due to scar formation or mechanical distortion, and at the valve or in areas of turbulent flow due to calcification or intimal hyperplasia.

Many factors must be considered when deciding to palliate a homograft or conduit stenosis with balloon dilation. Often these stenotic lesions are associated with some degree of pulmonary insufficiency that may be exacerbated by dilation of the stenosis. Therefore , in addition to the site and presumed pathophysiology of the stenosis, assessment of right ventricular dilation and function are critical in deciding whether surgical replacement, balloon palliation, or stenting is the optimal treatment for a given patient. In case of kinking, stenting of valve will be the best option. Moderate to severe stenotic lesions that are primarily valvar, or at anastomotic sites with minimal pulmonary insufficiency where right ventricular function is largely preserved, are appropriate for balloon dilation. If severe pulmonary insufficiency is present in the setting of significant right ventricular dysfunction or endocarditis of pulmonary valve then surgical replacement is recommended. Another recent development, percutaneous valve implantation, may be applied to the degenerated pulmonary allograft. Since stenosis is the main indication for undergoing percutaneous valve replacement and since the homograft in the RVOT is subject to calcification, this could be an alternative to surgery.

After a detailed right heart hemodynamic study, an AP angiogram with moderate cranial angulation and a straight lateral will often demonstrate the stenosis best. Because there is limited capacity for homografts or conduits to tear through intima into media . The recommended balloon sizes are limited to 110% of the implanated homograft/conduit diameter. Calcified lesions may require high pressure balloons.

Dilation of stenotic valved homografts or conduits has been successful in upto 50% of cases with an average gradient reduction of 45%. The increase in insufficiency that may occur with the use of stents in homograft or conduit stenosis, particularly if the valve must be crossed, must be weighed carefully against the potential benefit of stenosis relief. Aneurysm formation or conduit /homograft rupture has been reported and is of particular risk if oversized balloons are used to dilate calcified conduits or homografts.[12]

## CONCLUSION

The Ross AVR can be performed with good mid-term results, including the pediatric age group. The potential for development of significant autograft insufficiency and homograft stenosis warrants annual follow up through the intermediate and late terms.[13]

RV-PA conduit dysfunction after the Ross procedure can be successfully treated with balloon dilatation of PV, if right ventricular function is well preserved. This may help decrease the cumulative surgical burden in the lifetime management of right ventricular outflow tract lesions and thus justifies a further review of the Ross operation, particularly for young patients.

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