The American Journal of Medical Sciences and Pharmaceutical Research
(ISSN – 2689-1026)
Published: October 09, 2020 | **Pages:** 11-18
Doi: https://doi.org/10.37547/TAJMSPR/Volume02Issue10-02

IMPACT FACTOR
2020: 5. 286
OCLC - 1121105510

First Experience Of Ross Procedure In A Child With Bicuspid Aortic Valve

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ABSTRACT

Study objective. Evaluation of the immediate results of Ross procedure in a patient with aortic valve pathology.

Material and methods

This article describes the results of surgical treatment of 1 patient (11 years old) who underwent Ross procedure for aortic valve defect. The results of surgical treatment during the hospital period are analyzed.

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The results

There have been no cases of hospital death. There were no cases of acute cardiac insufficiency due to coronary circulation disorder during the operation. There were no complications in the postoperative period. The control ultrasound of the heart showed good hemodynamic parameters before discharge of auto- and allograftt.

Conclusion

Ross procedure, performed in patients under puberty may contribute to avoid reoperation, since the autograft grows in parallel with the child's body, without subsequently causing a pressure gradient in the position of the aortic valve. To determine the effectiveness of the operation, it is necessary to assess medium - and long-term results.

KEYWORDS

Aortic valve disease – Ross procedure - Autograft - Left ventricular outflow track.

INTRODUCTION

First performed in 1967 by Donald Ross, autotransplantation of the pulmonary artery valve into the aortic position allowed a new look at the treatment of patients with aortic valve pathology [1].

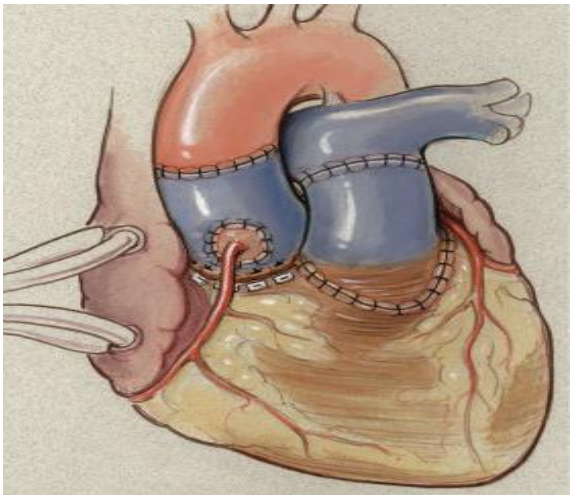

Fig. 1. Scheme of Ross' operation. Aortic root replacement with pulmonary autograft with coronary artery reimplantation.

Pulmonary autograft demonstrates optimal hemodynamic characteristics, is silent, resistant to infection, thromboembolic complications and hemolysis, retains function for a long time, grows together with other organs, so it can be an alternative to mechanical and biological valves in correction of aortic valve defects in patients with aortic pathology [2-5]. Positive results of Ross surgery have been published as an alternative to Bentall-De Bono surgery in patients with dilation of the ascending aorta [6].

MATERIALS AND METHODS

In December 2017 in our center, a Ross operation was performed on a male child aged 9 years old with a combined aortic defect with a predominance of insufficiency of the third degree who was hospitalized in the department as planned.

At the time of admission the patient complained of shortness of breath, heartbeat

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and rapid fatigue at moderate physical activity, weakness over the past 3 months.

In the preoperative period, the patient underwent standard laboratory and instrumental investigations: a clinical and biochemical analysis of blood and urine were without shiftings in indicators. According to the echocardiographic examination patient was diagnosed with: bicuspid aortic valve, grade 3 incompetence of the aortic valve . Bicuspid aortic valve with a systolic pressure gradient of 24.3 mm Hg as well as regurgitation on the aortic valve up to 3rd degree. Intracardiac shunting was not found. Ascending aorta - 2,0 cm, fibrous ring of aortic valve-18 mm. End diastolic volume- 65.1 ml, ejection fraction - 62.6%.

In order to clarify anatomy and angiomorphometry, the patient underwent angiocardiographic examination of the heart and main vessels: fibrous ring of the aortic valve-30 mm, aortic diameter at Valsalva level - 26 mm. ascending aorta- 34.5 mm. Diameter of the pulmonary valve fibrous ring - 20 mm. End diastolic volume of left ventricle - 138 ml, ejection fraction - 52%.

To evaluate the condition of the aortic root and to plan the volume of the forthcoming operation in our center, we routinely use a multislice CT scan with contrast enhancement, which revealed the following: aorta at valve level 32 mm, ascending aorta 28 mm, aortic valve leaflets thickened and deformed. Pulmonary trunk at valve level 28 mm.

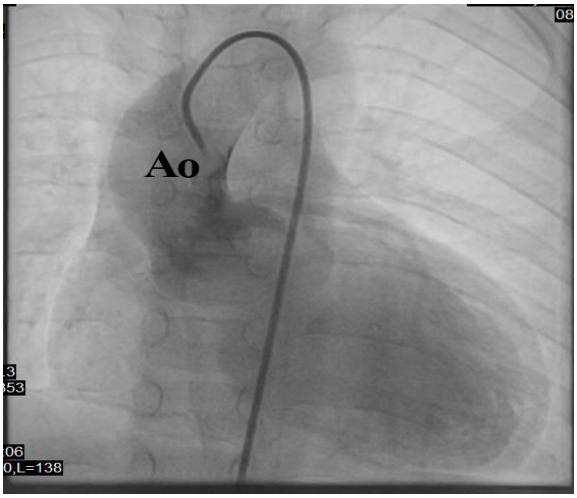

Fig. 2. Angiocardiography: Aortic valve stenosis.

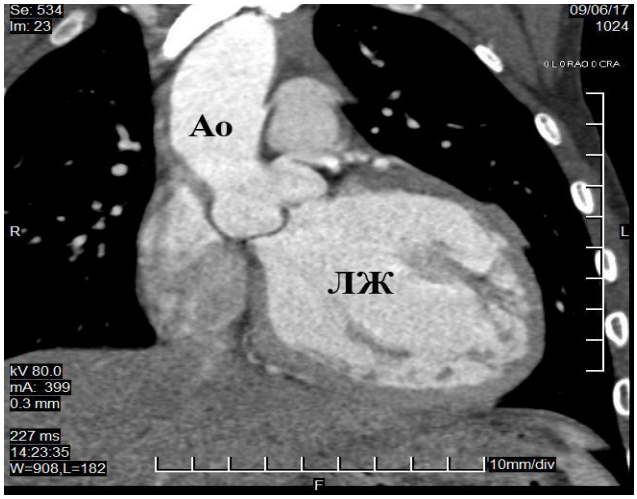

Fig. 3. MSCT: Aortic valve stenosis.

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Taking into account the condition of the aortic valve and the possible need for its replacement, based on the age of the patient and the risk of reoperation in case of its replacement, it was decided to consider the option of performing of Ross' operation in this patient. It should be noted, that good anatomy (adequate diameters of the main vessels and fibrous rings of the valves) contributed to this decision.

In this connection, the patient underwent a Ross operation (implantation of a pulmonary autograft in the aortic position with reimplantation of the coronary ostia and the formation of right ventricular outflow tract (RVOT), pulmonary trunk with the formation of a monocusp) under conditions of cardiopulmonary bypass for 155 minutes and pharmaco- cold cardioplegia 129 min with moderate hypothermia of 32 degrees Celsius.

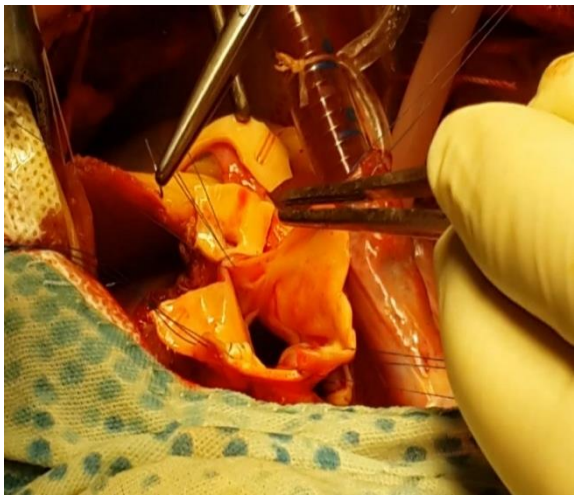

Fig. 4. General view of the pulmonary autographt after collection.

Fig. 5. Reimplantation of the left and right coronary arteries

In planning the extent of the operation for reconstructing the right ventricular outflow tract and forming the locking element in the pulmonary position, it was decided to use its own development, i.e., to form the RVOT and the pulmonary trunk by an autopericardial patch with a monocusp made of synthetic patch.

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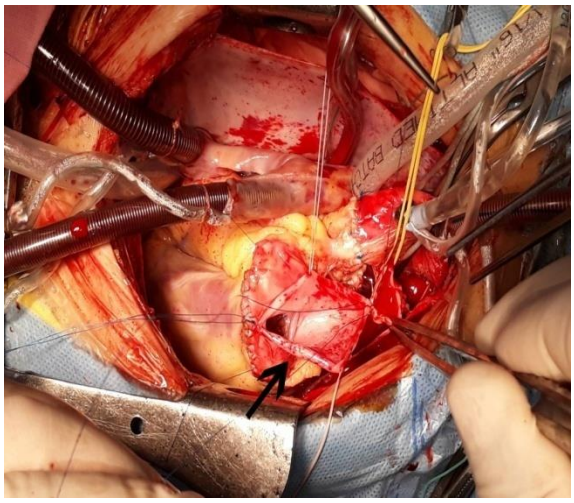

Fig. 6. Creation of a mono-cusp from a synthetic patch and a "cover" of RVOT in the position of the pulmonary valve.

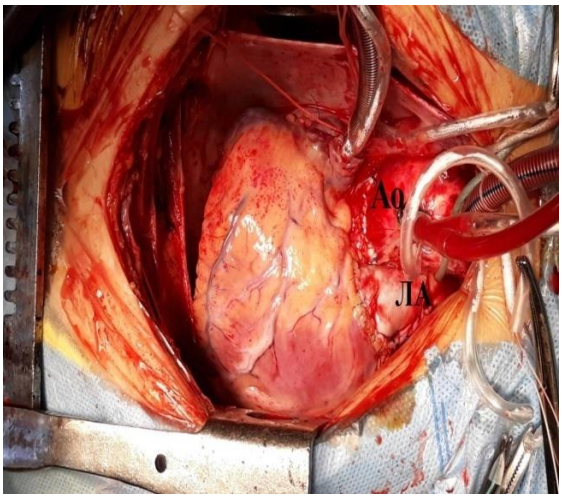

Fig. 7. Intraoperative view of the heart after full completion of the reconstruction.

To assess the quality of the intervention, we carried out a control MSCT whose results are presented in Fig (8-9)

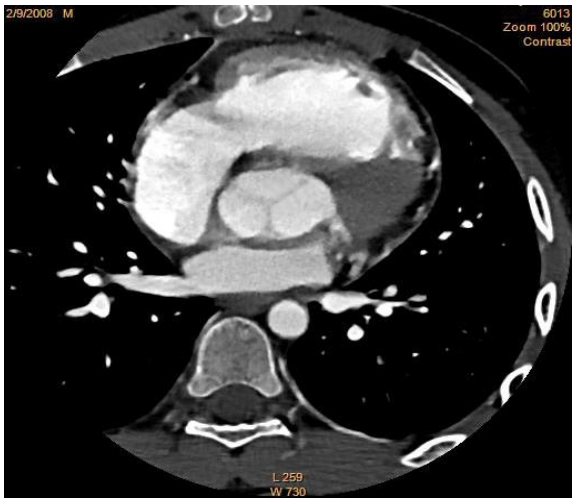

Fig. 8. Postoperative MSCT. General view of the valve autographt.

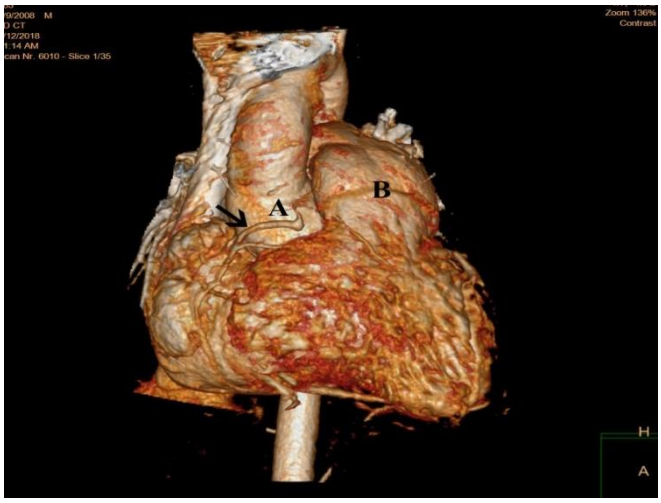

Fig. 9. MSCT. Longitudinal section of the heart at the level of RVOT and aorta.

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The postoperative period was relatively favorable without any surgical problems of postoperative wound. On postoperative echocardiography it was noted: on LVOT and RVOT laminar flows with a systolic pressure gradient of 6.8 mm Hg and 12 mmHg respectively. End diastolic volume of the left ventricle - 67 ml; ejection fraction-63%. The patient was discharged home in satisfactory condition on 8th day, under the supervision of a cardiologist at home area with appropriate recommendations.

DISCUSSIONS

The problem of the long-term period in aortic valve replacement in children is a mismatch of the diameter of the aortic valve with age parameters as a result of growth of the organism [7–9].

In 2013. Skillington and co-authors published the successful results of the long-term period of observation after Ross' operation: their own aorta was used to strengthen the pulmonary autograft. The technique of intraaortic implantation of pulmonary autograft allows to reduce the cases of aortic regurgitation and reduce the need for repeated intervention at the aortic root and aortic valve. Twenty years of analysis have shown the optimal geometry and function of the neoroot of aorta. Strengthening the pulmonary autograft in Ross's operation is a decisive factor in the viability of the aortal neoroot and therefore a key factor to avoid repeated surgery [8, 10].

Reimplantation of coronary arteries is critical in intra-aortic implantation of a pulmonary autograft [11].

Some authors suggest implantation of the pulmonary autograft into a synthetic vascular implant, believing that such a technique is technically simpler and does not require additional time. This method of strengthening the neoroot of the aorta shows positive long-term results [11-14].

Successful performance of Ross' operation, especially in children, depends on strict and consistent adherence to a number of technological principles:

1. Adequate protection of the myocardium from ischemic damage during aortic occlusion, when normal antegrade coronary perfusion is absent;
2. Precise observance of the surgical protocol of the operation:

Preparation, extraction an sampling of the pulmonary autograft;

implantation of xenograft into the position "right ventricle - pulmonary artery system"; choice of the level of reimplantation and orientation of the coronary ostia in implantation of pulmonary autograft;

the choice of the method of pulmonary autograft implantation, assessment of the need for reduction of the implantation site and its strengthening in order to prevent subsequent dilatation of the neo-aortic root [16].

The main and specific cause of surgical lethality for Ross' operation is coronary circulation disorder in the LCA system. Thus, Oury J.H., Mackey S.K., and Duran C.M.G. put it in first place among all problems because of the high complexity of the surgical technique [17].

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CONCLUSION

The Ross operation is a real alternative to mechanical graft for the correction of aortic valve defects in children. The low hospital mortality and the stability of the long-term results allow recommending it in clinical practice for pediatric patients, in order to avoid reoperations in the long term after the operation, as well as for patients who have contraindications for taking indirect anticoagulants. Despite the relative simplicity and reproducibility of implantation of pulmonary autograft in the form of a root, it is also advisable to evaluate the subcoronary technique as a way to prevent dilatation of the neo-aortic root represented by the wall of the pulmonary artery.

Diagnostic findings and objective examination data of patient M. 9 years showed that his condition is satisfactory. The patient notes the complete disappearance of preoperative complaints.

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