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Research Article

Patch Enlargement of the Aortic Root with the Incision in Right Muscular Trigone of Left Ventricle Outflow Tract

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Abstract

Successful aortic stenosis treatment depends on the corresponding prosthesis size implantation. Valve effective orifice index by S. Rashimtoola must exceed 0.85. In our practice we used two methods of aortic rot enlargement. Incision of the posterior aortic wall and mitral-aortic curtain by Nicks R. The second were the same maneuvers with incision prolongation on mitral valve anterior leaflet by Rittenhouse E.A. However, in the cases of advanced aortic root calcinosis these incisions seem to be critically dangerous. In these circumstances it is possible to change the incision direction to the right muscular trigone of the left ventricle outflow tract.

During 01.01.2015-01.09.2021 in the Cardiac Surgery Department of Belgorod regional clinic there were 28 cases of posterior aortoplasty in patients with 21-sized prostheses. Of them the aortoplasty with right muscular trigone incision constituted 4 cases. In all aortoplasty technics we didn't meet problems with hemostasis or conductive pathway lesion.

The literature review, our practice in David T.E. operation showed small surgical risks for posterior aortoplasty with right muscular trigone incision. It may be used in cases with mitral-aortic curtain and MV anterior leaflet calcinosis.

Keywords: Posterior Aortoplasty; Left Ventricle; Outflow Tract

Abbreviations

MV: Mitral Valve; AV: Aortic Valve; TV: Tricuspid Valve; IVS: Interventricular Septum; LVOT: Left Ventricle Outflow Tract; RVOT: Right Ventricle Outflow Tract; NCC: Non-Coronary Cusp; RCC: Right Coronary Cusp

Introduction

Aortic valve disease is the second most common heart disease in adults after ischemic disease. The success of surgical treatment of aortic stenosis depends on accurate knowledge of the complex anatomy of the aortic root and surrounding structures. Technically,

success is determined by the effective area of the implanted prosthesis opening, in other words, by the diameter of the internal lumen of the prosthesis. As well as its sufficiency for a particular patient. It is known that the insufficient value of the effective area of the orifice of the implanted prosthesis leads to a prolonged and incomplete regression of left ventricular hypertrophy and the preservation of its diastolic dysfunction [1]. The valve matching problem has two parts. The first is the surface area of the patient's body, calculated on the basis of his height and weight, and which at the time of surgery may differ greatly from the ideal height-weight ratio. The second part is the actual hypoplastic aortic root with small diameters of the aortic annulus and root at the level of the sinuses of Valsalva. To standardize the compliance of the prosthesis with a specific patient, the S. Rashimtoola scale was adopted [2]. For a surgeon, two questions arise in practice: 1). Will the implantation of a small prosthesis be sufficient for the regression of the clinic of aortic stenosis and morphological changes of the myocardium? 2). Should the aortic root patch be expanded in order to implant a larger valve size? Some researchers believe that the situation of the prosthesis-patient discrepancy is not common and can be neglected in the group of age-related patients [3].

However, most surgeons claim that this phenomenon is quite common and has serious clinical consequences [4]. Also, based on the results of long-term multicenter studies, the authors report a registered incidence of patient-prosthesis mismatch of 2-20% [5]. And therefore, it is concluded that an additional procedure for expanding the aortic root with a patch is required in no less than a percentage of cases of prosthetics of the aortic valve [6,7]. For example, in the multicenter database according to Yu W [7], the frequency of aortic plasty was more than 42%.

In adult patients, the expansion of the aortic root is performed by posterior aortoplasty. The most frequently performed are posterior aortoplasties by Nicks R. 1970 [8] and Manouguian S., Seibold-Epting U. 1979 [9]. During these operations, an incision is made of the mitral-aortic membrane and the anterior leaflet of the mitral valve. However, there are several situations when dissection of these structures is difficult or undesirable. For example, with their rough calcification or with mitral-aortic prosthetics.

Therefore, there is a need to perform aortic plasty, avoiding mitral-aortic membrane. The way out of the situation can be by changing the direction of the incision. It can be carried out on the muscle part of of the left ventricle outflow tract.

Materials and Methods

During period 01.01.2015-01.10.2021 in the Cardiac Surgery Department of Belgorod regional clinic there were 36 cases of posterior aortoplasty in 405 (8,9%) aortic implantations of valves 19-23 sizes. In the group of valves 19-21 sizes there were 28 cases of posterior aortoplasty in 190 (14,7%). The patient statistics is shown in the table 1. A median sternotomy approach, cardiopulmonary bypass with aorta and right atrium cannulation and with left heart venting were used. After cold blood cardioplegia an oblique aortotomy with continuation in noncoronary sinus was applied. The aortic valve was fully excised with measurement of the aortic annulus. The measurements of the annulus, effective orifice area of the prosthesis and the patient's body surface area were used to calculate the need for aortoplasty by Rashimtoola S.H. [2] index.

Preoperative data	
Age	67,61 ± 4,5 (63-77)
Sex	F = 25 M = 3
NYHA FC	II – 18 III - 10
LV EF	45-55% - 8 > 55% - 20
Peak valve gradient	98,2 ± 28,5 mmHg
Mean valve gradient	44,8 ± 20,5 mmHg
Mitral regurgitation	1+ (N = 13) 2 + (N = 15)
BSA	1,84 ± 0,14 (1,49-2,04)
Prosthesis EOA	1,78 cm²
Index Prosthesis EOA / BSA	0,96
Postoperative data	
LV EF	45-55% - 2 > 55% - 26
Mitral regurgitation	1+ N = 13 2 + N = 15
Peak prosthesis gradient	21,52 ± 5,64 mmHg (17-28)
Mean prosthesis gradient	10,67 ± 2,85 mmHg (8-14)

Table 1: Preoperative and postoperative patient`s statistics.

The most often used technique was Nicks R., 30 cases. In 2 cases we used this technique with extension of the Nicks R. incision on the medial part of the mitral valve anterior leaflet by Rittenhouse E.A. [10], In 4 cases of 21-size prosthesis implantation we met extremely advanced aortic root calcinosis. The calcification was expanded in to the mitral-aortic membrane and mitral valve anterior leaflet. These structures were debrided with plasty by single U-shape sutures with pledgets in some cases. The advanced degeneration made dangerous incision and patch sewing in this zone. To extent the aortic annulus we had to change the incision direction.

The initial vertical noncoronary sinus dissection was continued apart from mitral-aortic curtain. It was turned to lateral part of the noncoronary annulus arc, transected it and then continued on the right muscular trigone of the left ventricle outflow tract (Figure 1). This trigon is located between right coronary and noncoronary Valsalva sinuses. The synthetic patch sewing was started with the synthetic pledge in the nadir of the incision (Figure 2) located inside in left ventricle outflow tract. This incision permitted to add 3 U-stitches on the patch to the perimeter of the aortic annulus. The prosthetic valves were fixated with U-stitches with synthetic pledges from under the fibrous ring or outside the patch.

Figure 1: Scheme of posterior aortoplasty incisions.
1. Incision by Manouguian S. 2. Incision by Nicks R. 3. Incision continued on the right muscular trigone of the LVOT. 4. RCC. 5. NCC. 6. Muscular trigone between NCC and RCC. 7. Left branch bundle Hiss. 8. A-V node. 9. Hiss bundle. 10. Basal myocardium of the IVS. 11. Nadir of the right AV arch. 12. RVOT. 13. TV septal leaflet.

Figure 2: Posterior aortoplasty with incision in muscular trigone between noncoronary and right coronary sinuses.
1. Transected aorta. 2. Incision continued on the right muscular trigone. 3. Left atrium anterior wall. 4. Anterior leaflet of the MV. 5. U-stitches with synthetic pledges from under the fibrous ring. 6. Synthetic pledge in the nadir of incision.

Results

There was no mortality, atrioventricular blockade and hemorrhage in the group with aortoplasty. We had the only one case of paraprosthetic leak 2 mm in diameter which was valued as hemodynamically insignificant. Rashimtoola S.H. Index (prosthesis effective orifice area/BSA) constituted 0,96. Echocardiography measurements revealed normal LV EF, low peak and mean prosthesis gradients (Table 1). Patients were discharged 11-14 days after operation.

Discussion

Posterior aortoplasty is an important additional manipulation in the prosthetics of the aortic valve, aimed at implanting the valve size required by the patient's height and weight indicators. Recently, practice has shown that performed according to indications, it gives excellent clinical results [11]. Extensive samples of patients have shown that the risk of aortic dilation procedure by a set of methods (bleeding, failure of patch sutures) does not exceed the surgical risks of isolated aortic valve replacement [12,13].

The second problem of prosthetics of the aortic valve is a complete postoperative A-B block, requiring implantation of an artificial pacemaker. Mehaffey J.H. 2018 [14] reports the frequency of A-B blockades of 2.9% for 2,600 operations and leads to a decrease in the long-term survival of patients after implantation of the EX. Klapkowski A, 2016 [15] cites 6.9% of pacemaker implantation for 159 operations, which can probably be explained by less experience. The statistics described by Liebrich M, 2013 [16] turn out to be very interesting, according to which, with valve-preserving prosthetics of the aortic root (David T.E. operation), the frequency of implantation of the pacemaker out of 236 patients was 2.9%, which completely corresponds to the frequency of this complication with isolated prosthetics of the AC. Performing the David T.E. operation [17] requires deep isolation of the aortic root and the

excretory tract of the left ventricle. The suturing of the aortic prosthesis is performed by outward-facing U-sutures from inside the outflow tract of the left ventricle. In particular, the right muscular LVOT triangle is stitched, through which we propose to make an incision to expand the aortic root. Moreover, the imposition of these U-sutures is performed even deeper than the dissection of the right muscular triangle with the plastic surgery we offer. The safety of work in this zone confirmed by the results of the review and meta-analysis of Salmassi MY, 2019 [18]. Where he compared the results of operations of David T.E., and Bentall De Bono. Long-term multicenter studies have revealed even a slightly smaller number of complications in the form of bleeding and atrioventricular blockade using the David T.E. technique.

Conclusion

Our practice of performing David T.E. and Nicks R. posterior aortoplasty operations has shown that with careful execution, these techniques do not have a high risk of bleeding and damage to the conductive pathways. The technique of posterior aortoplasty performed by us in 4 cases with dissection of the right muscular triangle has no higher risks compared to other techniques. It can be used in cases of a narrow aortic root in combination with gross calcification of the aortic valve and surrounding structures. And also in cases of mitral-aortic prosthetics.

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