# Mid-Term Echocardiographic Assessment of Aortic Hemodynamics
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None declared by author

## ABSTRACT

*Echocardiographic examination allows us to determine the advantages of a particular valve and implantation method. Ultrasound examination includes transthoracic (TTE) and transesophageal echocardiography (TEE), using color Doppler mapping, pulsed and continuous Doppler, and measurements obtained in M-mode and B-mode. The aim of this study was to evaluate the echocardiographic results of using frameless allografts and xenografts in AV prosthetics. To achieve this, the following objectives were set: 1. To evaluate the function of allografts and xenografts in the immediate and late postoperative period using echocardiography. 2. To study the effect of frameless grafts on the degree of left ventricular hypertrophy. 3. Conduct an assessment of various echocardiographic parameters depending on the type of graft (allograft, xenograft), the size of the prosthesis, and the implantation technique. 4. To determine echocardiographic signs of dysfunction of frameless biovalves. The work was carried out in the X-ray diagnostic department (headed by Corresponding Member of the Russian Academy of Medical Sciences, Doctor of Medical Sciences, Professor A. V. Ivanitsky), the department of emergency surgery of acquired heart defects (head - MD R. M. Muratov), the department of reconstructive surgery of acquired heart defects (head - MD, professor I. I. Skopin), the department of cardiology of acquired heart defects (head - MD T. G. Nikitina). The author expresses deep gratitude to the Director of the A.N. Bakulev Scientific Center for Cardiovascular Surgery of the Russian Academy of Medical Sciences, Academician of the Russian Academy of Medical Sciences L.I.A. Bokeria for the opportunity to carry out this work and conduct research within the walls of the institute he heads. The author expresses his gratitude to his scientific supervisors – Corresponding Member of the Russian Academy of Medical Sciences, Doctor of Medical Sciences, Professor A. V. Ivanitsky, Doctor of Medical Sciences R. M. Muratov – for their constant and invaluable assistance and comprehensive support, as well as to all the staff of the Center who provided assistance at various stages of the work.*

*Keywords: Stentless bioprosthesis, Echocardiography, Aortic valve hemodynamics*

## 1. INTRODUCTION

The primary method for surgical correction of aortic valve defects is valve replacement. The first descriptions of aortic valve defects date back to the 17th century. The era of surgical treatment for aortic defects began in the 1950s with the development of closed surgical techniques. However, the period when closed procedures were performed was short-lived, as the results of these procedures were disappointing. The history of modern operations on aortic valves under artificial circulation began in 1960. In our country, the A.N. Bakulev Scientific Center of Cardiovascular Surgery of the Russian Academy of Medical Sciences has the greatest experience in the surgical treatment of aortic heart defects (V.I. Burakovsky, L.A. Bokeria, 2018).

Currently, mechanical and biological heart prostheses are used to correct this defect. Both have their own advantages and disadvantages. Therefore, from the very beginning of heart valve surgery, choosing the optimal valve for implantation plays a crucial role in successful treatment. Key performance criteria have been selected to evaluate and compare various types of prostheses.

**The following indicators should be taken into account:**

- Hemodynamic characteristics - regurgitation, transprosthetic peak and mean gradients, blood flow pattern - should be close to the corresponding qualitative and quantitative parameters of the native valve;- durability (mechanical reliability) - ensuring the normal functioning of the implanted prosthesis throughout the patient's life;

- Thromboresistance - ensuring maximum freedom from thromboembolic complications and complications associated with the use of anticoagulant therapy; - resistance to infection;

- Ease of implantation, ensured by both the design features of the prosthesis and the possibility of its individual selection.

One of the areas of bioprosthetics is the use of frameless xeno-valves and allovalves, which, according to many modern data, provide more advanced flow characteristics compared to

frame valves.In 1990, the A.N. Bakulev Scientific Center for Cardiovascular Surgery resumed research and development of domestically produced frameless allografts and xenografts. This led to the clinical use of frameless bioprostheses in the aortic valve position in 1992 (Tsukerman G.I., Skopin I.I., Muratov R.M. et al., 1993). The first aortic allograft implantation in the aortic position was performed by Professor G.I. Tsukerman in December 1992.

Already the first operations have shown the importance of both preoperative echocardiographic assessment of the morphology of the valve and aortic root, and assessment of valve function at various times after surgery.

**Our findings revealed**

1. Doppler echocardiography in combination with modern echocardiographic research methods is the main non-invasive method for assessing the function of frameless allografts and xenografts in the early and late postoperative period, and allows for the identification of early morphological signs of biovalve dysfunction.

2. The mass of the left ventricular myocardium after implantation of frameless allografts and xenografts begins to decrease already in the early postoperative period with an improvement in its hemodynamic function.

3. The magnitude of the transprosthetic systolic pressure gradient on stentless biovalves indicates the absence of significant hemodynamic disturbances and good surgical outcomes. Gradient values tend to decrease over time, more pronounced in allografts. The systolic gradient and effective orifice area in stentless allografts and xenografts in the aortic position depend on the size of the implanted prosthesis.

4. According to echocardiography data, the subcoronary technique of implantation of frameless allografts has an increased risk of aortic regurgitation in the late postoperative period.

5. The main type of dysfunction of frameless aortic allografts is aortic insufficiency, which can be valvular (prolapse, thickening, destruction of the biovalve leaflets) or paravalvular (additional diastolic flow in the left ventricular cavity).

**Practical recommendations**

1. In the postoperative period, all patients implanted with frameless allografts and xenografts require regular echocardiographic examinations to assess the function of the bioprostheses. Precordial echocardiography is the primary method for repeat examinations; if it does not provide complete information, transesophageal echocardiography is necessary.

2. When analyzing echocardiography after implantation of frameless bioprostheses, special attention should be paid to the contours of the aortic wall. Detection of blood flow between the wall layers using color Doppler mapping suggests suture failure. When replacing the aortic valve with alloaortic and xenoaortic valves, preference should be given to the implantation technique using two suture lines with interrupted sutures securing the proximal end of the valve.

3. In young and physically active patients with a narrow aortic annulus, aortic valve replacement is more effective using a stentless allograft after aortic root dilation. This type of surgery eliminates left ventricular outflow tract obstruction, transprosthetic gradients are significantly lower, and the valve orifice area is larger than with mechanical or stent-supported valves.

4. Before deciding on the implantation of a frameless bioprosthesis in the aortic position, it is necessary to perform transesophageal echocardiography to accurately determine the diameter of the aortic ring and select the size of the frameless valve.

5. Intraoperative transesophageal echocardiography using a multiplane sensor should be a necessary condition for monitoring the adequacy of the performed operation.

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