MODERN TRENDS IN HEART VALVE PROSTHETICS

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Abstract. Currently, it is becoming clear that standard techniques for heart valve replacement are suboptimal. Non-physiological hemodynamics, the presence of prosthesis-dependent complications in the form of thrombosis, prosthetic endocarditis, early biodegradation are the main factors that do not allow these prostheses to be an "ideal replacement" for the affected valve. Modern operations on the aortic valve allow almost complete reproduction of the natural anatomy and give encouraging results of application. This review is devoted to the discussion of modern trends in heart valve replacement.

Keywords: heart valve replacement, cardiac surgery, heart valves, cardiovascular complications.

СОВРЕМЕННЫЕ ТЕНДЕНЦИИ ПРОТЕЗИРОВАНИЯ КЛАПАНОВ СЕРДЦА

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Аннотация. В настоящее время становится ясно, что стандартная техники протезирования клапанов сердца являются субоптимальными. Нефизиологичная гемодинамика, наличие протеззависимых осложнений в виде тромбоза, протезного эндокардита, ранней биодеградации – основные факторы, которые не позволяют данным протезам быть «идеальной заменой» пораженного клапана. Современные операции на аортальном клапане позволяют почти полностью повторить естественную анатомию и дают обнадеживающие результаты применения. Данный обзор посвящен обсуждению современным тенденциям протезирования клапанов сердца.

Ключевые слова: протезирования клапанов сердца, кардиохирургия, сердечные клапаны, сердечно-сосудистые осложнения.

Relevance of the research

Congenital and acquired valvular heart defects are an important medical and social problem both in the Russian Federation and worldwide. In our country, approximately 60 thousand patients require heart valve replacement, while only about

20 thousand operations are performed per year [1]. Many cardiac surgery centers currently have old prosthetic technologies available, which significantly limits the indications for surgery. Modern minimally invasive and endovascular technologies are used extremely sparingly, not to mention high-tech interventions for the most physiological replacement of the affected valve [2].

The gold standard of heart valve replacement is frame prosthetics. Frame heart valve prostheses have the following design: they consist of a supporting apparatus, usually made of titanium, and a locking element made of a rigid material, such as carbide, or biological tissue. Such prostheses are fixed to a rigid support ring with U-shaped sutures. This technology is standardized, modern design bureaus produce entire lines of sizes for selecting a prosthesis based on the size of the support ring. Due to a clearly developed algorithm, the time of aortic clamping and the operation time is at the level of 40-50 minutes, which is quite acceptable for modern anesthetic care and carries minimal risks [3]. At the same time, the use of standard frame prostheses is limited. If a mechanical valve prosthesis is used, the patient who received it is doomed to lifelong anticoagulation with warfarin, a vitamin K antagonist [4].

This drug is extremely difficult to dose; when its concentration is exceeded, the hemostasis system shifts towards hypocoagulation, which is associated with a high risk of hemorrhagic complications (these complications can occur idiopathically, for example, hemorrhagic stroke, or be associated with trauma, due to which the patient is limited in physical activity and must protect himself from injuries). An insufficient dose, on the contrary, is associated with hypercoagulation - thrombosis of the mechanical prosthesis occurs due to suboptimal prosthetic hemodynamics and foreignness of the locking element of the structure. In addition, the activity of the drug strongly depends on its metabolism in the liver, which can change throughout life [5].

Nevertheless, blocking vitamin K-dependent components of the hemostasis system is the only method of effective anticoagulation in the presence of a mechanical heart valve prosthesis in a patient. Other anticoagulants do not have such a broad suppression of the internal pathway of activation of the coagulation link of hemostasis, and therefore the use of modern safe drugs is not yet possible [6]. Thus, the currently available mechanical prostheses of the heart valves are not a physiological replacement for native valves; they cannot be safely installed in patients with coagulopathies, some systemic diseases, and in old age. At the same time, this type of prosthetics, in fact, disables the patient [7].

An alternative to mechanical prostheses is biological prostheses on a supporting frame. These prostheses have a fundamental difference - their locking element consists of biological tissue taken from an animal of another species. This allows you to get rid of lifelong anticoagulation and taking any drugs that affect hemostasis, which is an absolute advantage of bioprostheses. Bioprostheses allow the patient to lead an active

lifestyle, play sports, and women of reproductive age can safely carry a fetus and give birth [8]. The flaps of biological heart valve prostheses consist of a natural elastic material processed in a special way. Most often, this is processed cattle pericardium.

This material "takes root" in the body much better, but at the same time, it does not have high biocompatibility, since it is taken from an animal of a different species. In addition, it is non-viable, since it has been deprived of antigenic properties by removing cellular elements with various ionic and non-ionic detergents. As a result, this material, although more physiological, is not able to exist in the patient's body for a long time. It does not have living cells in its structure, and therefore cannot renew itself. This leads to the fact that bioprostheses are only suitable for work for 7-8 years, after which their flaps are destroyed and the prosthesis must be changed. In addition, their implantation is associated with an increased risk of prosthetic infectious endocarditis, since the bioflaps have an adhesive surface and are not covered with endothelium [9]. Thus, non-optimal technologies of heart valve replacement are still used, which do not qualitatively affect the functional state of the patient and do not give a chance for a complete cure. Developing new technologies can significantly change this area of cardiac surgery [10].

Due to the limited use of new technologies of heart valve replacement, there is no clear understanding of the possibilities of cardiac surgery in the domestic medical community. This problem is especially relevant among non-specialized specialists. Cardiologists, gynecologists, therapists, rheumatologists and other specialists treating patients for the underlying disease may have an incorrect idea of the cardiac prognosis and modern trends in valve cardiac surgery.

List of references:

1. Kirklin J.K. Challenging homografts as the holygrail for aortic valve endocarditis. J Thorac Cardiovasc Surg.2016;151(5):1230–1231.

2. Dangas G.D., Weitz J.I., Giustino G. et al. ProstheticHeart Valve Thrombosis. J Am Coll Cardiol. 2016;68(24):2670–2689.

3. Soria Jiménez C.E., Papolos A.I., Kenigsberg B.B.et al. Management of Mechanical Prosthetic Heart ValveThrombosis: JACC Review Topic of the Week. J Am Coll Cardiol.2023;81(21):2115–2127.

4. Nappi F., Singh S.S.A, Nappi P. et al. Heart ValveEndocarditis. Surg Technol Int. 2020;37:203–215.

5. Spence J., LeManach Y., Chan M.T.V. Association between complications and death within 30 days after noncardiac surgery. CMAJ, 2019, vol. 191, no. 30, pp. E830–E837.

6. Ryu R., Tran R. DOACs in Mechanical andBioprosthetic Heart Valves: A Narrative Review of EmergingData and Future Directions. Clin Appl Thromb

Hemost.2022;28:107.

7. Bilkhu R., Jahangiri M., Otto C.M. Patient-prosthesis mismatch following aortic valve replacement. Heart.2019;105(Suppl2):s28–s33.

8. Nappi F., Al-Attar N., Spadaccio C. et al. Aortic valvehomograft: 10-year experience. Surg Technol Int. 2014;24:265–272.

9. Sodha N.R. Complex homograft aortic reconstruction:New recipes from old ingredients. J Thorac Cardiovasc Surg.2017;153(5):e77–e79.

10. Heinisch P.P., Carrel T. Commentary: Failing aorticroot homograft: Considering the transcatheter aortic valve re-placement option? J Thorac Cardiovasc Surg. 2019;158(2):388–389.

11. Sedeek A.F., Greason K.L., Nkomo V.T. et al. Repeataortic valve replacement for failing aortic root homograft.J Thorac Cardiovasc Surg. 2019;158(2):378–385.e2.

12. Serna-Gallegos D, Sultan I. Aortic root replace-ment: what is in your wallet? Eur J Cardiothorac Surg.2022;62(3):ezac280.

13. Sultan I., Bianco V., Kilic A. et al. Aortic root replacementwith cryopreserved homograft for infective endocarditis in the mod-ern North American opioid epidemic. J Thorac Cardiovasc Surg.2019;157(1):45–50.

14. Yokoyama Y., Kuno T., Toyoda N. et al. Ross procedureversus mechanical versus bioprosthetic aortic valve replacement:a network meta-analysis. J Am Heart Assoc. 2023;12(1):e8066.

15. Galzerano D., Kholaif N., Al Amro B. et al. The Rossprocedure: imaging, outcomes and future directions in aorticvalve replacement. J Clin Med. 2024;13(2):630.