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ДИСФУНКЦИЯ БИОПРОТЕЗА ТРИКУСПИДАЛЬНОГО КЛАПАНА У ПАЦИЕНТА С КРИТИЧЕСКОЙ КОМОРБИДНОСТЬЮ

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TRICUSPID BIOPROSTHETIC VALVE DYSFUNCTION IN PATIENTS WITH CRITICAL COMORBIDITIES

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Резюме. Клинический случай дисфункции биопротеза трикуспидального клапана у пациента с тяжелой коморбидностью представлен в статье. Женщина в возрасте 75 лет с большой аневризмой брюшной аорты и внутрипросветными тромботическими массами поступила в отделение сосудистой хирургии для проведения операции на аорте. Критический стеноз трикуспидального биопротеза с клапанным отверстием 0,46 см², неподходящая анатомия аорты для имплантации стент-графта, тяжелая стенокардия и тромбоцитопения были определены как критические сопутствующие заболевания, осложняющие возможность проведения операции.

Ключевые слова: дисфункция биопротеза клапана сердца, трехстворчатый клапан, аневризма брюшной аорты, тромбоцитопения, коронарный атеросклероз.

Resume. A clinical case of bioprosthetic tricuspid valve dysfunction in the patients with severe comorbidity is presented in article. A 75-year-old woman with a large abdominal aortic aneurysm and intraluminal thrombotic masses was admitted to the vascular surgery department for surgery. Critical tricuspid bioprosthesis stenosis, with a valve orifice of 0.46 cm², unsuitable aortic anatomy for stent-graft placement, severe angina, and thrombocytopenia, were identified as the most critical comorbidities, complicating the feasibility of abdominal aortic surgery.

Keywords: bioprosthetic valve dysfunction, tricuspid valve, abdominal aortic aneurysm, thrombocytopenia, coronary atherosclerosis.

Relevance. Valvular heart disease remains a major therapeutic challenge, with bioprosthetic valves providing a vital treatment option, especially for patients with severe comorbidities and advanced age. Bioprosthetic valves, which are constructed from biological tissues such as porcine or bovine pericardium, have advantages such as a reduced need for anticoagulation, making them appropriate for elderly patients and those at higher risk of thromboembolism. The tricuspid position poses unique considerations due to its anatomical and hemodynamic characteristics. While bioprosthetic valves can help relieve right-sided heart strain, they are often less durable than mechanical valves, with a lifespan of 10 to 20 years. Degeneration and calcification of bio tissue can generally lead to tricuspid bioprosthetic failure with the development of stenosis and insufficiency, which has a negative impact on cardiac function and followed by rapid right failure progression.

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Regular monitoring and appropriate interventions are critical to reducing the risks associated with bioprosthetic valve failure. Understanding the viability and potential problems of bioprosthetic valves is critical to improving patient care and outcomes.

Material and methods. A 75-year-old female, who had a complicated medical history, was diagnosed with a chronic infrarenal abdominal aortic aneurysm (54.8 mm) and had symptoms of weakness, fatigue and dyspnea during physical activity. The patient had previously undergone several cardiac interventions, such as mitral valve replacement, coronary artery bypass grafting (CABG), and supracoronary prosthetic replacement of the ascending aorta for dissection in 2016. Notably, she presented with severe stenosis and grade 2-3 regurgitation after having a bioprosthetic tricuspid valve replacement, which was now malfunctioning. Additional comorbidities included hypertension, thrombocytopenia, chronic kidney disease (CKD), and multifocal atherosclerosis involving coronary and peripheral arteries.

Echocardiographic evaluation revealed significant structural and hemodynamic abnormalities in the tricuspid bioprosthesis (Fig.1). The valve exhibited stiff, irregularly thickened flaps with limited mobility, and a 6 mm linear movable structure on one flap, raising concerns about mechanical instability.

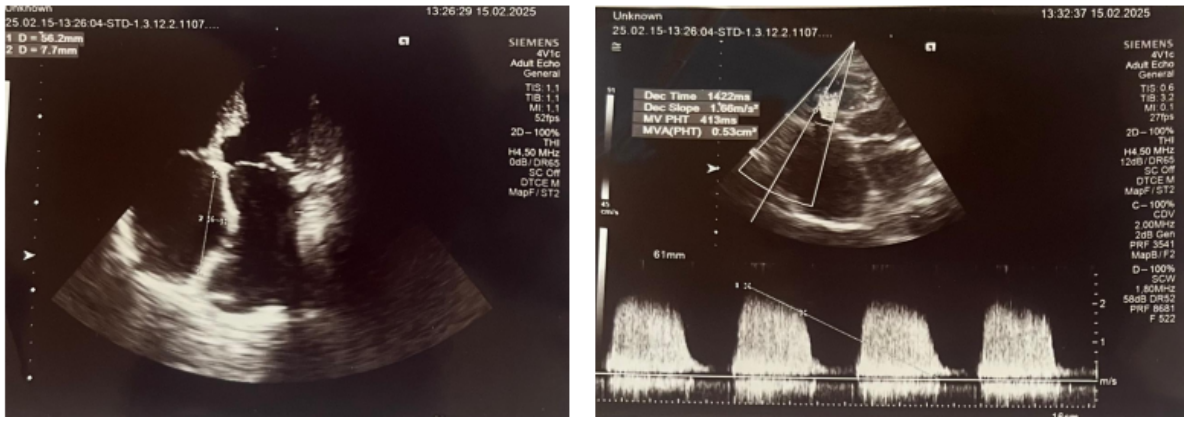

Fig. 1 – Echocardiographic evaluations showcasing 2D structural (left picture) and Doppler continuous wave hemodynamic (right picture) abnormalities

Hemodynamic assessment demonstrated accelerated transtricuspid flow (maximum velocity: 2.1 m/s) and significant pressure gradients, consistent with critical stenosis and second-degree regurgitation. The right atrium was markedly enlarged (volume index: 61 mL/m²), reflecting volume overload, while the left ventricular function remained preserved (ejection fraction: 56–58%). With a summed rest score (SSS) of 13 points and a total hypoperfusion of 18%, myocardial perfusion imaging showed considerable hypoperfusion in many left ventricular segments, suggesting impaired myocardial perfusion. Thrombocytopenia (platelets: 89 × 10^3/μL) and hypocoagulation syndrome (INR: 1.39, fibrinogen: 3.77 g/L) further exacerbated the patient's clinical presentation and presented more difficulties for transcatheter or surgical intervention. Multidisciplinary consultation with cardiac and vascular surgeons was sought to determine the optimal management strategy. Given the high-risk profile, a transcatheter valve-in-valve (ViV) intervention was

considered, with careful planning using cardiac CT to assess the tricuspid annulus anatomy and determine the appropriate access route (transfemoral or transjugular).

Results and their discussion. Hence, by presenting these results of thorough examination and analysis of the patient, it is possible to emphasize on a multimodal approach. Potential therapeutic techniques must be carefully considered when a bioprosthetic valve exhibits stiffness and uneven thickening. The challenge lies in accurately assessing the degree of valve dysfunction and determining the appropriate timing for intervention, particularly in high-risk patients. Transcatheter intervention planning heavily depends on cardiac CT.

Based on the unique anatomy of the tricuspid annulus, it helps define the ideal fluoroscopic detector position and access route, which can be either transfemoral or transjugular. It also helps determine the right device size for a possible valve-in-valve (ViV) treatment which has proved to be a feasible intervention (Hagel et al., 2024). Along with the VIV methodology there is an inherent risk of prosthesis-patient mismatch (PPM), which is when the effective orifice area (EOA) of a prosthetic heart valve is too small relative to the body size of the patient leading to inadequate hemodynamic performance and increased pressure gradients across the valve.

A more optimal expansion of the transcatheter heart valve (THV) and positive effects on post-implant valve hemodynamic and possibly long-term valve durability are made possible by bioprosthetic valve remodeling (BVR) and bioprosthetic valve fracture (BVF), which are achieved by either stretching or breaking the surgical valve ring. (Jonathon A Hagel., 2024)

Conclusion:

1. This case illustrates the challenges of treating bioprosthetic valve failure in the tricuspid position, particularly when a patient has severe comorbidities like thrombocytopenia, severe angina, significant tricuspid stenosis, and an extensive abdominal aortic aneurysm.

2. The bioprosthetic valve's structural and hemodynamic alterations, such as thicker flaps, restricted movement, and severe regurgitation, emphasize the challenges in determining the most suitable point and strategy for intervention.

3. A multimodal approach, incorporating advanced imaging techniques such as cardiac CT, is essential for planning transcatheter interventions like ViV, which offer a feasible solution but does carry its own risks.

4. Techniques like BVR and BVF may enhance outcomes by optimizing valve expansion and hemodynamics. This case emphasizes the importance of individualized treatment strategies, thorough preoperative assessment, and the integration of innovative interventional techniques to improve outcomes in high-risk patients with complex cardiovascular pathologies.

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