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**Experience in use of small valve prostheses in adults with narrow valve ring of the aortic valve**

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We selected 28 consecutive cases, in which valve prosthesis sized 18-20 mm were used, from 339 patients, who underwent aortic valve replacement. The prosthesis selection was based on the effective orifice area index (iEOA). 18 patients had no patient-prosthesis mismatch (iEOA≥0,85 cm2 / m2), ten - had moderate patient-prosthesis mismatch (iEOA 0,84-0,65 cm2 / m2) and no patient had severe patient-prosthesis mismatch (iEOA ≤0,65 cm2 / m2).

Highest values ​​of maximal valve gradients were measured in younger patients. Most patients (n=19) noted good quality of life, no edemaes, no shortness of breath and tolerated physical exertion well.

Small aortic valve prostheses using in aged patients is acceptable, even if moderate patient-prosthesis mismatch exists.

**Keywords:** Aortic valve replacement, narrow aortic valve ring, effective orifice area, patient-prosthesis mismatch

Introduction

The purpose of aortic valve replacement is to replace the damaged valve with competent prosthesis of sufficient size to normalize hemodynamics and decrese symptoms [5]. The size of the prosthesis is characterized by effective orifice area (EOA). When EOA is small, a mismatch between the size of the prosthesis and the patient's body surface area may occure (patient-prothesis mismatch, or PPM) [3]. This phenomenon is particularly important in patients with small aortic valve ring, which limits the choice of prosthesis. In such patients the surgeon shuld choose between using a prosthesis that is smaller than needed and the surgical aortic valve ring enlargement. Small prosthesis using is dangerous because high gradient on valvular prosthesis and physical limitations due to the insufficient valve size may occure, while expanding ring of aortic valve surgery increases the risk and prolongs the operation. Thus, the main question in choosing the prosthesis – it`s size. The prosthesis type (mechanical or biological) has less impact on hemodynamics.

The purpose of this work is to analyze our experience in aortic valve replacement with small sized prostheses (Ø18-20 mm) and to investigate the impact of moderate PPM on early and late results.

Materials and methods

Since 2011 to 2015, 339 aortic valve repair (AVR) operations were performed in our clinic. We selected 28 consecutive cases in which prosthetic valves sized 18-20 mm were used. Aortic stenosis was an indication for AVR in 26 cases, and aortic insufficiency - in 2. In 10 cases an isolated AVR was performed and in 18 – AVR was combined with other procedures: coronary artery bypass surgery, mitral valve repair or replacement, tricuspid valve repair, Maze-procedure. The mean age at the time of surgery was 66.3 ± 12.9 years. The mean body surface area was 1.77 ± 0.17 m2. The maximum valve gradient in was 86.7 ± 29.8 mmHg, mean gradient 52,2 ± 20.0mmHg. Prosthesis sized 18, 19, 20 mm were used: ATS HP 18 mm in 6 patients, SJM 19 mm in 10 patients , Edwards Perimount 19 mm in 7 patients , and ATS HP 20 mm in 5 patients .

The prosthesis choice is based on the effective orifice area index (EOA). According to the recommendations, indexed effective orifice area (-indexed effective orifice area) is used. iEOA is calculated effective orifice area of ​​the prosthesis devided to the patient's body surface area [3,6].

When iEOA is ​​less than 0.8-0.9 cm2 / m2 the gradient on the prosthesis increases exponentially. Therefore, iEOA ≥0,85 cm2/m2 is acceptable, iEOA 0,85-0,65 cm2 / m2 - characterized as moderate PPM, and iEOA≤0,65 cm2 /m2 - as severe PPM [2,5] . All patients resieved prostheses with maximal effective orifice area.

According to the literature, iEOA ≤0,65 cm2 / m2 is associated with higher mortality, so in patients with iEOA ≤0,65 cm2 / m2 either surgical aortic valve ring enlargement or prostheses with better hemodynamic parameters were used, to avoid severe PPM. Data about moderate PPM impact on early and late results is contradictory, so in some patients we assumed moderate prosthesis mismatch (iEOA 0,85-0,65 cm2 / m2). [1,4,5]

AVR was performed via median sternotomy by standard technique with sindle steaches with plaques.

Patients recieved warfarin from the second postoperative day. The INR values ​​maintained at 2.5-3.5. Patients with mechanical prosthetic aortic valves were prescribed life-long warfarin administration, patients with bioprosthesis were prescribed warfarin for 3 months after surgery. [2]

Prosthesis function was controlled postoperatively by echocardiographic examination with mean ang maximum gradients measurement.

Discussion and results

In 28 patients who underwent AVR with aortic prostheses sized ≤20 mm, 18 patients had no PPM (iEOA≥0,85 cm2 / m2) 10 – had moderate PPM (iEOA 0,84 -0.65 cm2 / m2). There were no cases of severe PPM (iEOA ≤0,65 cm2 / m2).

The postoperative period was uneventful in 27 patients (96%). There were no hospital mortality. The mean duration of ICU stay was 2,4 ± 0,97 days, medium artificial ventilation duration - 10,51 ± 7,6 hours. In 1 patient had extended ICU stay due to respiratory failure.

At discharge maximum aortic valve prosthesis gradient was 27,11 ± 6,95 mmHg. In patients with iEOA <0,85 cm2 / m2 maximum gradient was 30,5 ± 5,7mmHg, mean 14,3 ± 2,7mmHg. In those with iEOA≥0,85 cm2 /m2 maximum gradient was 25 ± 7 mmHg, mean gradient of 12,9 ± 4,3 mmHg.

Highest values ​​of maximum gradient (36,5 ± 2,34 mmHg) were measured in young patients (61 ± 19 years), while in older patients (68.49 ± 8.6 years) lower values ​​of maximum gradient were observed (24,3 ± 5,1 mmHg).

Postoperative follow-up was 21,36 ± 8,45 months. Most patients (n = 19) noted good quality of life and tolerated physical exertion well, had no edema or shortness of breath. 2 patients noted dyspnea at moderate physical exertion. In 1 patient hemorrhagic stroke occured in late postoperative period. There was 1 reoperation due to odontogenic infective endocarditis one year after AVR.

These data shoes that iEOA should be used for the selection of the valve prosthesis for AVR. We recommend to use prostheses whith better hemodynamic performance or consider surgical aortic valve enlargement techniques if needed, to avoid iEOA> 0,65 cm2 / m2. [2,5]

Using small sized prostheses, even if moderate PPM occures (iEOA 0,65-0,85 cm2 / m2), is acceptable in older patients with severe comorbidities, poor mobility, shorter life expectancy. This approach allows to decrease symptoms of heart failure, achieve acceptable hemodynamic results without increasing the risk of operation. [1,4] For young active patients without severe comorbidities, surgical options on aortic valve ring enlargement may be considered to avoid PPM, that may have a big impact on hemodynamics in this group.

Conclusion

In cases of planning AVR in patients with small aortic valve ring, the choice of the valve prosthesis and operative technique should be individualised. This study showed that small aortic valve protheses using in the elderly, even with moderate PPM, is acceptable and decreases symptoms of heart failure, achieving good hemodynamic results without increasing the risk of operation.

**References**

1. Kitamura T. Moderate Prosthesis-Patient Mismatch May Be Negligible in Elderly Patients Undergoing Conventional Aortic Valve Replacement for Aortic Stenosis / T. Kitamura, S. Torii, N. Hanayama, et al. // International Heart Journal. – 2013. – Vol. 54. – P. 11–14.

2. Pibarot P. Prosthetic heart valves: selection of the optimal prosthesis and long-term management / P. Pibarot, J. G. Dumesnil // Circulation. – 2009. – Vol. 119. – P. 1034–48.

3. Rahimtoola S. H. The problem of valve prosthesis‐patient mismatch / Rahimtoola // Circulation. – 1978. – Vol. 24. – P. 5820–24. 1

4. Urso S. Moderate Patient-Prosthesis Mismatch Has No Independent Effect on 30-Day Mortality After Isolated Aortic Valve Replacement / S. Urso, R. Sadaba, T. Monleón-Getino, G. Aldamiz-Echevarríaa // Revista Española de Cardiología. – 2010. – Vol. 63. – P. 409–14.

5. Wauthy P. Aortic Valve Stenosis - Current View on Diagnostics and Treatment [Електронний ресурс] / P. Wauthy, S. G. Malekzadeh-Milani // InTech. – 2011. – Режим доступу до ресурсу: http://www.intechopen.com/books/aortic-valve-stenosiscurrent-view-on-diagnostics-and-treatment/patient-prosthesis-mismatch-after-aortic-valve-replacement

6. Zoghbi W.  A. Recommendations for evaluation of prosthetic valves with echocardiography and Doppler ultrasound: a report From the American Society of Echocardiography’s Guidelines and Standards Committee and the Task Force on Prosthetic Valves / W. A. Zoghbi, J. B. Chambers, J. G. Dumesnil // Journal of the American Society of Echocardiography. – 2009. – Vol. 22. – P. 975–1014.