SENIILE CALCIFIC AORTIC VALVE STENOSIS: MODERN INTERVENTIONS IN UKRAINE

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Abstract

Background. Aortic valve stenosis remains the most dominant form of valvular heart disease. The aortic valve area below 1.0 cm² is an assignment to the interventions. The modern senile aortic valve stenosis treatment options are mini-surgical valve replacement (mini-SVR), balloon aortic valvuloplasty (BAV), and transcatheter aortic valve implantation (TAVI). This study aims to inform readers about up-to-date interventions for patients with senile calcific aortic valve stenosis in Ukraine, based on the experience of the Cardiac surgery department in Lviv, Ukraine.

Methods. From a single-centre retrospective registry (10/2015-02/2022), 204 patients were included. One hundred seven patients underwent mini-SVR, three BAV, and four – TAVI. Diagnostic modalities used to assess the anatomy of the aortic valve were: ECHO, ECG-gated computer tomography with aortic valve calcic scoring, and Angiography. Interventional procedure techniques were BAV, TAVI; surgical: mini-SVR via upper ministernotomy or right-sided minithoracotomy.

Results. Anatomical assessment of the aortic valve in senile aortic valve stenosis was based on the morphology of the aortic valve (bicuspid or tricuspid aortic valve), asymmetrical hypertrophy of the left ventricular outflow tract, and coronary ostia height. The age-related anatomical features were calcium deposits in the leaflet, coronary ostium and mitral annular calcification. Ministernotomy (in 67 cases) and a right-sided minithoracotomy (in 40 cases) were performed to secure the “heart step” without instability of the chest cage with the smaller valve size implantation than was expected before. Preserving the chest cage and avoiding aortic cross-clamp/cardio-pulmonary bypass were advantages of TAVI. Fragile patients expected TAVI risks: aortic root damage, paravalvular leak, moderate aortic insufficient, the risk of atrioventricular block and embolic stroke, and kidney dysfunction.


Keywords: aortic valve; aortic stenosis; aged; heart valve diseases; cardiac surgery.


Introduction

Aortic valve stenosis remains the most dominant form of valvular heart disease [1]. Senile or age-dependent calcific aortic stenosis is a typical form of aortic valve stenosis in people above 65 years old, with no gender prevalence.

With the progress of diffuse coronary atherosclerosis in older people, the left ventricle ejection fraction (EF) slowly decreases below 60%. Combination of spontaneous senile calcification of the aortic valve and coronary heart disease (CHD)
with decreased ejection fraction results in the opening limitation of cusps of the aortic valve [2]. Consequently, it leads to the development of morphological and functional stenosis of the aortic valve [3].

Senile calcific aortic stenosis is very often compared with a «low flow, low gradient aortic stenosis». The difference is that even small calcification of the aortic cusps leads to moderate aortic stenosis. Those patients only need special treatment with clinical symptoms of aortic valve dysfunction or left ventricle hypertrophy above 20 mm. Aortic stenosis with EF 45-60% and aortic valve area (AVA) above 1.5 cm² is treated with medication, including statin supplementation and diet [4]. Aortic valve stenosis with a narrowing of the aortic valve area (1.0 – 1.5 cm²) is considered a terminal stage, which requires optimal medical treatment. Despite the EF, the aortic valve area below 1.0 cm² is an assignment to the interventions [4]. Aortic valve stenosis treatment options are typical “open cardiac surgery” - surgical aortic valve replacement (SAVR) (1) or Ozaki-procedure (2); mini-surgical valve replacement (mini-SVR) (3), endovascular balloon aortic valvuloplasty (BAV) (4) and transcatheter aortic valve implantation (TAVI) (5). Mini-SVR and endovascular procedures are considered modern [3,5] and performed in Ukraine [6]. This study aims to inform readers about modern treatment options for patients with senile calcific aortic valve stenosis in Ukraine, based on the experience of the Cardiac surgery department in Lviv, the west of Ukraine.

Techniques.

(1) Ultrasound examination of the heart (transesophageal and transthoracic ECHO) was performed on the GE VIVID 9.

(2) Computed tomography angiography of the heart and aorta was done on the LightSpeed 64 VCT XT (General Electric, USA) with ECG gating and contrast enhancement with Ultravist 470 (Bayer Healthcare, Germany). Aortic valve calcic scoring (AVC Score) was performed by multidetector computed tomography for the definition of true-severe stenosis with AVC Score >2000 AU for men and >1200 AU for women [8].

(3) Angiography and endovascular procedures were performed on Siemens Artis Zee Floor Eco (Munich, Germany).

(4) Mini-SVR was performed with a J-shaped upper mini sternotomy extended into the right fourth intercostal space or right-sided minithoracotomy through third intercostal space.

Data Analysis. All images were post-processed and analyzed at dedicated workstations (General Electric, USA; Siemens, Germany) by an experienced radiologist, cardiologist, interventional cardiologist and cardiac surgeon.

Results

Management of patients with calcific aortic stenosis in 204 cases was by mini-SVR (107), BAV (3) and TAVI (4). We used data from 2015 when the first mini-SVR in Ukraine was performed in Lviv. The decision for the treatment option was made according to individual patient characteristics and anatomical characteristics based on diagnostic modalities (Fig 1).

Anatomical difficulties in senile aortic valve stenosis.

The anatomical points we paid attention to in assessing aortic valve stenosis were: morphology of the aortic valve (bicuspid or tricuspid aortic valve), asymmetrical hypertrophy of the left ventricular outflow tract (LVOT); coronary ostia height (significant in case of the coronary ostia obstruction). In addition, increased patient age required precise attention to calcium deposits, which has resulted in age-related anatomical difficulties. We performed the analysis of leaflet calcification (symmetric or asymmetric), coronary ostium calcification and mitral annular calcification (MAC).
The morphometrical evaluation included sinuses of Valsalva height (for modelling the implant for TAVI); the height of the commissures (very important for the commissural alignment during implantation); aortic annulus diameter (especially narrow aortic annulus) and the angle of the aorta (gooseneck).

**Figure 1.** Visualization of the senile severe aortic stenosis. A, Ultrasound examination of the heart with remarkable sickness of the aortic cusps (red dots). Ao, aorta; LV, left ventricle; LA, left atrium. B-C, Chest computed tomography with identification of Calcium deposits (red dots) on the noncoronary (N), right (R), left (L) aortic cusps and left coronary artery (LCA). D, 3D reconstruction of the Chest computed tomography with severe calcifications of the aortic valve (red dots) on the right coronary cups (RCC), left coronary cups (LCC), and noncoronary coronary cups (NCC).

**Mini-surgical valve replacement.**

After Heart Team evaluation, patients under 75 years at low risk for surgical aortic valve replacement, with LVEF <50%, appropriate anatomy of the aortic root, and assessment of comorbidity and frailty were treated by mini-SVR (Fig. 2).
Age-provoked changes, such as porcelain aorta or bone fragility, should be essential contraindicators for surgery. Preserving the chest cage and avoiding aortic cross-clamp in CPB were advantages of TAVI. Nevertheless, predicted difficulties were implantation, beating heart, and potentially larger valves than during SAVR or mini-SVR.

Predicted complications in elderly patients were: the risk of aortic root damage, paravalvular leak, moderate aortic insufficient, the risk of atrioventricular block and embolic stroke, kidney dysfunction (due to contrast), and potential damage to the main vessels. The predicted reoperation was in 8-12 years.

Discussion

This study shows modern treatment options for patients with senile calcific aortic valve stenosis in Ukraine, based on the experience of the Cardiac surgery department in Lviv, the west of Ukraine. Two options are considered up-to-date: mini-SVR and TAVI [3,5,9]. Both procedures are described to be good options for high-risk patients with comorbidities [2,3], which is typical for older people.

Mini-SVR started in our hospital in 2015 and showed promising results for older people in daily clinical practice. However, TAVI started only in 2020 and overlapped with the COVID-19 pandemic (2020-2021) and the russian-Ukrainian war (from February 2022), which explained the small number of patients. The main ideas for senile aortic valve stenosis management we would like to point out are: TAVI or SAVR are both options for surgical treatment [2]; successful outcomes for intervention are based on adequate preoperative planning [10].
The correct assessment of the aortic root anatomy allows for choosing the best treatment strategy [11]. Mini-invasive techniques allow this type of surgery to be performed thoroughly and safely for the patient [5]. Reduction of chest trauma leads to faster rehabilitation and recovery. Therefore, it is crucial for patients of age for whom physical activities are recommended. In the case of SAVR, a prolonged postoperative period could lead to complications [4].

In our experience, mini-SVR requires strong technical skills from the surgical team. However, it is not a limitation but rather a challenge. Mini-SVR displayed the usual «open-heart» surgery, which was the gold standard for severe aortic valve stenosis treatment for years [12]. At our hospital, minimally invasive procedures have been used often since their first implementation into practice. Our vision follows the world trends to the wide-spreading of endovascular procedures. The new trend of «TAVI for young patients” (≤ 75 y.o.) seems to be a reality in the nearest future [13]. Development and implementation of modern endovascular techniques, such as TAVI, gradually displays even minimally invasive techniques, not only SAVR.

Nevertheless, TAVI is considered the best option for people of ages prone to have cerebrovascular events. This issue is still debated to prove what procedure is safer for severe aortic valve stenosis treatment in fragile populations [14], while TAVI carried an inherent risk of stroke years ago. The current study has several limitations, inherent to the single-centre, retrospective design. The study finding was performed from descriptive analyses, which has well-known limitations. This study is a primary part of the analysis, which is planned to obtain clinical data, follow-up and statistical analysis of the data.

Conclusions

Modern interventions, such as mini-surgical valve replacement and transcatheter aortic valve implantation, are accessible procedures in Ukraine for senile calcific aortic valve stenosis treatment.

AUTHOR CONTRIBUTIONS
D.B. performed endovascular and surgical procedures; U.P., D.B., A.G. contributed to the design and writing of the manuscript.
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CONFLICT OF INTEREST
The authors have completed the ICMJE Disclosure Form. The authors declare that there are no potential conflicts of interest.

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