

CASE STUDY

ULTRASONIC DECALCIFICATION OF AORTIC VALVE IN MODERN ERA: A CASE REPORT

DOI: 10.36740/WLek202203128

Borys Todurov, Andriy Markovets, Stepan Maruniak, Vitaly Demyanchuk
HEART INSTITUTE MINISTRY OF HEALTH OF UKRAINE, KYIV, UKRAINE

ABSTRACT

Aortic stenosis (AS) – a constantly progressing disease characterized by thickening and calcification of leaflets of the valve, which leads to obstruction of the blood outflow from the left ventricular (LV), inadequate cardiac output, heart failure, and even sudden death. Prevalence of stenosis consistently increases with age, 0.2% incidence observes in the 50–59 year cohort of patients and almost 10% in patients from the 80–89 year cohort. We report the case of a 78-year-old man who presented with severe aortic valve stenosis. Since conventional valve replacement was problematic because of a small annular diameter we performed ultrasonic aortic valve decalcification. As a result, the systolic pressure gradient across the aortic valve decreased from 106 mm Hg to 22 mm Hg. Our case demonstrated that even in modern era ultrasonic aortic valve decalcification can be an effective option for restoration of mobility of the aortic valve cusps. We advocate the use of it for elderly patients with small aortic annulus in which surgical or transcatheter valve replacement, valve reconstruction could be extremely difficult or unavailable and consider ultrasonic valve decalcification as an additional tool in cardiac surgeon's hands.

KEY WORDS: ultrasonic decalcification, aortic valve stenosis, valve-sparing operation

Wiad Lek. 2022;75(3):732-734

INTRODUCTION

Aortic stenosis (AS) – a constantly progressing disease characterized by thickening and calcification of leaflets of the valve, which leads to obstruction of the blood outflow from the left ventricular (LV), inadequate cardiac output, heart failure, and even sudden death. Prevalence of stenosis consistently increases with age, 0.2% incidence observes in the 50–59 year cohort of patients and almost 10% in patients from the 80–89 year cohort [1,2]. Half of the AS patients die within 2 years after detection of the symptoms of the disease [3]. The gold standard for the treatment of AS traditionally is surgical. Since the 60s of the last century, mechanical decalcification is well known method that allows repair the aortic valve [4]. Due to high risk of cusp perforation and high rate of valve restenosis this method has not been practiced for some time. In 1972, with the development of ultrasound medical equipment the decalcification approach has found its rebirth [5]. Almost 45 years after, we are introducing our own experience of ultrasonic valve decalcification for patient having AS.

CASE REPORT

A 78-years-old man was admitted because of dyspnea, palpitations, periodical chest pain. Echocardiography studies revealed a severe AS with the peak systolic pressure gradient 106 mm Hg (mean 64 mm Hg), fibrosis and severe calcification of the valve cusps 3+ (Fig. 1) with effective aortic valve area 1.0 cm^2.

According to coronary angiography, there were no signs of the coronary arteries lesions. The patient was taken to the operating room where median sternotomy was performed and cardiopulmonary bypass with moderate hypothermia (32°C) and standard heparinization (300 IU/kg IV) was established. After aortic cross clamped, ascending aorta was opened and cardioplegia solution (Custodiol; Koehler Chemi, Alsbach Haenlien, Germany) to volume of one liter was pumped directly into the ostia of the coronary arteries. Then, aortic valve was carefully examined for localization, prevalence and the depth of tissue calcification. It turned out that the inclusion of calcium was located solely on the aortic side the cusps, seized mostly free edges and did not penetrate into the entire thickness of the cusp tissue. Decision was made to perform valve-sparing operation – aortic valve decalcification using an ultrasonic dissector Sonoca 300/MBC 601 UAM (Soring GmbH, Germany). We used mode of maximum power (35 kHz) with supply of sterile saline with a speed 10 ml/min and simultaneous vacuum evacuation of calcium detritus from the wound. We started decalcification procedure from the most affected cusp. Calcium deposits were gently and carefully removed within the border of healthy tissue, preventing rupture or perforation of the cusps (Fig. 2).

To avoid the entering of waste into the ostia of the coronary arteries external suction were additionally used. At the end of the decalcification procedure a test for aortic valve mobility and competence was carried out. Postoperative course was uneventful with no complications. Echocardi-

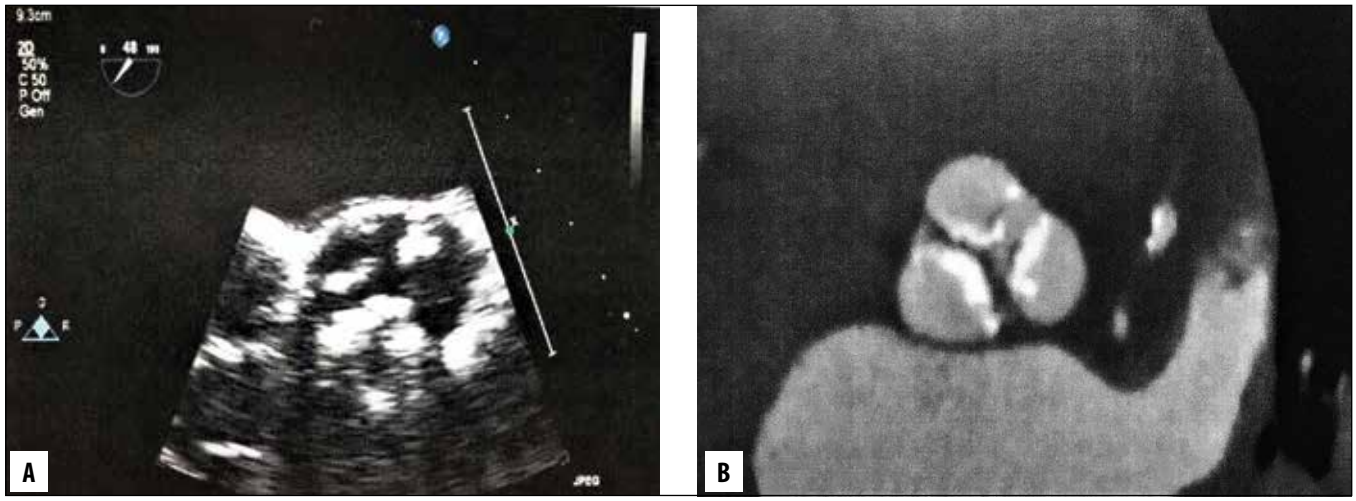

Fig. 1. A). 2D transthoracic echocardiography, shot axis view shows severe calcified aortic valve B). CT scan demonstrates severe calcinosis in aortic valve cusps

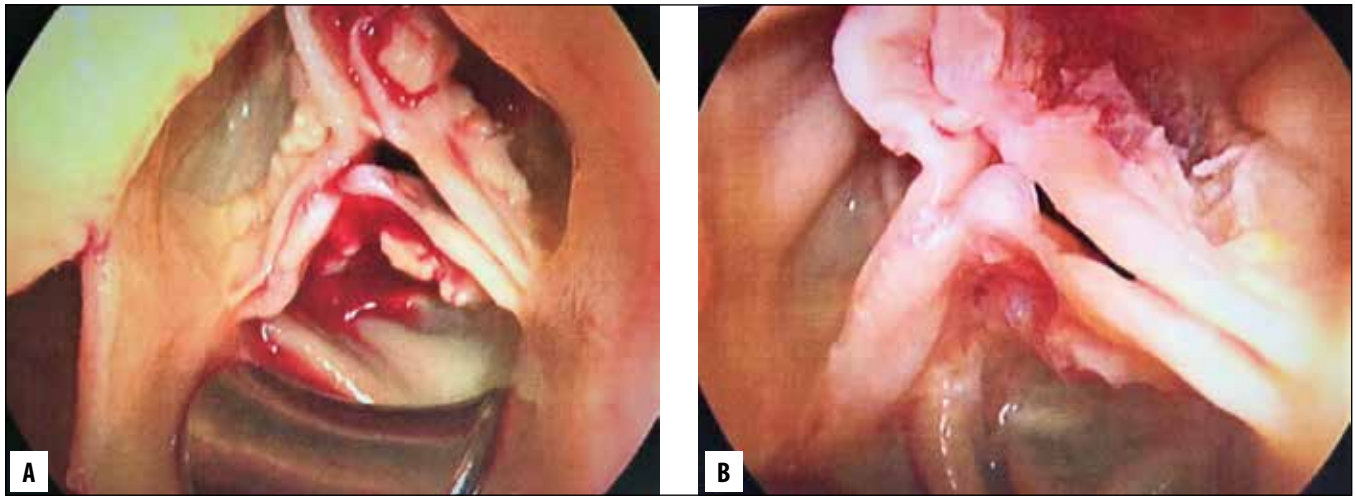

Fig. 2. A). Intraoperative view of stenotic calcified aortic valve and B). aortic valve after decalcification

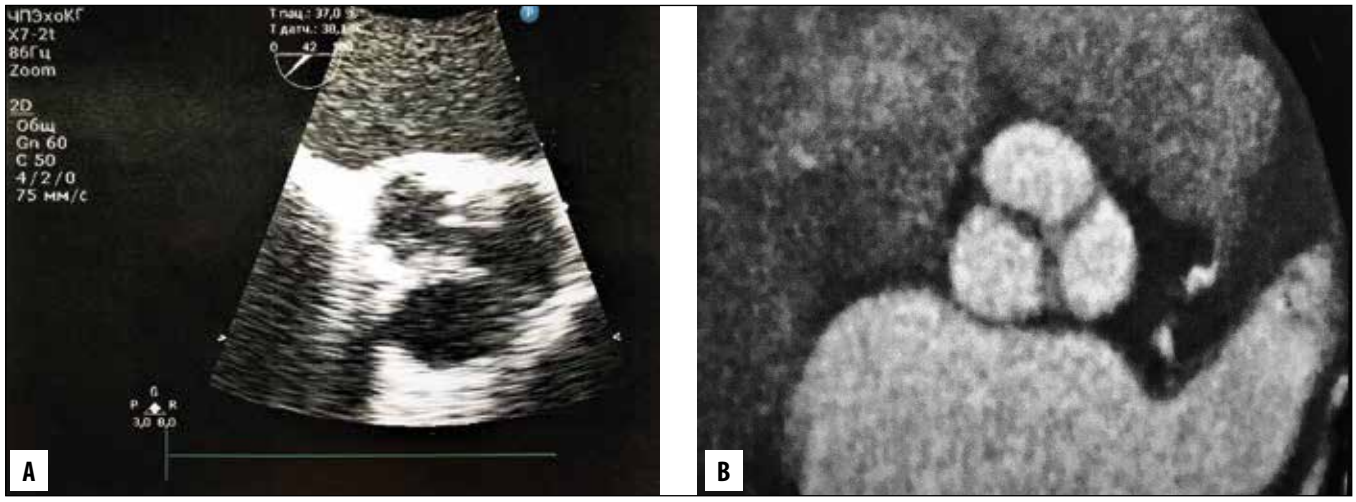

Fig. 3. A). 2D transthoracic echocardiography, shot axis view and B). CT scan demonstrates near to normal, decalcified aortic valve cusps

ography before discharge showed the peak systolic pressure gradient - 22 mm Hg (mean 10 mm Hg), regurgitation - 1/2 +, calcification - 1/2 + (Fig. 3).

On the 7th postoperative day the patient in a stable condition was transferred to the cardiology department for rehabilitation.

The objective of decalcification procedure was to restore mobility of the valve cusps and to slow the progression of stenosis. However, the outcome of mechanical valve-sparing operation was not long lasting, as a high incidence of restenosis and regurgitation was often to go along with the results of the procedure [6,7]. Over time, the surgical equipment, innovations were constantly improving and created the second wave of decalcification in cardiac surgery. It happened due to emergence of a new ultrasound instruments, the principle of which was based on the transformation of electricity into ultrasonic vibrations. Exposure of biological tissue into ultrasound at a frequency of 25-35 kHz leads to appear of cavitation effect. Cavitation is characterized by the formation of micro bubbles in the liquid filled with gas. The rupture of these bubbles into intracellular fluid create a tiny crack destructions of the tissue. Thus, by means of ultrasound the calcium deposits are broken and becomes finely dispersed and expelled from the tissue outwards.

CONCLUSIONS

Our case demonstrated that even in modern era ultrasonic aortic valve decalcification can be an effective option for restoration of mobility of the aortic valve cusps. We advocate the use of it for elderly patients with small aortic annulus in which surgical or transcatheter valve replacement, valve reconstruction could be extremely difficult or unavailable and consider ultrasonic valve decalcification as an additional tool in cardiac surgeon's hands.

REFERENCES

1. Eveborn G.W., Schirmer H., Heggelund G. et al. The evolving epidemiology of valvular aortic stenosis. The Tromsø Study. Heart. 2013; 99: 396-400.
2. Coffey S., Cairns B.J., Lung B. The modern epidemiology of heart valve disease. Heart. 2016; 102: 75-85.
3. Otto C.M., Prendergast B. Aortic-valve stenosis – from patients at risk to severe valve obstruction. New Engl J Med. 2014; 371: 744-756.
4. Kolh P., Kerzmann A., Honore C. et al. Aortic valve surgery in octogenarians: predictive factors for operative and long-term results. Eur J Cardiothorac Surg. 2007;31:600–606.
5. Messas E., IJsselmuiden A., Goudot G. et al. Feasibility and Performance of Noninvasive Ultrasound Therapy in Patients With Severe Symptomatic Aortic Valve Stenosis: A First-in-Human Study. Circulation. 2021;143(9):968-970.
6. Totsugawa T., Hiraoka A., Tamura K. et al. Ultrasonic annular debridement in minimally invasive aortic valve replacement. Gen Thorac Cardiovasc Surg. 2020;68(1):81-83.
7. Villemain O., Robin J., Bel A. et al. Pulsed Cavitational Ultrasound Softening: a new non-invasive therapeutic approach of calcified bioprosthetic valve stenosis. JACC Basic Transl Sci. 2017;2(4):372-383.

ORCID and contributionship:

Borys Todurov: 0000-0002-9618-032X [A,F]
Andriy Markovets: 0000-0002-9389-7480 [B,D]
Stepan Maruniak: 0000-0001-7538-2443 [B,D]
Vitaly Demyanchuk: 0000-0001-6076-8685 [E]

Conflict of interest:

The Authors declare no conflict of interest.

CORRESPONDING AUTHOR

Stepan Maruniak
Heart Institute Ministry of Health of Ukraine
5A Bratyslavska st., 20017 Kyiv, Ukraine
tel: +380509510268
e-mail: maruniak.stepan@gmail.com

Received: 26.05.2021
Accepted: 28.11.2021

A - Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article