Aortic Valve Neocuspidization with Glutaraldehyde-Treated Autologous Pericardium (Ozaki Procedure) – A Promising Surgical Technique

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Key question
What is aortic valve neo-cuspidization (AVNeo)?

Key findings
This is a surgical technique equivalent to aortic valve replacement (AVR) using autologous pericardium to produce neo-leaflets.

Take-home message
AVNeo provided favorable mid-term results with various aortic valve diseases and seems to be a feasible procedure that may offer an alternative to AVR.

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INTRODUCTION

Ozaki et al.\[1\] reported in 2011 their first institutional report about a surgical technique with which they replaced all three aortic valve leaflets using glutaraldehyde-treated autologous pericardium. Since this procedure is not widely spread among cardiac surgeons, but it has been gaining some ground, we aimed to assess the current practice of state-of-the-art aortic valve neocuspidization (AVNeo) and its results.

Search Strategy

The search strategy using MEDLINE, from 1950 to June 2019, and the PubMed interface was: (“Aortic Valve”[Mesh] OR “Aortic Valve Stenosis”[Mesh] OR “Aortic Valve Prolapse”[Mesh] OR “Aortic Valve Insufficiency”[Mesh] OR “Bicuspid Aortic Valve” [Supplementary Concept] OR “Aortic Valve Disease” [Supplementary Concept] OR “Aortic Valve, Calcification of” [Supplementary Concept] OR “Heart Valve Diseases”[Mesh] OR “Heart Valve Prolapse”[Mesh] OR “Heart Valves”[Mesh]) AND (“Cardiac Valve Annuloplasty”[Mesh] OR “Transplantation, Autologous”[Mesh] OR “Pericardium”[Mesh] OR “Glutaraldehyde-Treated Autologous Pericardium” OR “aortic valve reconstruction” OR “neocuspidization” OR “Ozaki procedure” OR “Ozaki technique” OR “Ozaki method”).

Search Outcome

Nine hundred and thirty-nine papers were found using the reported search on PubMed. From these, 11 papers were identified, which provided the best evidence to the topic.

RESULTS

Publications by Ozaki’s Group

In 2011, Ozaki et al.\[1\] published their first case series with 88 patients from April 2007 to August 2009. They retrospectively reviewed these 88 cases and evaluated short-term and mid-term results. No operations converted to prosthetic valve replacement and no anticoagulation was administered postoperatively, except when the patients had atrial fibrillation. The preoperative mean gradient through the aortic valve was 81.6±31.1 mmHg and it decreased to 19.0±9.1 mmHg one week after surgery and to 12.9±5.8 mmHg one year later. The degree of aortic regurgitation (AR) was always less than mild postoperatively. The first author describes that the preparation of the autologous pericardium was initiated by cleansing fat and other redundant tissues on the outer surface of the pericardium with the harmonic scalpel. Then, an excised pericardium (with a size of at least 7 x 8 cm) is treated with 0.6% glutaraldehyde solution for 10 minutes. The treated pericardium is rinsed for six minutes, three times, using physiological saline solution (Figure 1). Then, the pericardium is trimmed with the corresponding measured value using templates (Figure 2).

Fig. 1 – Glutaraldehyde-treated autologous pericardium.

Ozaki et al.\[2\] went on with their work and published a second paper with 404 cases of patients who underwent AVNeo, with a mean follow-up of 23.7±13.1 months. Survival rate was 87.7% at 53 months. Freedom from reoperation rate was 96.2%. Only two patients had to undergo reoperation, both because of infective endocarditis (IE). There were seven in-hospital mortalities resulting from a noncardiac cause. Postoperative echocardiography revealed good results with low peak pressure gradients after surgery (Figure 3).

In a study with a subset of 51 patients with age over 80 years, Ozaki et al.\[3\] observed no conversion to AVR. Mean follow-up was...
In their last publication, in 2018\(^5\), 850 patients had already been operated on between April 2007 and December 2015 by Ozaki’s team. Preoperative echocardiography revealed a peak pressure gradient average of 68.9±36.3 mmHg with aortic stenosis that decreased to 19.5±10.3 mmHg one week after surgery and to 15.2±6.3 mmHg eight years after surgery. There was no conversion to aortic valve replacement (AVR). There were 16 in-hospital deaths. Fifteen patients needed reoperation (13 IE, one break of thread, and one tear of cusp case). See the results in Figure 4.

Clinical Reports from Other Groups

Reuthebuch et al.\(^6\) operated on a total of 30 patients by means of the Ozaki technique between September 2015 and May 2017. The patients’ mean ± standard deviation (SD) age was 66.83±10.55 years, and 66.67% (n=20) of them were male. A combined aortic pathology of stenosis and regurgitation occurred in 11 patients (36.67%). Seven patients (23.33%) had pure aortic stenosis and 12 patients (40%) had regurgitation only. One patient (3.33%) had active endocarditis. Between postoperative day 30 and the three-month follow-up, one more patient died from aspiration pneumonia. No patient required reoperation or experienced an additional thromboembolic event within the first three months. One patient developed moderate aortic valve regurgitation postoperatively. This was found to be due to valvular endocarditis; the patient underwent reoperation five months after the initial operation and a biological valve was implanted. After three months, none of the patients had evidence of aortic valve stenosis. Moderate aortic valve regurgitation was seen in one patient (3.57%). Mild AR was seen in three patients (10.71%), whereas no or only trace AR was seen in the majority of patients (n=24; 85.71%). The mean transvalvular pressure gradient was 6.57±3.53 mmHg and peak gradient was 13.51±8.88 mmHg.

Iida et al.\(^7\) performed AVNeo for aortic stenosis in 57 patients from December 2010 to June 2017. Their mean age was 77.5±8.8 years. Preoperative echocardiography revealed an average peak pressure gradient of 89±32.9 mmHg that decreased to 22±10.7 mmHg one week after the procedure and to 19.2±9.7 mmHg 20 months after the procedure. There were no conversions to AVR. There were two noncardiac-related deaths. Two patients underwent reoperation owing to IE and recurrent AR. The mean follow-up period was 30.4±20.8 months. Freedom from reoperation rates were 98.1% and 95.3% at 12 and 81 months of follow-up, respectively.

Nguyen et al.\(^8\) operated on nine patients with severe aortic valve diseases by means of an upper ministernotomy. The pericardium was harvested endoscopically, and then a ministernotomy was performed and the Ozaki procedure was accomplished in a similar manner to the conventional technique. No in-hospital or 30-day mortality was observed in their series, and no conversion to full sternotomy was required. Transthoracic echocardiography on discharge showed five competent valves and three valves with trivial regurgitation.

Mourad et al.\(^9\) carried out a prospective single-centre study including 52 consecutive patients who underwent AVNeo...
Every Like Is Not the Same, But One May Give an Idea of the Other

Among the various repair techniques for aortic valve diseases, the leaflet extension technique for AR has been used in cases of severe cusp retraction that cannot be corrected by means of other techniques[12-14]. The ideal material for leaflet extension remains controversial and one of them is also the autologous pericardium advocated by Kwak et al. [12], who evaluated the 20-year clinical outcomes of the leaflet extension technique for AR caused by rheumatic valvular disease. We would like to highlight that this is not the same technique as Ozaki’s, since the leaflets are not resected, but the fact that the autologous pericardium is also employed might well give us an idea of the durability of this material.

In that study [12], there were no cases of operative mortality, but postoperative complications occurred in five patients. Overall survival at 10 and 20 years was 93.5% and 87.1%, respectively. Freedom from reoperation at 10 and 20 years was 96.7% and 66.6%, respectively. Kwak et al.[12] concluded that long-term results of the leaflet extension technique showed acceptable durability.

Clinical Bottom Line

Current literature suggests that AVNeo with Ozaki procedure seems to be a promising technique and good alternative to AVR with prostheses. Long-term results with a longer follow-up of 10 to 15 years are to be published yet. The authors who published their first experiences with this technique achieved comparable clinical outcomes to conventional therapies with good hemodynamics and a warfarin-free condition. Nevertheless, clinical trials are still necessary.

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Authors' roles & responsibilities

MPBO Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published

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