

Sutureless Aortic Valve Implantation in a Patient with Ascending Aortic Aneurysm and Porcelain Aorta

Pablo A. Filippa¹, MD; Germán J. Chaud^{1,2}, MD; Joaquín Gundelach^{1,2}, MD; Marcos Durand¹, MD; Jaime Horta³, MD; Carolina Gonzalez³, MD; Yelka Tenelema¹, MD; Cristóbal Alvarado^{2,4}, MD; Gustavo Meriño¹, MD

¹Cardiovascular Surgery Department, Hospital Las Higueras, Talcahuano, Chile.

²Universidad Católica de la Santísima Concepción, Concepción, Chile.

³Anesthesiology Department, Hospital Las Higueras, Talcahuano, Chile.

⁴Research and Statistical Department, Hospital Las Higueras, Talcahuano, Chile.

This study was carried out at the Cardiovascular Surgery Department, Hospital Las Higueras, Talcahuano, Chile.

ABSTRACT

Implanting sutureless aortic valves enables a reduction in surgical times and related complications. Nonetheless, their application has been limited in cases involving aortic aneurysms due to anchor system concerns. We present a case of aortic valve replacement using a Perceval™ sutureless aortic valve in a patient with stage IV chronic kidney disease, an ascending aortic aneurysm, and a porcelain aorta. The procedure was performed concomitantly with coronary

artery bypass grafting involving two grafts, as well as ascending aorta and hemiarch replacement. This case underscores the critical importance of time efficiency, technical modifications for valve implantation, and strategic surgical planning to mitigate potential intraoperative and postoperative complications.

Keywords: Aorta Ascending Aneurysm. Aortic Aneurysm. Dental Porcelain. Postoperative Complications.

Abbreviations, Acronyms & Symbols

CT	= Computed tomography
STJ	= Sinotubular junction

INTRODUCTION

Implantation of sutureless aortic valves enables quicker procedures, thereby reducing surgical times and associated risks^[1]. However, historically, their application has been limited by the presence of concomitant aortic root and sinotubular junction (STJ) aneurysms, necessitating a STJ/annulus ratio < 1.3 ^[2]. In this paper, we highlight the challenging application of a sutureless aortic valve in a patient with a severely calcified ascending aortic aneurysm and concomitant coronary artery disease. This case underscores the feasibility of utilizing sutureless valve technology in complex aortic pathology, which expands the potential indications for its use in cases where it has historically controverted.

CASE PRESENTATION

A 70-year-old female patient, with a medical history including stage IV kidney dysfunction, hypertension, type II diabetes, former smoking habits, and a previous stroke resulting in residual mild right hemiparesis, was transferred to our institution due to symptomatic severe aortic insufficiency in a New York Heart Association III/IV status, evidenced by transthoracic echocardiography with a regurgitant jet occupying 60% of the left ventricular outflow tract and a left ventricular ejection fraction of 55%. Preoperative computed tomography (CT) scan revealed a porcelain aorta with concurrent aneurysms of the ascending portion (60 mm) and proximal arch (48 mm), while the aortic root appeared normal (Figure 1A). Coronary angiography indicated 80% stenosis in the main trunk and 70% stenosis in the proximal left anterior descending artery (Figure 1B). The patient's case was discussed by a Heart Team, and a percutaneous strategy was declined due to the presence of an ascending aortic aneurysm and left main coronary artery stenosis. The study was approved by the hospital ethics committee (SSMOriente190324) and informed consent was obtained.

Correspondence Address:

Germán J. Chaud

 <https://orcid.org/0000-0003-0256-3360>

Department of Cardiac Surgery, Hospital Las Higueras

Alto Horno 777, Talcahuano, Chile

Zip Code: 4260000

E-mail: germanchaud@gmail.com

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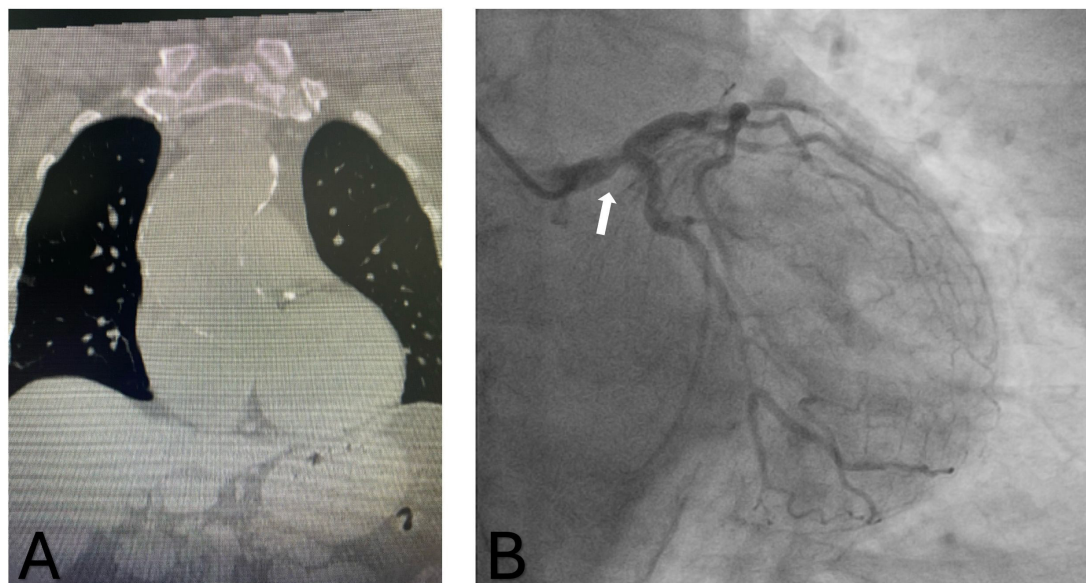


Fig. 1 - (A) Preoperative computed tomography scan showing ascending aortic aneurysm with porcelain aorta. (B) Coronary angiogram with main trunk stenosis (arrow).

Surgical Technique

The surgery was approached by median sternotomy. Central aortic cannulation was guided by epiaortic echocardiography and performed using the Seldinger technique. The patient was gradually cooled to 30°C, and a 12 Fr arterial cannula was introduced into the brachiocephalic trunk to facilitate antegrade cerebral perfusion. Upon reaching the target temperature, circulatory arrest was initiated, and myocardial protection was achieved by administering Del Nido cardioplegia retrogradely and directly into the coronary ostia. Subsequently, the ascending aorta and hemiarch were replaced with a 32 mm Dacron® graft secured with 4-0 polypropylene sutures and reinforced with Teflon™ felt. The Dacron® prosthesis was then cannulated and cross-clamped, starting systemic perfusion. During rewarming, a distal second obtuse marginal coronary bypass graft was constructed using a saphenous vein. The aortic valve was then excised, and proximal aortic-Dacron® suturing commenced at the posterior STJ level, facilitating subsequent implantation of a size M sutureless Perceval™ aortic valve (LivaNova PLC, London, United Kingdom) (Figure 2A). Completion of the proximal aortic-Dacron® suture anteriorly was followed by anastomosis of the proximal end of the venous graft into the Dacron® prosthesis. Finally, a left internal mammary artery to left anterior descending artery anastomosis was performed (Figure 2B).

Cardiopulmonary bypass and aortic cross-clamping durations were recorded at 125 and 62 minutes, respectively, with a circulatory arrest period of 26 minutes. Postoperative transesophageal echocardiography revealed a mean aortic gradient of 2.9 mmHg and no evidence of perivalvular leak. The immediate postoperative course was notable for severe vasoplegia and acute kidney dysfunction, which resolved to baseline levels. The patient was discharged on day eight without further complications. At the

10-month follow-up, the patient remains asymptomatic, with a CT scan revealing no surgical complications or valve migration.

DISCUSSION

The use of rapid deployment aortic valves had been contraindicated in patients with root and ascending aortic aneurysms due to concerns regarding the anchor system^[3]. Nonetheless, a handful of published cases have demonstrated the feasibility and excellent outcomes of this approach^[2-5]. This case report highlights several key points. Sutureless valves have been shown to reduce normal cardiopulmonary bypass times by up to 40%, making them a valuable tool in the treatment of severely ill patients^[4]. These saved minutes can be invaluable, especially in combined procedures. The optimal sequence for valve deployment may vary depending on the patient's specific situation. One approach involves creating a new STJ with aortic-Dacron® anastomosis before valve deployment. Alternatively, starting with the posterior wall of the aortic-Dacron® anastomosis also allows for proper positioning of the valve before completing the anterior portion of the anastomosis in usual fashion.

On the other hand, a porcelain aorta is a predictor of mortality and stroke and presents additional challenges for surgical intervention, including arterial cannulation and aortic clamping^[6]. Epiaortic echocardiography is an invaluable tool at time of cannulation to find the perfect spot in severe aortic calcification. Planning for cerebral protection and avoiding aortic cross-clamping are emphasized to reduce the risk of distal embolization.

CONCLUSION

While a limited number of cases have been published, this case underscores the importance of rapid valve deployment in

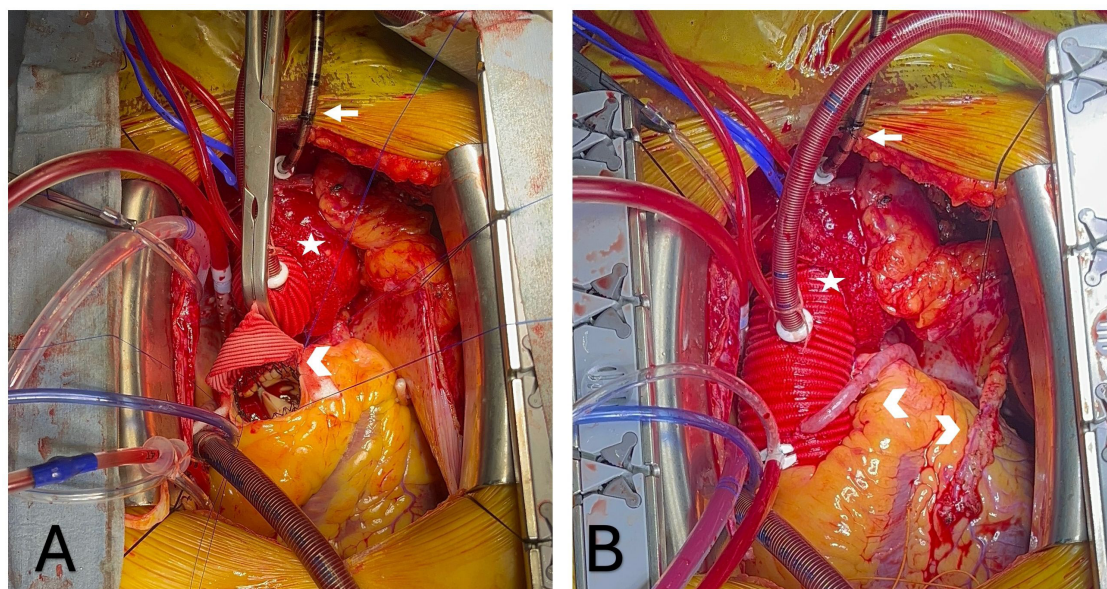


Fig. 2 - Intraoperative view showing Dacron® cannulation (white star) and 12 Fr brachiocephalic arterial cannula (white arrow) (A) with posterior aortic-Dacron® sinotubular junction suture performed and sutureless valve deployed (white head arrow); (B) completion of anterior aortic-Dacron® anastomosis and coronary bypasses (white head arrow).

challenging patients and its feasibility alongside concomitant ascending aortic replacement without valve migration. Moreover, dealing with a porcelain aorta adds complexity and highlights the importance of meticulous planning and teamwork. Nevertheless, larger series are still needed to confirm the efficacy of sutureless valves in such scenarios.

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Authors' Roles & Responsibilities

PAF 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; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; final approval of the version to be published

GJC 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; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; final approval of the version to be published

JG 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; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; final approval of the version to be published

MD 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; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; final approval of the version to be published

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CG 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; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; final approval of the version to be published

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CA	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; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; final approval of the version to be published
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