Case Report

Sutureless Aortic Valve Implantation in Patient with Porcelain Aorta via Unclamped Aorta and Deep Hypothermic Circulatory Arrest

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Abstract

Severe atherosclerotic calcification of the ascending aorta, the so-called porcelain aorta, precludes cardiac surgeons from placing an aortic cross-clamp and direct aortic cannulation due to the increased risk of systemic embolism and stroke. In the present report, we support the option of sutureless valve implantation in a case of a porcelain ascending aorta, with deep hypothermic circulatory arrest and also without aortic cross-clamp.

Keywords: *Aortic valve, aortic valve surgery, deep hypothermic circulatory arrest, perceval valve, porcelain aorta, self-expanding valve, sutureless valve*

Introduction

Severe atherosclerotic calcification in the ascending aorta, also known as a "porcelain aorta," precludes cardiac surgeons from placing an aortic cross-clamp due to the increased risk of systemic embolism and stroke.[1,2] The impossibility of safely cannulating and clamping the ascending aorta due to the risk of cracking atherosclerotic plaques has generated several methods to minimize aortic manipulation.[3]

In the present report, we support the option of sutureless valve implantation in a case of an extremely calcified (porcelain) ascending aorta, with deep hypothermic circulatory arrest (DHCA) and also without aortic cross-clamp.

Case Presentation

An 81-year-old woman referred to our hospital due to pulmonary edema as a result of severe aortic valve stenosis (aortic valve area 0.5 cm^2, mean pressure gradient 42 mmHg, and peak pressure gradient 67 mmHg). The patient intubated and admitted to the cardiologic intensive care unit while she was in the waiting list for transcatheter aortic valve implantation (TAVI). The patient went to the surgery the next day. From her personal history, the patient had left mastectomy on 1974 because of cancer and hepatic segmentectomy due to a cystic formation on 1988. She also had a chronic renal dysfunction (glomerular filtration rate = 39.9 ml/h).

The patient's expected operative risk, calculated according to the logistic European System for Cardiac Operative Risk Evaluation, was 29.86%. The programed conventional aortic valve replacement was abandoned due to the detection of a porcelain ascending aorta from computed tomography (CT) scan preoperatively. CT revealed a severed calcified from the ascending aorta to the aortic arch [Figure 1].

Before sternotomy, an 8-mm prosthetic graft was anastomosed to the right axillary artery. After sternotomy, a cardiopulmonary bypass was initiated with a venous return from the right atrium and a left ventricular venting from the right upper pulmonary vein. Cardiopulmonary bypass was instituted, and the patient was cooled down to 18°C. Because of the porcelain aorta, no clamp was used and the aortic valve replacement went under total circulatory arrest. The proximal ascending aorta with a less calcified site was opened in an elongated fashion [Figure 2]. During 30 min of DHCA, the aortic valve leaflets were removed and a 23-mm perceval S valve was implanted into the decalcified aortic root [Figure 2]. Techniques of valve

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sizing and implantation were employed as described by Shrestha *et al*.[4] Myocardial protection was obtained with the Custodiol-histidine-tryptophan-ketoglutarate solution (Essential Pharma, Newtown, PA, USA) retrogradely delivered during hypothermic circulatory arrest (HCA). The aorta was closed with isolated mattress sutures 4-0 polypropylene inforced with Teflon-felt [Figure 3]. The total cardiopulmonary bypass time was 100 min. The postoperative was uneventful without the need of temporal or permanent pacemaker and she discharged home in good clinical conditions. In the follow-up, no significant paravalvular leak was noted while she is in optimal health status.

Conclusion

A severely calcified ascending aorta and arch are considered to increase the risk of a cerebral emboli occurring in patients undergoing aortic valve replacement. Several technical options have been used to avoid this complication, such as DHCA with or without ascending aortic replacement, endarterectomy of the ascending aorta, aortic inspection, and cross-clamping during HCA.[4-6]

Nowadays, the transcatheter technology allows treating the aortic stenosis in strongly symptomatic patients with prohibitive operative risk or in the presence of a porcelain aorta.[7] However, it is well known that there are some extreme cases where transcatheter procedures could be ineffective, such as in the case of an unexpected operative finding of grossly atheromatous ascending aorta, the switching to TAVI could be unfeasible, such as in surgical units that do not dispose of the transcatheter technology or a hybrid operative theater.

In our case report, we successfully manage to replace the aortic valve within a porcelain aorta, using a perceval biological sutureless valve in deep hypothermia and total cardiac arrest. This collapsible and expandable device offers the advantage of the possibility of a small aortotomy.[7-9] The sutureless valve was adopted following intraoperative detection of an unexpected porcelain ascending aorta because of its potential for shortening the duration of DHCA.[8]

Kaneko *et al*. suggest that device development and technical maturity are likely to improve transcatheter aortic valve replacement outcomes in the future; nevertheless, surgical treatment remains a proven safe procedure, especially in octogenarians, and the current study suggests that selecting patients by age maximizes these benefits.[10]

Despite the notion among physicians including cardiac surgeons that porcelain aorta is "inoperable," surgical AVR using DHCA, sutureless valve, and total cardiac arrest is a viable option and has to be studied.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The

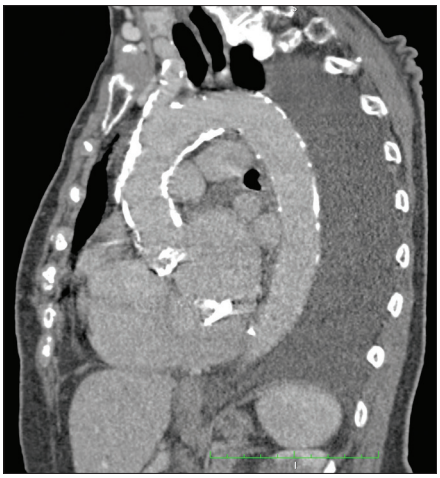

Figure 1: The preoperative computed tomography showing the extremely calcified aorta and the aortic valve

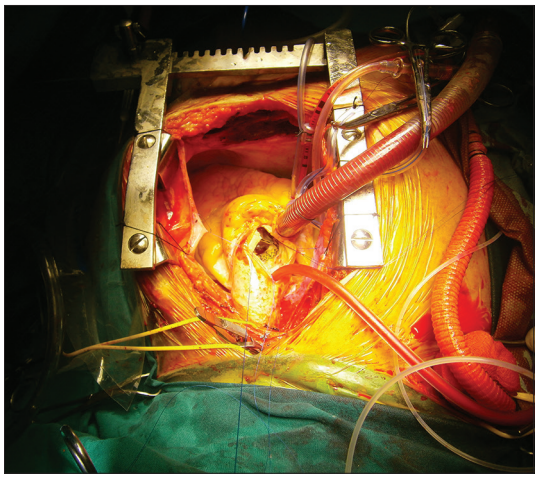

Figure 2: Intraoperative photo with the elongated aortotomy and the perceval S aortic valve implanted

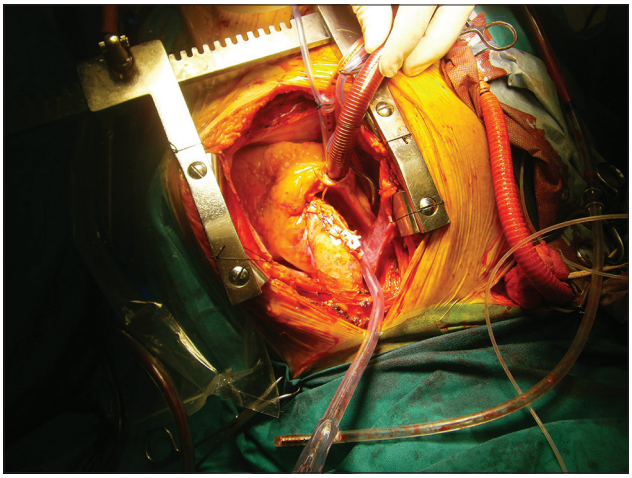

Figure 3: The special closure of the elongated aortotomy performed in a less calcified area

patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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