

How to tackle an unexpected porcelain aorta in the setting of planned aortic valve replacement combined with coronary surgery?

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Received date: February 20, 2024; **Accepted date:** March 03, 2024; **Published date:** March 11, 2024

Citation: Abdelkader Boukhmis, Khaled Khacha, Yacine Djouaher, (2024), How to tackle an unexpected porcelain aorta in the setting of planned aortic valve replacement combined with coronary surgery?, *J Clinical Research and Reports*, 15(2); DOI:10.31579/2690-1919/355

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Abstract

Unexpected porcelain aorta is a real challenge to safely completing aortic valve replacement combined with coronary artery surgery. This condition often leads to an aborted sternotomy in the hope of performing transcatheter procedures, the feasibility of which may be hampered by anatomical considerations. We report the case of a 71-year old man with history of hypertension, type 2 diabetes mellitus and chronic kidney disease, which was referred for severe aortic valve stenosis and severe coronary artery disease. He benefited from an anaortic off-pump coronary surgery and clampless aortic valve replacement under hypothermic circulatory arrest to overcome an unexpected porcelain aorta. Our patient had uneventful postoperative courses without any neurological disorders, or worsening of his moderate kidney failure. He was discharged within postoperative day 15. After 12 months of follow-up, he was asymptomatic and his transprosthetic mean pressure gradient was 23 mmHg.

Keywords: aortic calcification; off pump coronary artery bypass; circulatory arrest; aortic valve stenosis

Introduction

Porcelain aorta is a nearly or completely circumferential calcification of the ascending aorta and/or aortic arch precluding safe aortic cross-clamping or cannulation [1].

Surgical aortic valve replacement (SAVR) combined with coronary surgery is a real challenge in the presence of an unexpected porcelain aorta. Indeed, cross-clamping of such an aorta may induce cerebral embolization, aortic dissection, or death from uncontrollable hemorrhage [2].

In the era of transcatheter aortic valve replacement (TAVR) and percutaneous coronary intervention (PCI), the proportion of patients in whom SAVR was attempted but aborted because of intraoperative discovery of porcelain aorta is constantly increasing [3].

However, for anatomical considerations, the feasibility of these transcatheter procedures in the context of aborted sternotomy is not

guaranteed for all patients, with more frequent valve malposition requiring implantation of a second valve [4].

For this reason and to avoid aborted sternotomy, off-pump coronary artery bypass surgery (OPCAB) combined with a clampless SAVR under hypothermic circulatory arrest (HCA) have been performed in order to tackle this unexpected trap.

Case presentation:

A 71-year old men with a history of hypertension, type 2 diabetes mellitus, chronic kidney disease, unstable angina and dyspnoea (New York Heart Association class II) was referred for severe aortic stenosis (aortic valve area: 0.7 cm², mean pressure gradient: 53 mmHg) and severe proximal stenosis of the left anterior descending artery (LAD). After performing a median sternotomy and opening the pericardium, the unexpected circumferential calcifications of the ascending aorta and the

aortic arch, respecting the sinuses of valsalva, led us to perform an OPCAB of the LAD by the left internal thoracic artery (**Figure 1**). Subsequently, we instituted a cardiopulmonary bypass between the

brachiocephalic arterial trunk, which was free of calcifications, and the right atrium (**figure 1**) then the patient was cooled down to 20-22 °C.

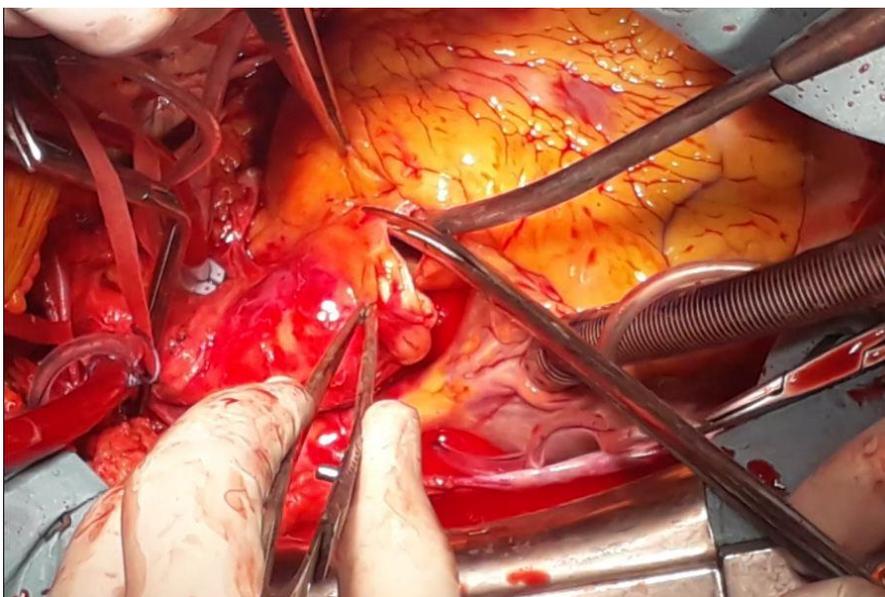


Canulation of the brachiocephalic arterial trunk and the right atrium without starting cardiopulmonary bypass, then Off-pump bypass grafting of the left anterior descending artery with the left internal thoracic artery

After initiating HCA, the innominate artery was cross-clamped at its origin, and antegrade cerebral perfusion was started with a perfusate temperature of 20 C.

With the patient in the Trendelenburg position, a transverse aortotomy was made, passing a few millimeters above the right coronary ostium

(**Figure 2**). We then performed an SAVR using a No: 23 stented bioprosthesis with a single dose of selective antegrade cold blood cardioplegia.



Aortic valve replacement under hypothermic circulatory arrest and antegrade cerebral perfusion

After deairing the aorta, general rewarming was initiated after 33 minutes of circulatory arrest. This patient had uneventful postoperative courses without any neurological disorders, worsening of renal disease, or reoperation for bleeding. He was discharged within postoperative day 15. After 12 months of follow-up, he was asymptomatic and his transprosthetic mean pressure gradient was 23 mmHg.

Discussion:

In the presence of an unexpected porcelain ascending aorta, SAVR combined with a coronary artery surgery become a real challenge. Chest X-ray film or cine angiography are not able to determine whether there is nearly or completely circumferential calcification and cannot detect atherosclerotic plaques with little or no calcification. For this reason, aggressive preoperative and intraoperative evaluation of the aorta using multislice computed tomography, transesophageal echocardiography and epiaortic ultrasound is important in elderly patients as well as those with systemic atherosclerosis before any cardiac surgery [5]. The current guidelines favour TAVR over SAVR in the case of a porcelain aorta diagnosed preoperatively [6], leading many surgeons to abort the operation upon its intraoperative discovery, in the hope of offering these patients a TAVR with or without PCI [7]. However, it is important to note that although TAVR represents a clampless treatment option, it is responsible for a greater incidence of disabling strokes (7.2%) and more frequent valve malposition, than in patients without heavily calcified aorta [4]. Furthermore, for anatomical reasons, TAVR is not always feasible, and SAVR was the only option in 36.8% (n=7/19) of patients referred to a high-risk valve centre after an aborted sternotomy [3].

Several strategies have been proposed to overcome this issue, combining OPCAB surgery with: (a) transapical TAVR [9], (b) SAVR with sutureless Perceval valve in order to reduce its HCA duration [10], (c) aortic root replacement with a composite valve graft during a relatively brief HCA [4]. (d) the use of aortic endoclamps to replace aortic valve only requires a brief period of HCA, but there is still the risk of embolization [4], (e) extensive ascending aortic endarterectomy combined with HCA, which carries a postoperative stroke rate of 34.9% and an unknown risk of aneurysmal degeneration [4], (f) apicoaortic conduits where the risk is the formation of thrombus or the occurrence of stagnation due to competition between antegrade and retrograde flow [4].

Future directions:

In order to avoid aborted sternotomies due to unexpected porcelain aorta, which have a higher hospital and long-term mortality [7], a preventive strategy based on routine preoperative chest computer tomography imaging should be adopted.

On the other hand, a hybrid approach combining OPCAB and Transapical TAVR is an attractive and less invasive alternative for resolving this critical clinical scenario [9]. In the absence of a hybrid operating theatre, it has been shown that OPCAB combined with surgical aortic valve replacement under hypothermic circulatory arrest, preferably with a sutureless valve prosthesis, is a safe and valuable option [3, 11].

Limitations and strengths:

The strength of this case report lies in the fact that it proves that it is possible to avoid an aborted sternotomy in the presence of a porcelain aorta, even without transcatheter technology or a hybrid operative theatre. It also demonstrates that the combination of OPCAB and SAVR is safe in such a critical scenario. The limitation of this case report is the non-availability of a sutureless valve prosthesis at the time of surgery, which could certainly have shortened the duration of circulatory arrest.

Conclusion:

Off-pump coronary surgery combined with a clampless aortic valve replacement under hypothermic circulatory arrest can safely overcome an unexpected porcelain aorta and avoid aborted sternotomies.

Routine preoperative evaluation of the aorta using multislice computed tomography should be performed in elderly patients as well as those with systemic atherosclerosis.

Acknowledgments:

None to declare.

List of abbreviations:

HCA: Hypothermic circulatory arrest.

LAD: Left anterior descending artery.

OPCAB: Off-pump coronary artery bypass.

PCI: Percutaneous coronary intervention.

SAVR : Surgical aortic valve replacement.

TAVR : Transcatheter aortic valve replacement

Funding:

We attest that we have not received any financial support or grants from any institution during the realization of this report.

Conflict of interest :

The authors have no conflict of interests to declare.

Author contributions :

Conception, data collection, and writing of the original draft (AB); literature review (AB and KK); methodology (AB and YD); resources (AB, YD).

Ethical statement:

All procedures performed in this cases study involving human participants, were in accordance with the ethical standards of the Faculty of Medicine of Algiers and with the 1964 Helsinki declaration and its later amendments. Written and informed consent for publication was obtained from the patient.

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DOI:10.31579/2690-1919/355

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