Author’s response to reviews

Title: Minimal invasive aortic valve replacement: Associations of radiological assessments with procedure complexity

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Editorial Department of Journal of Cardiothoracic Surgery

Bruce Roberts Boti, MSc
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Dear Editor of JCTS,

Thank you very much for your consideration. A detailed point-by-point response to the suggestions of the reviewers is presented below. The tracked changed version of the manuscript is added as a supplementary file.

On behalf of all authors,

Yours Sincerely,

Bruce Robert Boti, MSc

Reviewer reports:

Reviewer #1 (Minor Revision): The most important thing for the surgeon to determine is the best therapeutic option for his or her patient. The rapid deployment prostheses and the minimally invasive surgery have been options for selected patients. However, with the use of TAVR and
conventional techniques we need to determine what the real benefit of using each technique will be. I would like to see a discussion about the therapeutic options that are available to surgeons. I think the discussion needs to be deepened in this direction.

We thank the reviewer for bringing up this topic. We agree that the benefit of the new therapeutic options should be studied. When a patient with aortic valve stenosis comes in our institute, they initially are considered for surgery. The heart team assess the patient’s cardiac history, the patient’s frailty, risks and technical suitability. High- to intermediate risk patients are usually considered for TAVI and the low- to intermediate-risk patients are considered for mini-AVR and CAVR. The mortality rates between these options is comparable, so that means that the choice of therapeutic option depends on the careful evaluation of the heart team per individual patient.

We added the following to the manuscript:

• Discussion:

Mini-AVR and CAVR are not the only choice of intervention for AS. The patient can also be treated through the less invasive transcatheter aortic valve implantation (TAVI). TAVI is favoured for high-risk and intermediate-risk patients who clinically are frail and old and have an increased risk for surgery. Mini-AVR and CAVR are favoured for low-risk and intermediate-risk patients, who might have endocarditis and might require additional interventions like revascularization of the coronaries. Surgery is considered when the aortic valve annulus is out of range for TAVI, the aortic root morphology is unfavourable for TAVI, and when the morphology of the valve (bicuspid valves, degree of calcification) is unfavourable for TAVI [30]. For the therapeutic choice between TAVI, mini-AVR and CAVR, a dedicated heart team assesses each patient based on previous cardiologic history and baseline characteristics, calculate the risk of surgery, evaluate the feasibility of TAVI or surgery, and local experience. TAVI is associated with increased pacemaker implantation, vascular complications and paravalvular leakage [31]. For mini-AVR and CAVR these complications are less common. However bleeding complications, acute kidney injury and new-onset atrial fibrillation happen more frequent when compared with TAVI [32]. When an institute is able to perform both surgical as percutaneous valve replacement, the heart team can evaluate technical suitability and risk-benefit ratio and decide the best course of action.
Reviewer #2 (Minor Revision): This article is of interest to those involved in this type of procedure.

Clarity is important, and unfortunately the term "minimally invasive" gives an impression that this is a minor procedure. Invasiveness is the use of the heart lung machine, when one considers that the sternum or chest is opened, the aorta is clamped, and the heart is subjected to ischemic injury. Unfortunately this term has been use as a means of attracting patients to a particular surgeon or institution. No fault of the authors, but I wish someone would clarify that this is actually small incision (maximally invasive)

We agree with the reviewer that the term “minimal invasive” is misleading and thank the reviewer for bringing up this topic. An alternative used term for this procedure is ‘minimal access aortic valve replacement’. Nevertheless, “minimally invasive aortic valve replacement” has become the standard, so we opted to use this terminology after the elucidation of this term.

The following changes have been made to the manuscript:

• Introduction

Mini-AVR aims to minimize the degree of surgical intrusiveness by operating through a smaller incision (also known as ‘minimal access AVR’). Nevertheless, this procedure can still be considered an invasive surgical procedure. Because the term “Mini-AVR” has achieved common acceptance, we opted to use this as well in the remainder of this manuscript.

Reviewer #3 (Accepted): It's a good simple radiological test to assess all min inv AVR. Also surprisingly to see bigger annular dimension gives longer x clamp time.
We thank the reviewer for his compliments. We were also surprised to see that larger annular dimensions resulted in longer X-clamp time.

Reviewer #4 (Minor Revision): I have read with interest the paper written by Boti et al. The paper deals with an important issue which is of importance for the surgeons in the field. I advise the following recommendations:

1- the two following important RCT’s need to be cited and mentioned in the introduction:


B- Manubrium-limited ministernotomy versus conventional sternotomy for aortic valve replacement (MAVRIC): study protocol for a randomised controlled trial.
Randomized controlled trial
Akowuah E, Goodwin AT, Owens WA, Hancock HC, Maier R, Kasim A, Mellor A, Khan K, Murphy G, Mason J

We thank the reviewer for mentioning these important RCT’s. The following changes have been added to the manuscript:

- Introduction
Recent randomized controlled trials have shown that mini-sternotomy did not result in shorter hospital stay, faster recovery, improved survival, or less transfusion of blood compared to CAVR [4], [5].

2- the following relevant paper needs to be cited and mentioned in discussion section:

Right Thoracotomy Minimally Invasive AVR: Use of Preoperative CT Scan to Plan Incision
Arthur Martella, Steven Kernis, Steven Curiale, Uche Ndubizu and Jane Cichelli
Journal of Cardiothoracic Surgery201510 (Suppl 1) :A28

We thank the reviewer for mentioning this paper. We added the following to the manuscript:

• Discussion

In Martella et al [24], preoperative CT scans were used to plan the incision for right thoracotomies. Their results showed that if the incision location is perpendicular to the plane of the aortic valve, the surgeon has a better view on the exposed valve. It was shown that for this procedure, anterior and medially positioned aortas are more challenging because the angle towards the valve becomes more difficult, especially for right thoracotomies.

3- Define the calcium scoring system and the scoring categories in methods section.

We thank the reviewer for pointing out this topic. In our approach, we presented a quantitative measure of the aortic valve calcification. The calcium volume is measured in mm3. We added the following to the Methods section of the revised manuscript:

• Methods
We measured the calcium volume quantitatively in mm³ after thresholding the Hounsfield Unit intensities to separate the calcifications from the enhanced blood and aortic wall. The calcium volume is calculated after setting a volume of interest including aortic annulus and leaflet. Calcifications in the left ventricular outflow tract, coronary arteries and ascending aorta are excluded [23].

4- There is a satisfactory implanted valve for which authors need to be commended, did pre-op CT play a role in patient selection regarding the annulus size and the future implanted valve size? Can CT predict the implanted valve size? If yes can the specificity and sensitivity be reported?

We thank the reviewer for mentioning this topic. The pre-op CT did not play a role in patient selection regarding annulus size and the implanted valve size. This was not clearly described in the initial manuscript and we adjusted the text to be more clear.

We added the following in the manuscript:

• Methods

All patients that underwent mini-AVR at two institutes (Amsterdam UMC, location Academic Medical Center, The Netherlands; Onze Lieve Vrouwe Gasthuis, The Netherlands) and had a preoperative CT-scan between December 2014 and March 2018 were included in this study. The CT-imaging was not part of the treatment selection.

5- the 3D image should be the surgeon view, so this needs to be rotated to get into a more understandable orientation with clinical application.

We thank the reviewer for mentioning this. We agree that the addition of a surgical view is valuable.

We added a surgical view to the original view.

The following has been added to the revised manuscript.
Figure 1: A: Anterior (surgical) view of the aorta and ribcage. B: Laterosuperior view of the aorta and partial rib cage. The access distance and access angle are determined based on the location of three landmarks: aortic annulus center, sinotubular junction and incision location (manubriosternal joint).