MECHANICAL PRESSURES – A NOVEL CANDIDATE PREDICTOR OF CONDUCTION DISTURBANCES AFTER TRANSCATHETER AORTIC VALVE IMPLANTATION

Giorgia Rocatello[1*], Nahid El Faquir[2], Matthieu De Beule[1,3], Peter de Jaegere[2], Johan Bosmans[4], Patrick Segers[1], Peter Mortier[1,3]

[1]Ghent University, IBiTech-bioMMeda, Belgium

[2]Erasmus MC Rotterdam, Department of Cardiology, The Netherlands

[3] FEops NV, Ghent, Belgium

[4]University Hospital Antwerp, Belgium

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1. INTRODUCTION

Conduction abnormalities are one of the most frequent complications after transcatheter aortic valve implantation (TAVI) and they often lead to pacemaker implantation [1]. High pressures generated by the inserted device on the LVOT (left ventricular outflow obstruction) wall in vicinity of the conduction system might be the main cause of injury of the conduction system leading to these abnormalities. In this study, TAVIguide, a CE marked preoperative planning tool that allows patient-specific finite-element simulations of TAVI procedures, is used to investigate whether the pressures on the aortic wall as result of the interaction between the implanted device and the surrounding tissues are a candidate predictor of conduction abnormalities.

2. MATERIALS AND METHODS

Ninety-five patients, of whom 59 developed new conduction abnormalities after implantation of self-expanding CoreValve were enrolled (EMC Rotterdam, UZA Antwerp). For each patient, a 3D patient-specific aortic model was segmented from preoperative cardiac CT images (Mimics v18.0). The lower boundary of the membranous septum, which constitutes an anatomical landmark for the left ventricular exit of the His bundle, was identified in the 3D models starting from dedicated landmarks assessed on the preoperative CT images. Finite-element simulations were performed in Abaqus to virtually implant the Medtronic CoreValve device at the same implantation depth as done in reality for each patient. The maximum contact pressure in the selected region of interest was assessed.

A 2-tailed Mann-Whitney test was performed in SPSS to test pressure level differences between patients with and without conduction disturbances post-TAVI, with the significance level set at 0.05. Receiver-operating characteristic (ROC) curve and sensitivity-specificity analysis were performed for the investigated parameter.

3. RESULTS AND DISCUSSION

Anatomical variability on the membranous septum (location, length and shape) was observed in the investigated population. In the selected region of interest, significantly higher contact pressure values were observed in patients with new conduction abnormalities after TAVI ($p<0.001$). The area under the curve equal to 0.78 was obtained from the ROC curve analysis, showing good accuracy of the test. Furthermore, the pressure value of 0.36 MPa was identified as cut-off that maximizes sensitivity and specificity, resulting in a sensitivity of 84% and in specificity of 67%. Based on the obtained results, we conclude that the contact pressure is a potential predictor for new conduction abnormalities after TAVI.

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References

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