

The Effect of Sinus Diameter on the Opening and Closing Performance of Aortic Valve Under the Expansion of Aortic Root

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Abstract: In order to explore the effect of aortic sinus diameter on aortic valve opening and closing performance in the case that aortic valve itself has no obvious disease and aortic root expands continuously. In this study, 20 groups of aortic root models with different aortic sinus and root diameters were constructed according to the size of clinical surgical guidance to simulate the possible expansion of aortic root at the later stage of operation. The valve sinus diameter DS were set to 32 mm, 36 mm, 40 mm and 44 mm, the aortic root diameter DA values were set to 26 mm, 27 mm, 28, 29 mm and 30 mm. Time-dependent pressure loads were applied to the valve and the vessel wall of the aortic and the ventricle side. Structural mechanics calculation was performed by using finite element software. The maximum stress, orifice area and contact force of the valve were analyzed to evaluate the valve opening and closing performance in dilated state. The orifice area of the valve was small when the DS=32 mm, DA=26 mm, 27 mm and DS=36 mm, DA=26 mm. The valve was incompletely closed when the DS=32 mm, 36 mm and 40 mm, DA=30 mm and DS=44 mm, DA=29 mm, 30 mm. The calculated values of the rest of the 12 models were within the normal range and the valve motion was normal. The results showed that the size of the aortic sinus affects the open and closed performance of the aortic valve. The smaller sinus diameter is adapted to the larger root diameter and the larger sinus diameter is adapted to the smaller root diameter. When the sinus diameter is 40 mm, it can well adapt to the relatively large range of root expansion.

Keywords: Root diameter, sinus diameter, aortic valve, finite element analysis.

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