Bileaflet Prosthetic Heart Valve Disease: Numerical Approach Using 3-D Fluid-Structure Interaction Model With Realistic Aortic Root

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ABSTRACT

abstract

Surgical replacement, in the incidence of severely diseased heart valve, is vital in order to restore the normal heart function. Every year around 280,000 valve replacements occur around the world, half of them are bileaflet mechanical heart valves (BMHVs). Despite the remarkable improvement in valve design resulting in minimizing prosthetic valve complications (thromboembolic events or pannus formation), these complications are still possible with BMHV Implantation. As a consequence, an obstruction in one or both MHV leaflets could happen and threaten the patient life. In the present study, an obstructed bileaflet MHV with different percentages of malfunction was simulated assuming 3-D fluid structure interaction (FSI) adapting k-w turbulence as a robust model for the transitional flow using 2.5 million elements and creating a realistic aortic root model with three sinuses. Velocity contours for different percentages of malfunction were compared mainly at B-datum plane and the perpendicular plane to the B-Datum. Also, the development of coherent structures was investigated. Clinically, the maximum pressure gradients were estimated by mimicking the Echo Doppler assumptions (using the simplified Bernoulli equation).

Topics: Diseases , Fluid structure interaction , Heart valve prostheses

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