Fluid structure interaction on paravalvular leakage of transcatheter aortic valve implantation related to aortic stenosis: a patient-specific case

ABSTRACT

This study investigated the impact of paravalvular leakage (PVL) in relation to the different valve openings of the transcatheter aortic valve implantation (TAVI) valve using the fluid structure interaction (FSI) approach. Limited studies were found on the subject of FSI with regards to TAVI-PVL condition, which involves both fluid and structural responses in coupling interaction. Hence, further FSI simulation with the two-way coupling method is implemented to investigate the effects of hemodynamics blood flow along the patient-specific aorta model subjected to the interrelationship between PVL and the different valve openings using the established FSI software ANSYS 16.1. A 3D patient-specific aorta model is constructed using MIMICS software. The TAVI valve identical to Edward SAPIEN XT 26 (Edwards Lifesciences, Irvine, California), at different Geometrical Orifice Areas (GOAs), is implanted into the patient's aortic annulus. The leaflet opening of the TAVI valve is drawn according to severity of GOA opening represented in terms of 100%, 80%, 60%, and 40% opening, respectively. The result proved that the smallest percentage of GOA opening produced the highest possibility of PVL, increased the recirculatory flow proximally to the inner wall of the ascending aorta, and produced lower backflow velocity streamlines through the side area of PVL region. Overall, 40% GOA produced 89.17% increment of maximum velocity magnitude, 19.97% of pressure drop, 65.70% of maximum WSS magnitude, and a decrement of 33.62% total displacement magnitude with respect to the 100% GOA.