Fluid-structure interaction in problems of patient specific transcatheter aortic valve implantation with and without paravalvular leakage complication

ABSTRACT

Paravalvular Leakage (PVL) has been recognized as one of the most dangerous complications in relation to Transcathether Aortic Valve Implantation (TAVI) activities. However, data available in the literature about Fluid Structure Interaction (FSI) for this specific problem are relatively limited. In the present study, the fluid and structure responses of the hemodynamics along the patient aorta model and the aortic wall deformation are studied with the aid of numerical simulation taking into account PVL and 100% TAVI valve opening. In particular, the aorta without valve (AWoV) is assumed as the normal condition, whereas an aorta with TAVI 26 mm for 100% Geometrical Orifice Area (GOA) is considered as the patient aorta with PVL complication. A 3D patient-specific aorta model is elaborated using the MIMICS software. Implantation of the identical TAVI valve of Edward SAPIEN XT 26 (Edwards Lifes ciences, Irvine, California) is considered. An undersized 26 mm TAVI valve with 100% valve opening is selected to mimic the presence of PVL at the aortic annulus. The present research indicates that the existence of PVL can increase the blood velocity, pressure drop and WSS in comparison to normal conditions, thereby paving the way to the development of recirculation flow, thrombus formation, aorta wall collapse, aortic rupture and damage of endothelium.

Keyword: Paravalvular Leakage (PVL); Hemodynamics; Transcatheter aortic valve implantation (TAVI); Fluid-structure interaction (FSI); Edward sapien valve aortic valve (ESV); Aortic stenosis (AS)