The 10th TSME International Conference on Mechanical Engineering
10th – 13rd December 2019
Pattaya, Thailand

SIMULATION STUDY ON INFLUENCE OF LEAFLET SHAPE AND OPEN ANGLE OF TRI-LEAFLET MECHANICAL HEART VALVE ON BLOOD FLOW

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Abstract. A mechanical heart valves is a device implanted in patients with the dysfunctional heart valves. It has been using to save many lives. Several types of mechanical heart valves have been developed to improve hemodynamic of blood that flows through the valves. The open angle and the curvature of leaflet of the mechanical heart valves may affect the hemodynamic of blood flow. Therefore, this paper was aimed to study on the influence of fully open angle and the curvature of the leaflet shape of the valves on velocity and shear stress of blood flow through tri-leaflet mechanical heart valves. This paper studied on three dimensional models of eight tri-leaflet mechanical heart valves: flat tri-leaflet heart valves at the fully open angles of 85, 87 and 90 degree, curved tri-leaflet heart valves with the curved inner radius of 8.672 mm at fully open angle of 85, 87 and 90 degree, curved tri-leaflet heart valves with the curved inner radius of 8 and 9.328 mm at fully open angles of 85 degree. The SST k-ω turbulent model in FLUENT was applied to analyse unsteady incompressible blood flow. As the results of computational simulation, the maximum shear stress was found at after peak systole phase in both flat and curved tri-leaflet heart valves. The flat tri-leaflet heart valve at the fully open angle of 90 degree provided the highest shear stress of blood flow compared with the flat tri-leaflet heart valves at other levels of open angle. While the curved tri-leaflet heart valve at the fully open angle of 85 degree provided the highest shear stress of blood flow compare with the curved tri-leaflet heart valves at the other levels of open angle. The highest velocity was found in the region between leaflets for all types of tri-leaflet heart valves, resulting in high shear stress in that region. Therefore, the fully open angle and the leaflet shape of tri-leaflet heart valves affect to velocity profile and shear stress of blood flow that may lead to blood clotting conditions in the mechanical heart valves.