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Design of Percutaneous Left Ventricular Assist Device (PVAD) and its analysis using Systemic Mock Circulation Loop (SMCL)

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Abstract

Percutaneous Left Ventricular Assist Device(PVAD) have quite cumbersome design methodologies as compared to conventional Left Ventricular Assist Device(LVAD). The aim of this study was to (i) design a micro-axial blood pump(PVAD), (ii) Validate the model using Computational Fluid Dynamics(CFD)(iii) test the model using Systemic Mock Circulation Loop(SMCL) and Particle Image Velocimetry(PIV). An in-house PVAD of shroud diameter 8mm, hub diameter 3mm, and length 16mm was designed, and manufactured using a PolyJet 3D printer. One of the most crucial aspect of the design is the successful elimination of the bearing from the leading edge. An optimum wrap angle of 250 degrees was found out, and the blade outlet angle was imposed as 90 degrees to eliminate the need for diffusor. The PVAD's pump characteristics were then obtained by building an experimental setup of SMCL, developed in-house. The dynamic response of PVAD was recorded by varying Preload, After-Load, Healthy Heart and Diseased Heart conditions in SMCL. The PVAD showed an optimum flow rate of 2.5L/min at 60mm of Hg, whereas the maximum flow rate is 3L/ min at 40mm of Hg. Particle image Velocimetry showed small regions of recirculation at trailing edge and between blades. The Wall Shear Stress(WSS) was less than 400Pa for 95% of impeller regions. The PIV study showed conformity with CFD results within 5% of deviations.

Biography:

Shivam Gupta is a research scholar in Department of Engineering Design in Indian Institute of Technology, Madras, India and has a Bachelors degree in Mechanical Engineering. He is currently working in Percutaneous Left ventricular Assist Device.

Speaker Publications:

1. "Detailed electron impact fine-structure excitation cross-sections of Kr+ and linear polarization of its subsequently emitted photons."; Journal of Quantitative Spectroscopy and Radiative Transfer/ 2019/ 10.1016/j.jqsrt.2020.106992

2. "Diagnostic of low temperature neon plasma through fine-structure resolved collisional-radiative model"; Plasma Sources Science and Technology / 2019 / 10.1088/1361-6595/ab4684

3. "Modeling of laser produced Zn plasma with detailed electron impact fine structure excitation cross-sections"; Plasma Sources Science and Technology / 2019 / 10.1088/1361-6595/ab3a22

8th World Heart Congress; Webinar – May 11-12, 2020;

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