Computational Fluid Dynamic Study of Blockage in Artery With and Without Bypass

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Abstract: In complex vessel geometry different temporal, spatial variation takes place which occur under pulsatile conditions. The high Wall Shear Stress (WSS) at the wall affected by the disturbed flow may ultimately lead to endothelial cell dysfunction, which leads to atherogenesis and thrombosis. The present study observes WSS and streamlines due to stenosis with and without By-pass Artery. It was found that by adding bypass Artery there is tremendous decrease in wall shear stress in the stenosis. Reverse flow of blood through stenosis was observed in 30^0 Bypass Models. Hence the blood flow stabilizes and can be reached at optimum level in 50% stenosed artery. Based on this paper findings, it can be deduced that there would be a low risk of further atherosclerosis when the bypass artery is added.

1. Introduction

Heart diseases are a fatal factor when weighed against an average human's life expectancy. Sudden deaths, mostly, happen due to these heart diseases. For the incident of heart failure, sudden heart death is one of the major causes, which could occur for a number of reasons. "Aging" is statistically one of the highest contributors for a sudden heart death, categorized under the reasons of "natural death". In an experiment performed on an age group ranging from 45 to 65, men had a 7 times higher chance of dying due to sudden heart death as compared to women. Engineering sciences has intertwined with the "medicine" branch which has created a catacomb of opportunities in medical problem solving and diagnosis. There are many cardiovascular diseases which affects people and atherosclerosis is the most common form of cardiovascular disease. Atherosclerosis causes several deaths per year. Blood movement decides the progression and initiation of such cardiovascular disease and decide the behavior of the Wall of the vessel. According to major Medical Services, about 80% of the mortality is caused due to cardiovascular system it is mostly caused due to any increment in the blood resistance which causes the loss of blood flow in the concerned vascular bed.

Bypass Method in coronary artery goes by another name coronary artery bypass graft. Fundamentally, an artery is abstracted from a different part of the patient body as a graft. This created graft is known to divert blood from around the narrowed components of the specific artery. The techniques used in the process are considered consequential [1]. The categorization is done twofold: firstly, individual technique and secondly, sequential technique. The individual technique thoroughly depends on the number of arteries that were blocked and henceforth utilizes the same number of graphs. Here, in this technique the surgeon is supposed to connect each and every graft in an end to side manner of the arteries' vessel. On the contrary sequential technique requires only one graft which is connected to a whole narrowed down artery by a side-to-side cessation and/or a culminate to side cessation. This graft and technique is to be operated from experience. The hemodynamic as well as the flow pattern of the graft is linked to its patency rate and therefore, it is consequential. The reason behind it is that after