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Mathematical Investigation of Early Atherosclerosis

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Arteriosclerosis is hardening of arteries. Its one of the variances is atherosclerosis. Atherosclerosis is a chronic inflammatory disease caused by the accumulation of plaque in the intima, the innermost layer of arteries. Atherosclerosis is the leading root cause of many cardiovascular diseases worldwide. The complete biochemical process of atherosclerotic plaque formation in relation to the autonomous system of ten non-linear ODEs is presented here. Concentrations of low-density lipoprotein (LDL), high density lipoprotein (HDL), free radicals, oxidized LDL, chemoattractant, monocytes, macrophages, T cells, smooth muscle cells (SMC), foam cells and collagen are considered as the dependent variables of this non-linear system. To reduce the ten-dimensional nonlinear system into a three-dimensional nonlinear system, quasi steady state approximation theory is applied. Numerical analysis of this reduced system reveals the effects of some important model parameters. This can be carried forward to develop possible clinical strategies in controlling this disease dynamics.

Author: Dr MUKHERJEE, Debasmita (Department of Statistics, Sunandan Divatia School of Science,SVKM's NMIMS (Deemed to be) University)

Co-authors: Dr N GUIN, Lakhsmi (Department of Mathematics, Visva-Bharati, Santiniketan 731235, India); Dr CHAKRAVARTY, Santabrata (Department of Mathematics, Visva-Bharati, Santiniketan 731235, India)

Presenter: Dr MUKHERJEE, Debasmita (Department of Statistics, Sunandan Divatia School of Science,SVKM's NMIMS (Deemed to be) University)

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