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A Numerical Computation Model for Low-Density Lipoprotein (LDL) Aggregation and Deposition in the Human Artery YONGLI ZHAO, SCSU, SHAOBIAO CAI, PSU, ALBERT RATNER, University of Iowa — Cholesterol caused cardiovascular events are commonly seen in human lives. These events are primarily believed to be caused by the built up of particles like low-density lipoprotein (LDL). When a large number of LDL circulates in the blood, it can gradually build up in the inner walls of the arteries. A thick, hard deposit plaque can be formed together with other substances. This type of plaque may clog those arteries and cause vascular problems. Clinical evidences suggest that LDL is related to cardiovascular events and the progression of coronary heart disease is due to its aggregation and deposition. This study presents an investigation of LDL aggregation and deposition based on particulate flow. A soft-sphere based particulate computational flow model is developed to represent LDL suspending in plasma. The transport, collision and adhesion phenomena of LDL particles are simulated to examine the physics involved in aggregation and deposition. A multiple-time step discrete-element approach is presented for efficiently simulating large number of LDL particles and their interactions. The roles the quality and quantity the LDL playing in the process of aggregation and deposition are determined. The study provides a new perspective for improving the understanding of the fundamentals as related to these particle-caused cardiovascular events.

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