TCSUH Special Seminar

Reduce Blood Viscocity, Supress Turbulence in Blood Flow, and Prevent Heart Attacks with Magnetorheology

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ABSTRACT:

Heart attacks and strokes are the leading causes of death in the industrial countries. Recent research indicates one common thread, high blood *v*iscosity, linking all vascular diseases. Moreover, turbulence in blood flow makes different regions of the vasculature vulnerable to development of atherosclerotic plaque. Turbulence is also responsible for systolic ejection of murmurs and places heavier workload on the heart, leading to trigger heart attacks. Presently neither medicine nor method is available to suppress turbulence or disturbed blood flow. The only method to reduce the blood viscosity is to take medicine, such as aspirin or other blood thinners**.** However, all these medicines have side effects in high doses. In addition, using medicine to reduce the blood viscosity does not help to suppress turbulence. In fact, the turbulence gets worse as the Reynolds number goes up with the reduced blood viscosity.

Here we report our new magnetorheological technology: When a strong magnetic field is applied to blood along its flow direction, red blood cells are polarized and aggregated into short chains along the flow direction. The blood viscosity becomes anisotropic: Along the flow direction the viscosity is significantly reduced, but in the directions perpendicular to the flow, the viscosity is considerably increased. In this way, turbulence in blood flow is suppressed because the motion in directions perpendicular to the flow is forbidden. The blood flow becomes laminar. With the reduced blood viscosity along the flow direction, the blood circulation is greatly improved and the workload for the heart is significantly reduced. While these effects are not permanent, they last for about 24 hours and are repeatable. By selecting suitable magnetic field, we can keep the blood viscosity within the normal range, maintain the laminar blood flow, and prevent heart attacks and other vascular diseases.

BIO:

Rongjia Tao was the first graduate student of the CUSPEA (China-US-Physics-Exam and Application) program admitted by Prof. T. D. Lee to study physics at Columbia University in 1979. He received his Ph.D. in physics from Columbia University in 1982. After spending two years as a postdoctoral fellow with David Thouless at University of Washington and University of Cambridge, one year as Research Assistant Professor with Ducan Haldane at University of Southern California, and four years as assistant professor at Northeastern University, he joined Southern Illinois University at Carbondale (SIUC) in 1989 where he served as Professor of Physics and Department Chair. In 2000, he moved to Temple University to serve as Professor of Physics and Department Chair (2007-2014).

His research area includes Quantum Hall Effect, electrorheology, magnetorheology, superconducting ball, etc. His recent work on viscosity reduction for crude oil, chocolate, and blood, suppressing turbulence with symmetry-breaking physics are well reported by leading science journals and news media for their importance. In 1987 he received the Omni prize for the analytical solution for the "vicious neighbor problem" (shared with Fred Wu). He is a fellow of American Physical Society and editor in chief for Modern Physics Letters B and International Journal of Modern Physics B.

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