Abstract Submitted
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Ordered and chaotic flow of red blood cells flowing in a narrow tube[1] NATALIE N. BEAMS, JONATHAN B. FREUND, University of Illinois at Urbana-Champaign — Red blood cells are well known to line up in an orderly arrangement when forced to flow through a narrow capillary-scale round tube (diameter $\leq 8\mu$m). However, in slightly larger tubes, small perturbations from the center of the tube can cause this order to break down, resulting in apparently chaotic flow. Investigating this breakdown using a high-fidelity boundary integral solver for flowing blood cells, we show the existence of a bifurcation point for the appearance of this non-orderly behavior. The bifurcation point is found to be dependent on the diameter of the tube and the density of the cells, with more cells required to instigate chaotic behavior in smaller tubes (e.g., 27.5% cells by volume for a 11.28μm diameter tube, but only 5.63% for similar behavior in a tube twice that width). Increasing the cell interior viscosity is also observed to increase the amplification of perturbations. Additionally, as a counterpoint, we show that cells flowing chaotically in $D = 12\mu$m tubes, apparently indefinitely, will slowly organize into a regular single file if D is decreased to $D \approx 10\mu$m.

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