Abstract Submitted
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Why are there no short circuits in the arterial network? SHYR-SHEA CHANG, SHENYINYING TU, Department of Mathematics, University of California Los Angeles, YU-HSIU LIU, Institute of Zoology, National Taiwan University, VAN SAVAGE, Department of Biomathematics, University of California Los Angeles, SHENG-PING HWANG, Institute of Cellular and Organismic Biology, Academia Sinica, MARCUS ROPER, Department of Mathematics, University of California Los Angeles — Efficient transport within vascular networks requires red blood cells be delivered at the same rate to each capillary, to ensure even oxygen supply throughout an organism. However, real vascular systems are massive networks in which distance from the heart to capillary vessels can vary over several orders of magnitude. Why are there no short-circuits? Why don't capillaries closer to the heart receive more red blood cells than farther capillaries? We used the trunk arterial network of a zebrafish embryo as a model for understanding the mechanisms underlying red blood cell partitioning within the microvasculature. Using mathematical modeling and experiments in living zebrafish we show that a tuned hydrodynamic feedback mechanism evenly splits red blood cells between trunk vessels. This key design feature comes at a cost to the overall efficiency of the network in that creating a uniform flux means that many red blood cells no longer travel through capillaries.

Shyr-Shea Chang
University of California, Los Angeles

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