Math predicts size of clot-forming cells

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UC Davis mathematicians have helped biologists figure out why platelets, the cells that form blood clots, are the size and shape that they are. Because platelets are important both for healing wounds and in strokes and other conditions, a better understanding of how they form and behave could have wide implications.

"Platelet size has to be very specific for blood clotting," said Alex Mogilner, professor of mathematics, and neurobiology, physiology and behavior at UC Davis and a co-author of the paper, published this week in the journal *Nature Communications*. "It's a longstanding puzzle in platelet formation, and this is the first quantitative solution."

Mogilner and UC Davis postdoctoral scholars Jie Zhu and Kun-Chun Lee developed a mathematical model of the forces inside the cells that turn into platelets, accurately predicting their final size and shape.

They were collaborating with a team led by Joseph Italiano and Jonathon Thon at Harvard Medical School and Brigham and Women's Hospital, Boston.

Platelets are made by bone marrow cells called megakaryocytes. They bud off first as large, circular pre-platelets, form into a dumbbell-shaped pro-platelet, then finally divide into a standard-sized, disc-shaped platelet. A typical person has about a trillion platelets in circulation at a time, and makes about 100 billion new platelets a day, each living for 8 to 10 days.

Inside the pre- and pro-platelets is a ring of protein microtubules, which exerts pressure to straighten and broaden the nascent cells. But overlying the ring is a rigid cortex of proteins that prevents the platelets from expanding.

By tweaking the number of microtubules in the bundles, Mogilner, Zhu and Lee found that they could correctly predict how pro-platelets would flip into a dumbbell shape, as well as the size and shape of mature platelets.

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