



Research News

Paper trail leads to heart valve discoveries

Bioengineers' filter-paper models hint at how valves calcify

Researchers are configuring layered filter paper to mimic aortic heart valves.

[Credit and Larger Version \(/discoveries/disc_images.jsp?cntn_id=299528&org=NSF\)](#)

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Paper is at the heart of an experimental device developed by [Rice University \(/cgi-bin/good-bye?http://news.rice.edu/2019/08/05/paper-trail-leads-to-heart-valve-discoveries/\)](#) bioengineers to study heart disease.

They are using paper-based structures that mimic the layered nature of aortic valves, the tough, flexible tissues that keep blood flowing through the heart in one direction only. The devices allow the engineers to study in detail how calcifying diseases slow or stop hearts from functioning.

The work, detailed in *Acta Biomaterialia* ([/cgi-bin/good-bye?https://www.sciencedirect.com/science/article/pii/S1742706119305355?via%3Dihub](#)), shows that collagen 1, a natural protein and a component of the valves' fibrous extracellular matrix, appears to have a strong association with calcification when it is found outside its usual domain. Valves hardened by calcium deposits are less flexible and lose their ability to seal the heart's chambers.

"When tissues make a lot of excess type 1 collagen, it's called fibrosis," said [NSF-supported <https://www.nsf.gov/awardsearch/showAward?AWD_ID=1404008&HistoricalAwards=false>](#) Rice bioengineer Kathryn Grande-Allen, who directed the study with Rice graduate student and lead author Madeline Monroe. "Fibrosis can happen in many types of tissues and it accompanies calcific aortic valve disease (CAVD). That doesn't necessarily mean collagen will always cause CAVD, but it definitely drove the calcification-linked phenotype in the cells we cultured."

Collagen generally stays in the valve's fibrosa layer, one of three in each of the three leaflets that make up an aortic valve. The researchers prepared paper layers to support heart valve cells embedded in either collagen or hyaluronan. They discovered that when collagen 1 proteins are present in multiple layers, the cells behaved in a way that would ultimately lead to mineralized lesions.

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