

Zernike Colloquium

February 2nd, 2023

16:00h

5111.0080

Drivers of Cancer Cell Unjamming

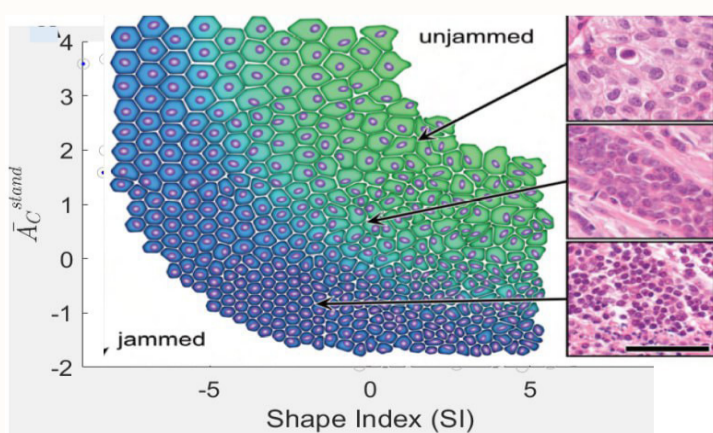


by Josef A. Käs



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In embryonic development, cells have to be unjammed to move freely. When development is finished, the cells freeze in their positions due to a jamming transition to a metastable solid-like state. Thus, healthy tissues are close to unjamming. Pathological changes, as observed in cancer, disturb this state and cause collective cell unjamming, so that large amounts of malignant cells become motile. Cancer cell unjamming requires a fundamentally new type of jamming transition with respect to classical jamming since the cancer cell aggregates within solid tumors are volume filling and there is not enough free space for a purely density induced transition. My lab has derived an unjamming-based marker that detects the ability of cells to move in static histological images. This gives us access to an unparalleled amount of data since we can use the histological slides of cancer patients to infer a comprehensive state diagram of unjamming as a collective motility transition in cell clusters of solid tumors. I will show that neither the cell shape nor the more traditional cell density serve alone as drivers of cancer cell unjamming. Both hypotheses ignore the mechanical impact of the cell nucleus on the jamming behavior. The drivers of cancer cell unjamming can be best identified by my diagram of cell unjamming with a combination of cell and nucleus shape as one state variable and nucleus number density as the other. Unjamming is based on a yield stress behavior.



My lab has used vital cell nucleus tracking in conjunction with measurements of the nucleus deformation in cancer cell clusters, to determine the stress a cancer cell must exert to become motile. The viscoelastic resistance of the cells' cytoskeleton and nucleus, cell contractility, and cell-cell adhesion are cell properties that modulate cell unjamming. Moreover, my lab's retrospective clinical study with 1380 breast cancer patients proves that cancer cell unjamming correlates with an increased metastatic risk. Cancer cell unjamming is an early event within the metastatic cascade.

Coffee from 15:30h
Drinks & Snacks after



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