

Translational Opportunities in Cancer Mechanobiology

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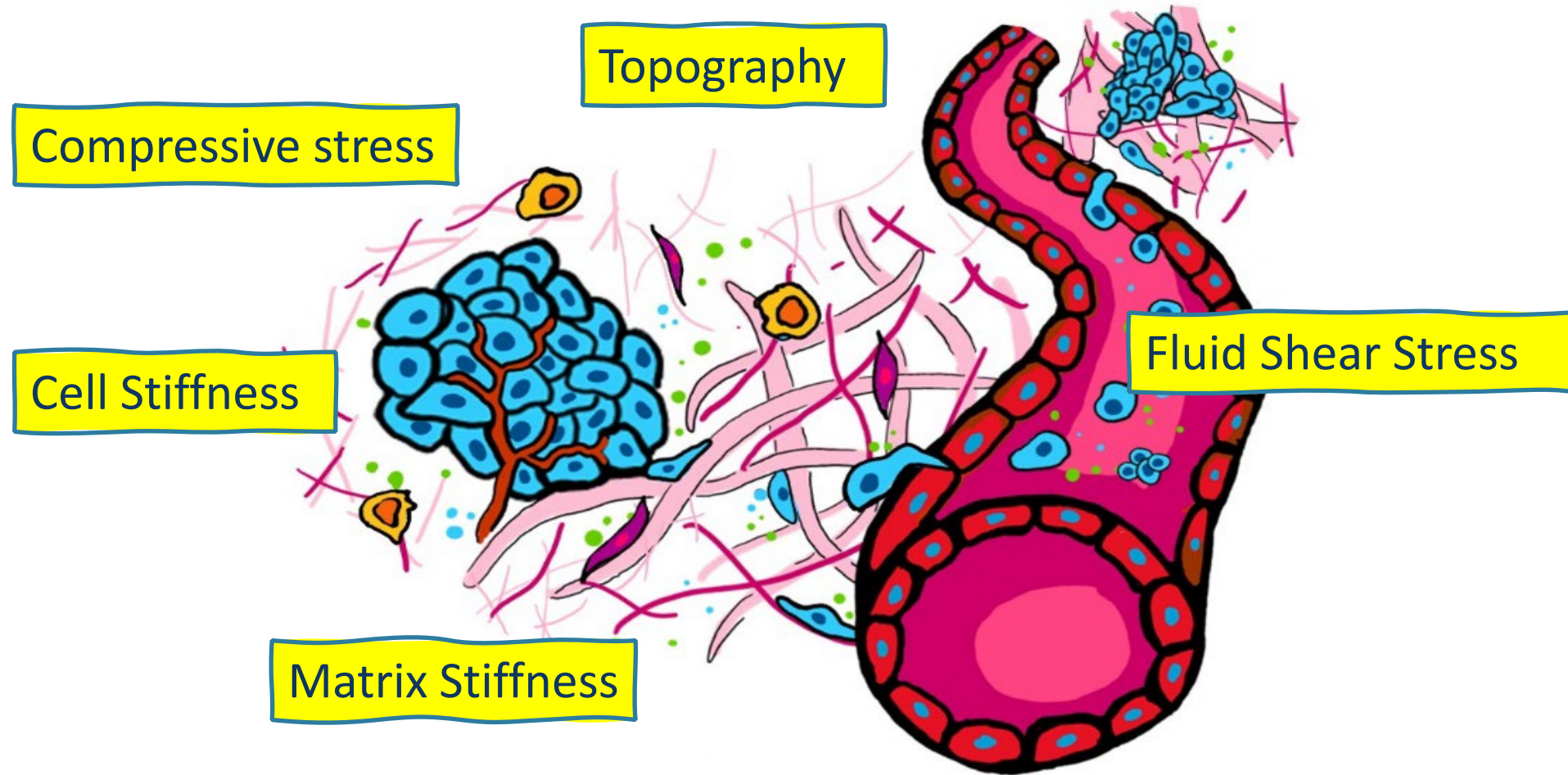
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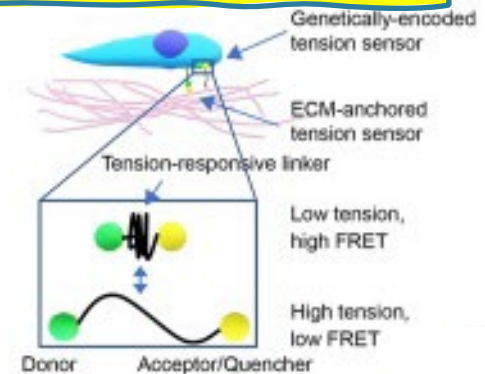
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Mechanobiology of cancer

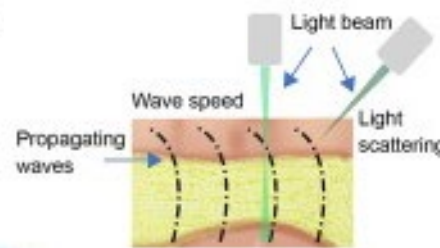


Advancement in mechanobiology methodologies

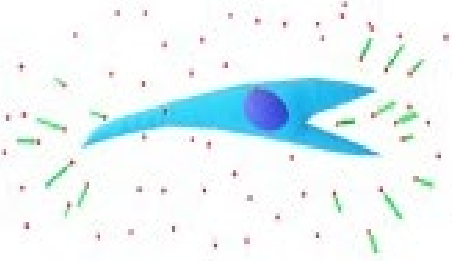
FRET Tension Sensors



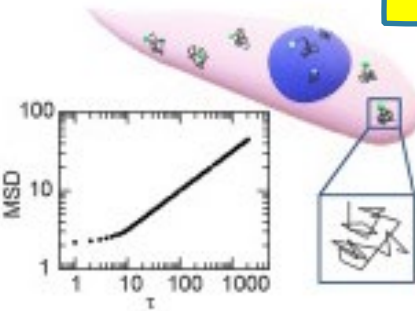
Elastography



Traction Force Microscopy



Microrheology



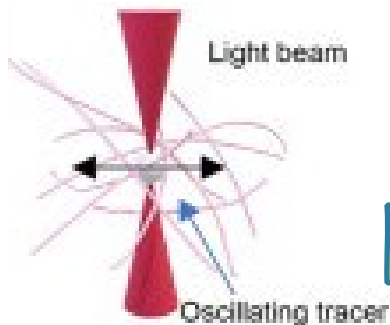
1920... 1990

2000

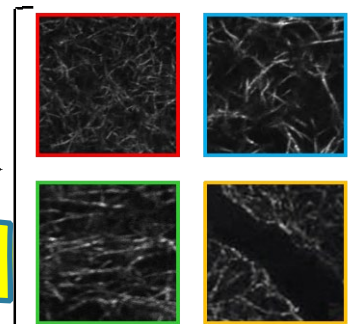
2010

2020

Optical Tweezers



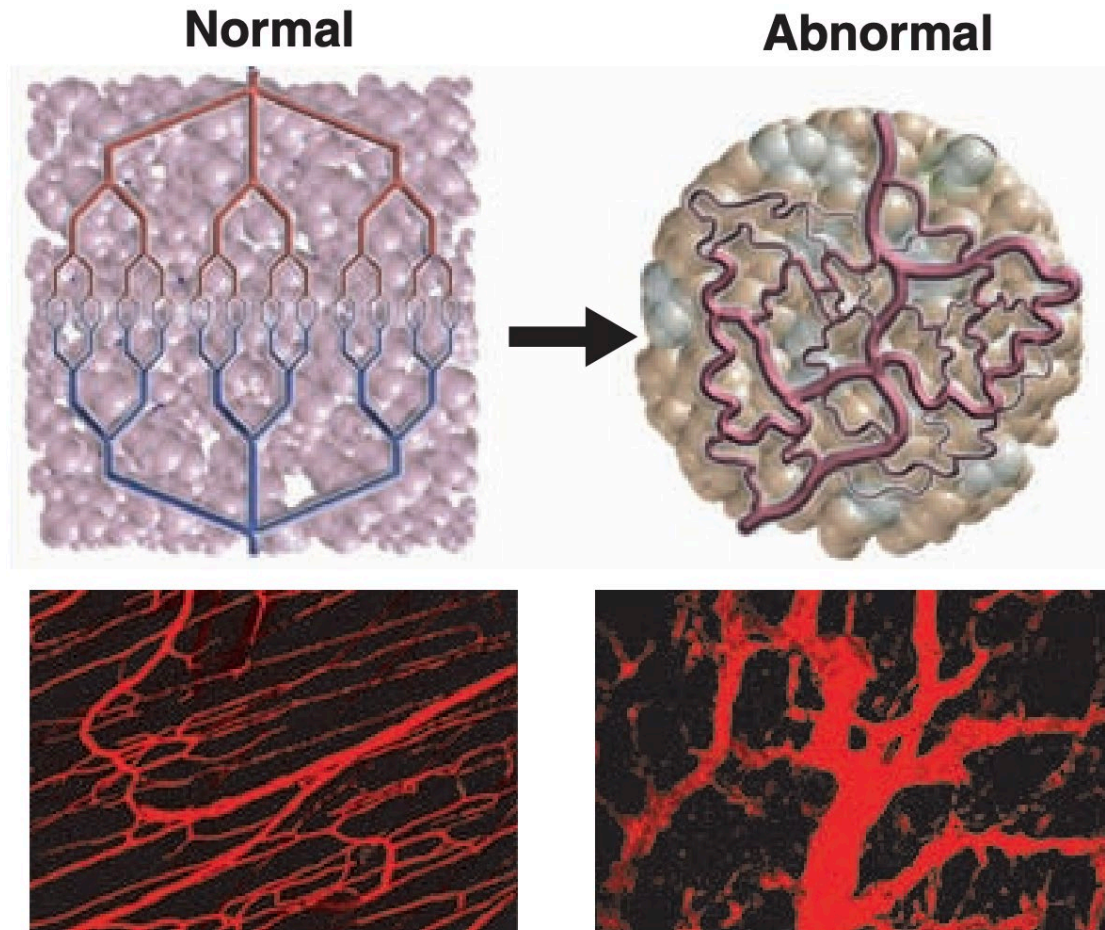
Tailored Biomaterials



Atomic Force Microscopy



Mechanobiology of tumor angiogenesis

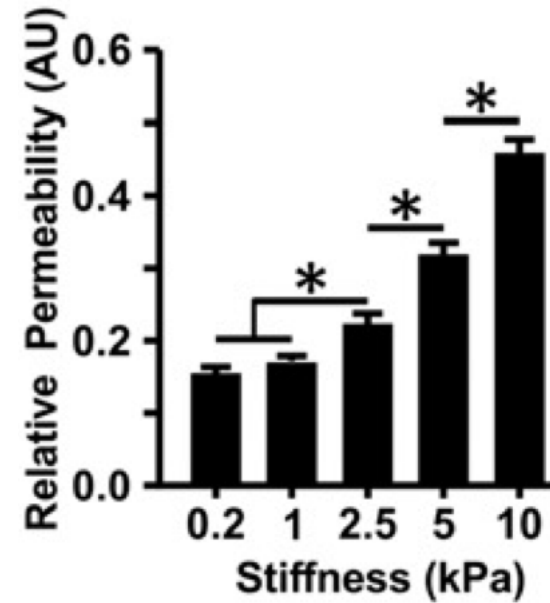
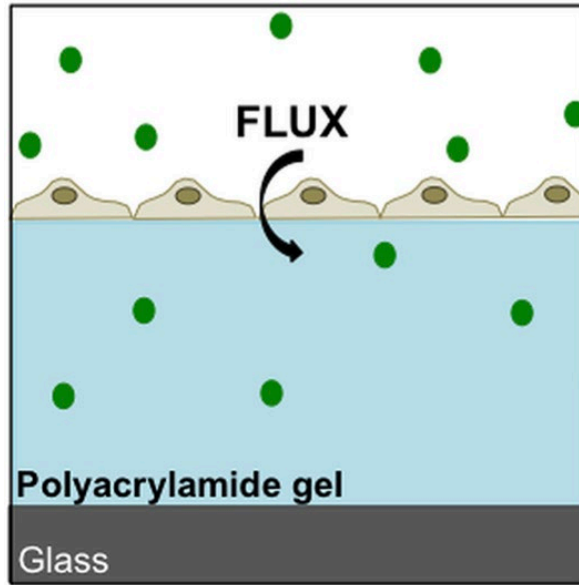


RK Jain, Science, 2005



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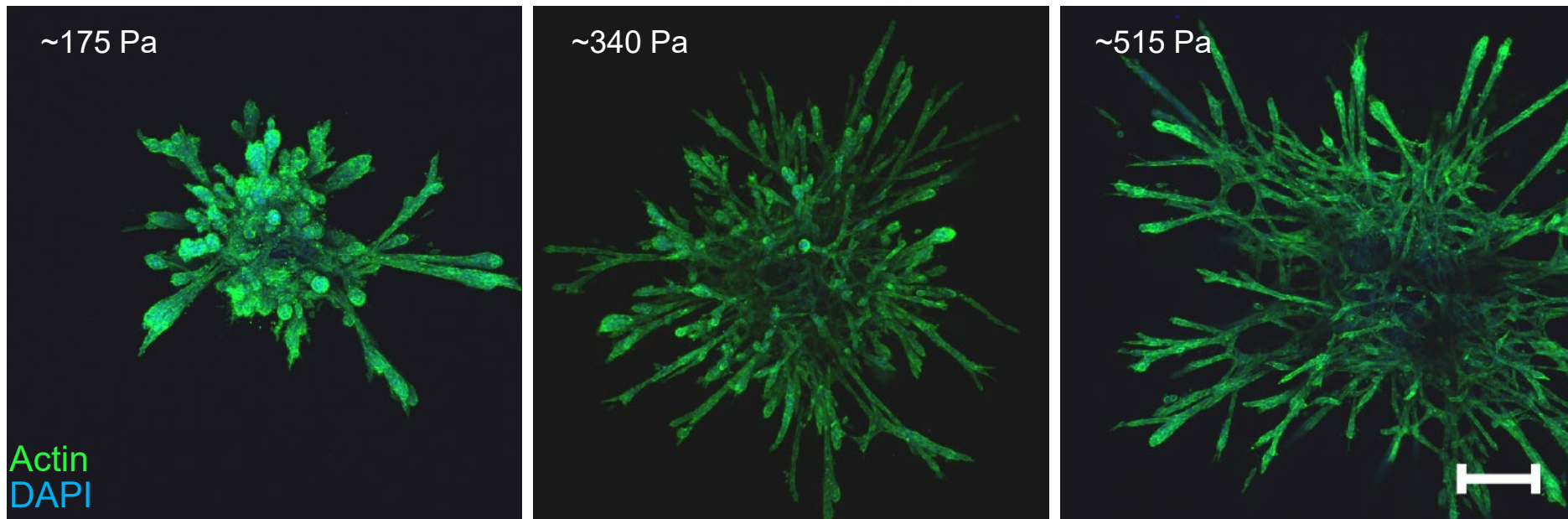
Matrix stiffness disrupts barrier integrity



Huynh et al, Science Translational Medicine, 2011



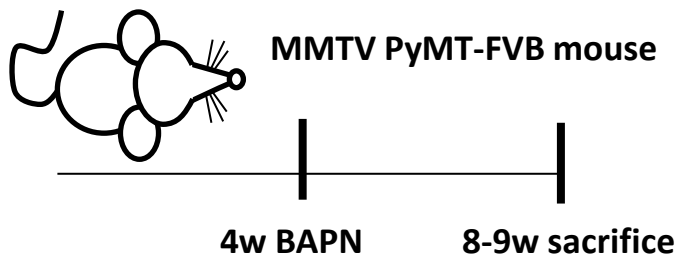
Matrix crosslinking increases outgrowth



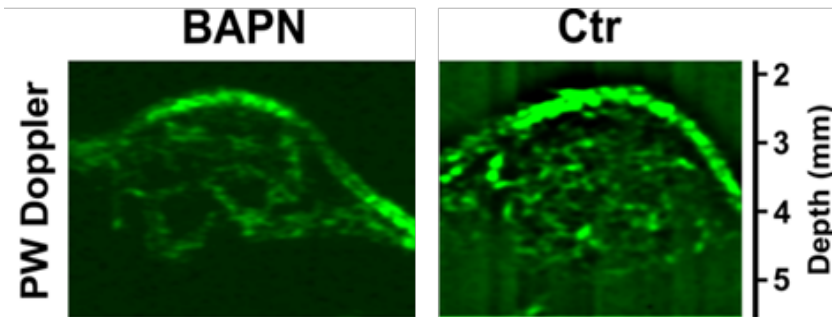
Mason et al., *Acta Biomaterialia*, 9 (2013) 4635-44.



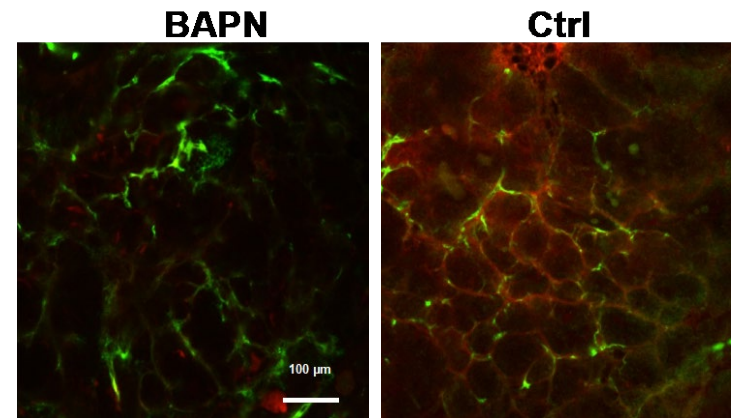
Matrix crosslinking increases angiogenesis and vascular permeability



Vascular Density



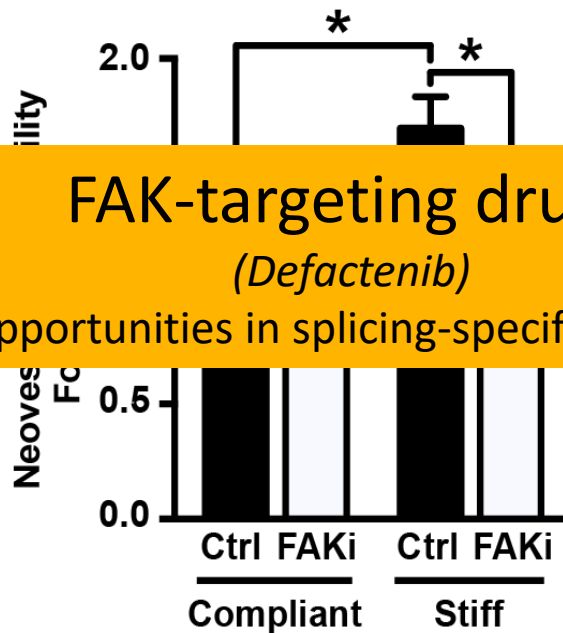
Vascular Permeability



Bordeleau et al., PNAS, 2017



Inhibiting cellular response to stiffness as a therapeutic

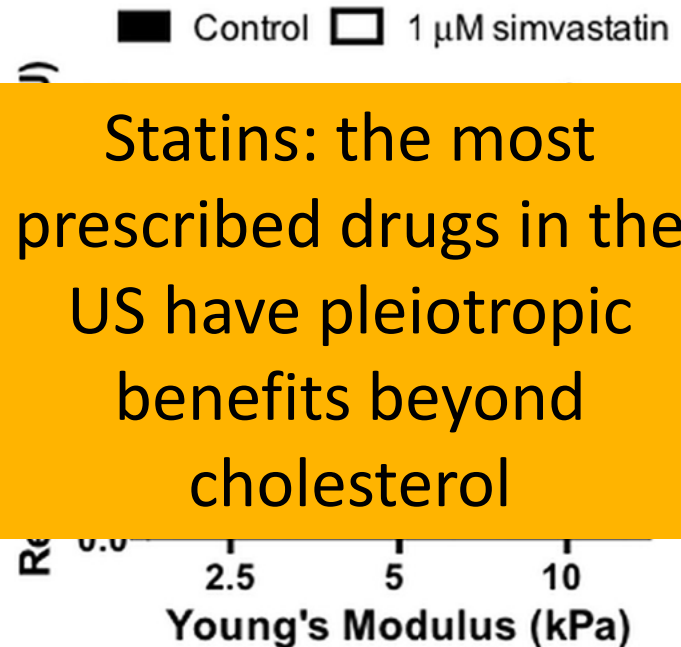


FAK-targeting drugs

(Defactenib)

Opportunities in splicing-specific drugs?

Wang et al, FASEB J, 2018

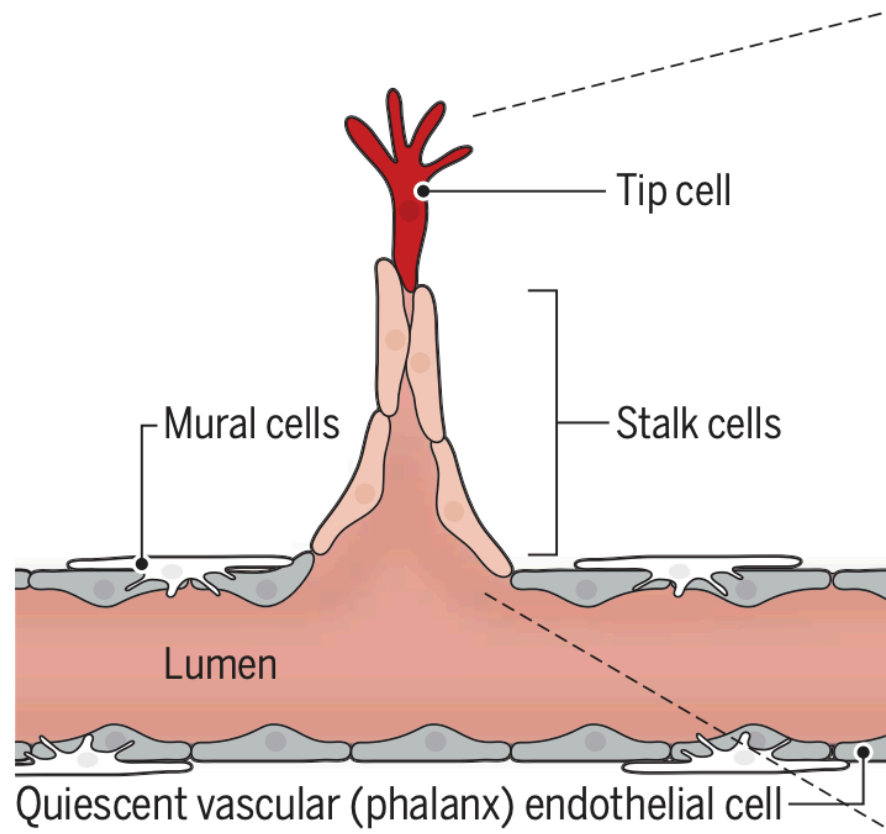


Statins: the most prescribed drugs in the US have pleiotropic benefits beyond cholesterol

Lampi et al, PloS One, 2016



Mechanometabolism: Targeting endothelial cell metabolism

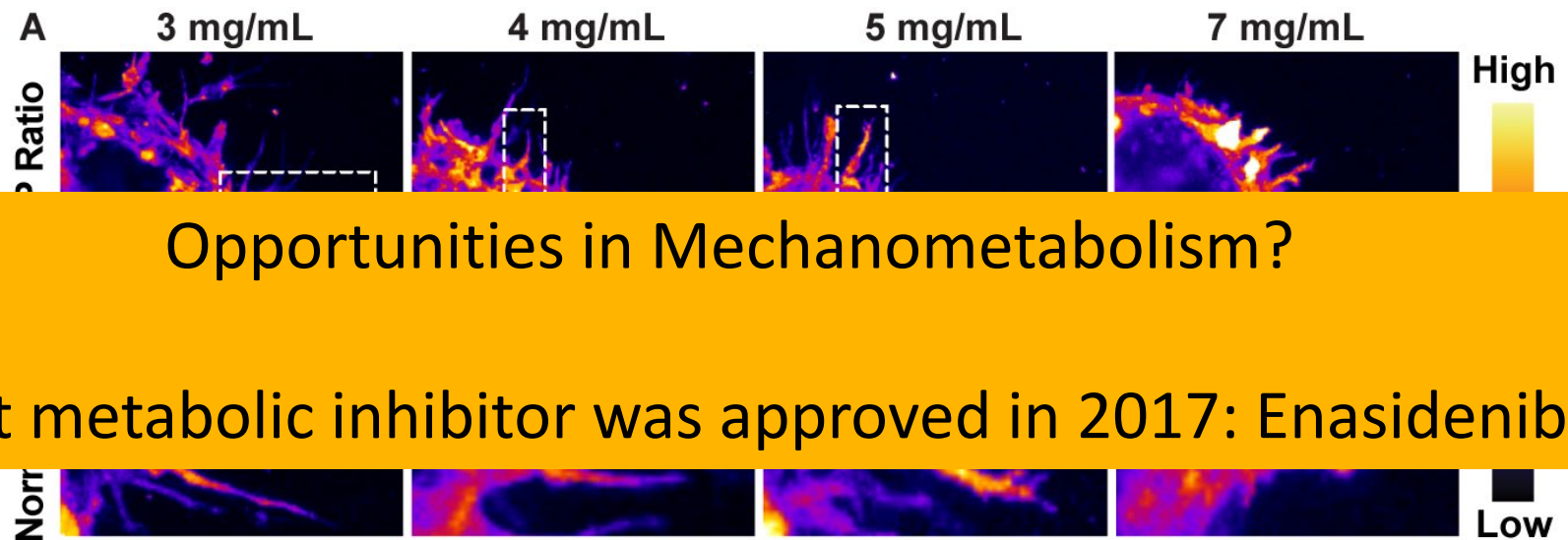


Li and Carmeliet, Science, 2018



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Metabolic requirements increase in denser matrices



Wang et al, APL Bioengineering, 2024



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Cancer mechanobiology is of global interest

APHELION: Assessment of Physical Sciences and Engineering Advances in Life Sciences and Oncology



<http://scienceus.org/wtec/docs/AphelionFinalReport-web.pdf>

“Mechanometabolism Unleashed”: Sussex, England, June 2025

“CellMech2025”: Leuven, Belgium, Sept 2025

“Physics of Cancer”: Leipzig, Germany, Sept 2025

“Mechanobiology in Time and Space”: Singapore, Sept 2025



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Cancer mechanobiology is growing



2010: A single session of **~22** submissions: “The Physics and Engineering of Cancer Cells and Their Microenvironment”
(with Jerry Lee)

2012: Cancer Technologies Track of **146** submissions
(with Mehmet Toner)

2019: Cancer Technologies Track of **160** submissions



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Summary

The mechanobiology field exemplifies the power of basic science in providing the foundation on which translational approaches can be built



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Acknowledgements



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