



TECHNION
Israel Institute
of Technology



KORIN LAB
Cardiovascular NanoMed Engineering Lab

Transport of Red Blood Cell Carriers through a Microfluidic Model Mimicking Human Pulmonary Capillary

Danielle Nemcovsky



PHILADELPHIA, PA
JULY 13-18, 2025



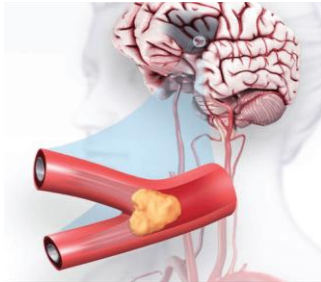
European Research Council
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**NEXT-GENERATION
DELIVERY INNOVATIONS**

Cardiovascular Diseases

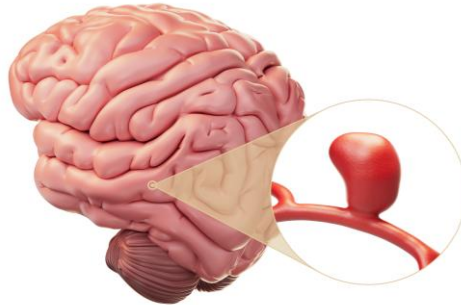
- ~17.9 million deaths per year¹
- Limited & temporary treatment
- Risk factors & high recurrence
- Local in nature
- VTC to improve treatment effectiveness

Stroke



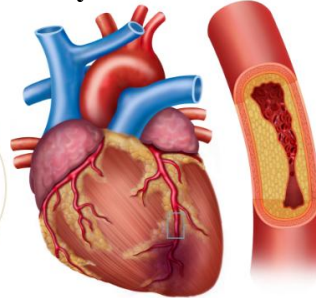
<https://www.stroke.org/en/about-stroke>

Aneurysm



Khoury *et al.* Sci.Adv. 2024

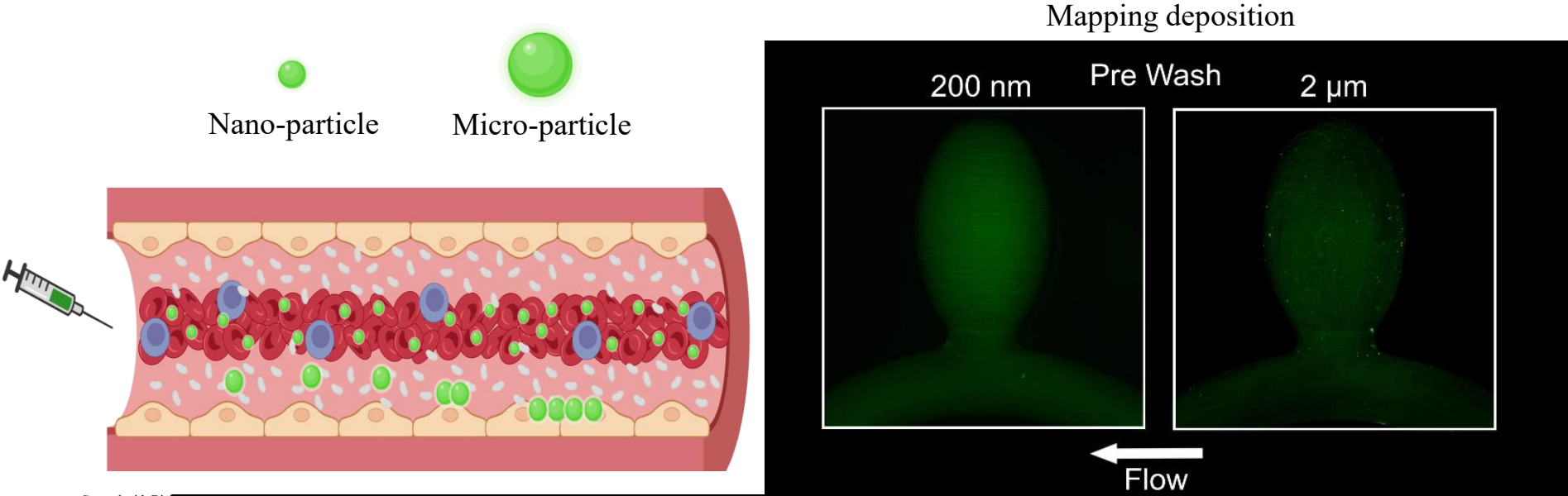
Myocardial infraction



<https://surl.li/emoaql>

[1] https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1

Drug Delivery in the Cardiovascular System

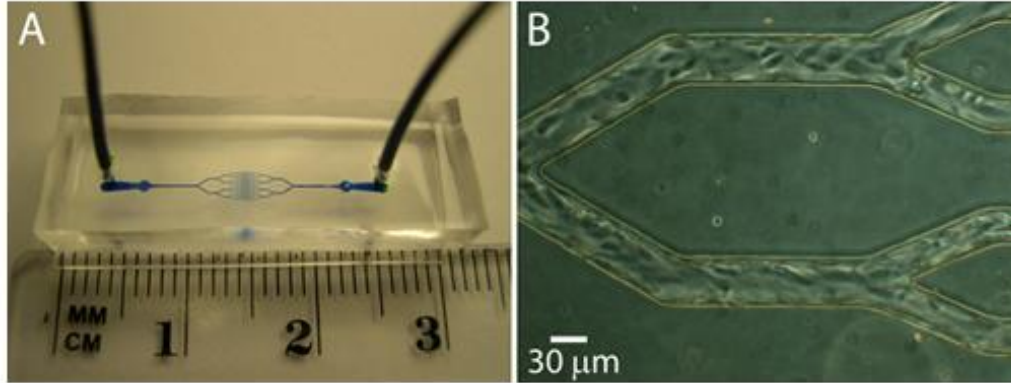


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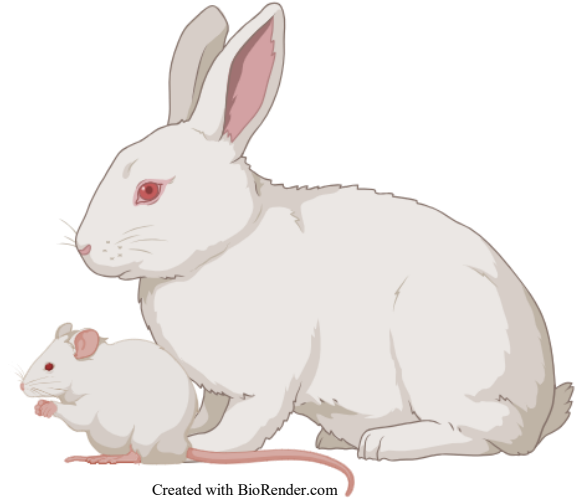
Design platform to evaluate potential drug delivery carrier

Microfluidic models of Microvasculature

- Highly controlled platform
- Complex geometries
- Recapitulate human physiology

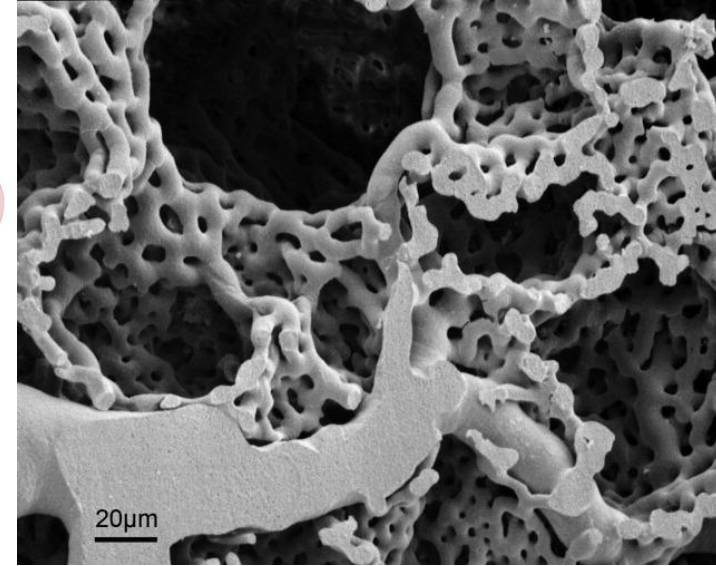
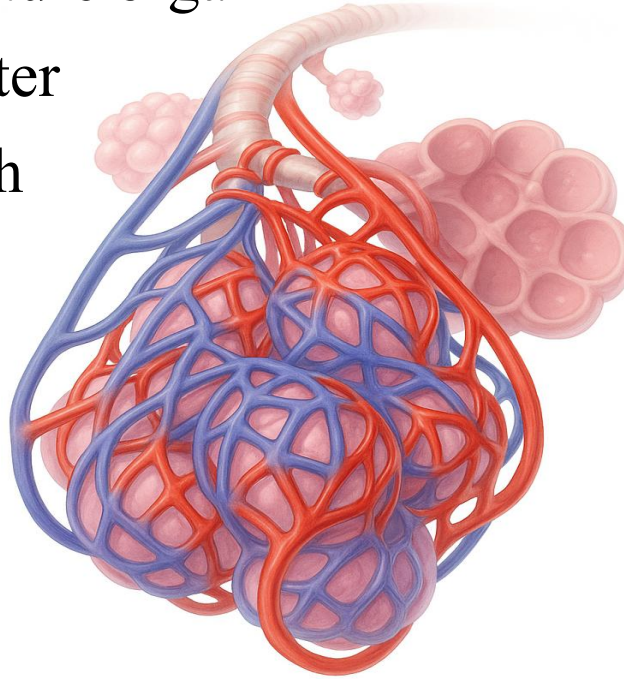


Myers et al., JoVE (Journal of Visualized Experiments). 2012



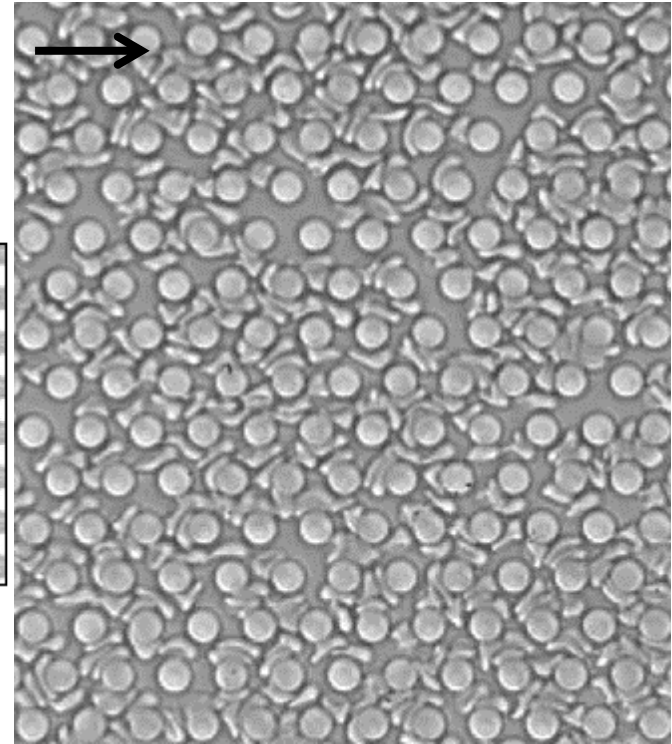
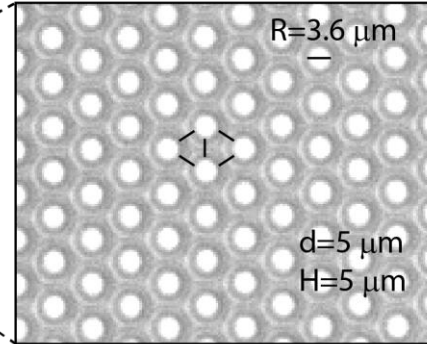
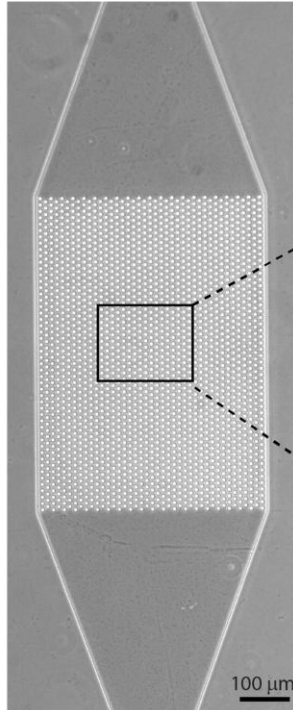
Pulmonary Capillary Network (PCN)

- Largest vasculature organ
- 2-13 μm diameter
- Close-knit-mesh



Mühlfeld *et al.*, The Anatomical Record: Advances in Integrative Anatomy and Evolutionary Biology, 2010

Microfluidic Model of the PCN

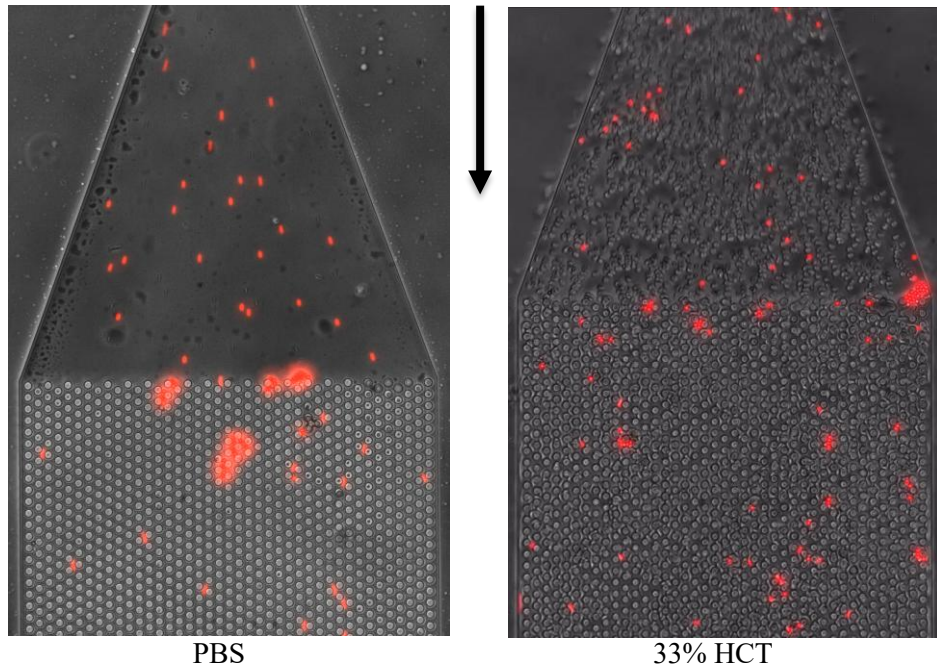


Stauber *et al.*, *Biomicrofluidics*, 2017

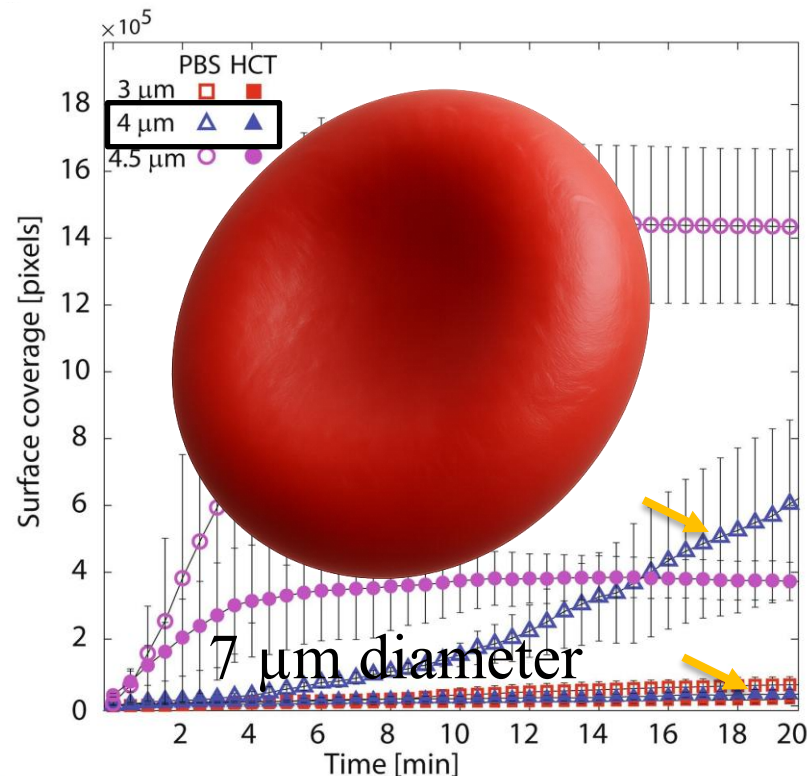
Belenkovich *et al.*, *Journal of Biomechanics*, 2022

Particle Entrapment in the PCN

4 μm particles

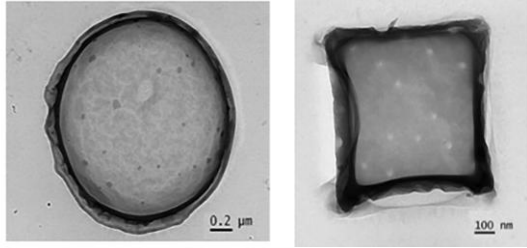


Belenkovich et al., *Journal of Biomechanics*, 2022



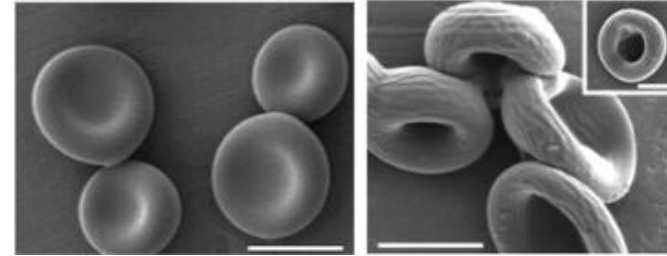
From Stiff to Deformable Particles

Deformable particles



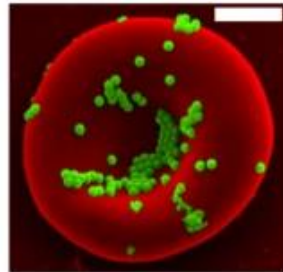
Palange *et al.* Molecular Therapy. 2017

Synthetic RBCs



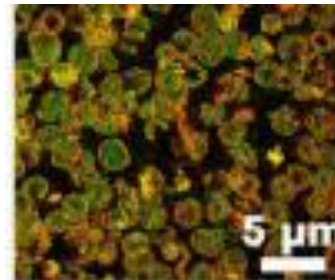
Doshi *et al.* PNAS. 2009

RBC hitchhiking



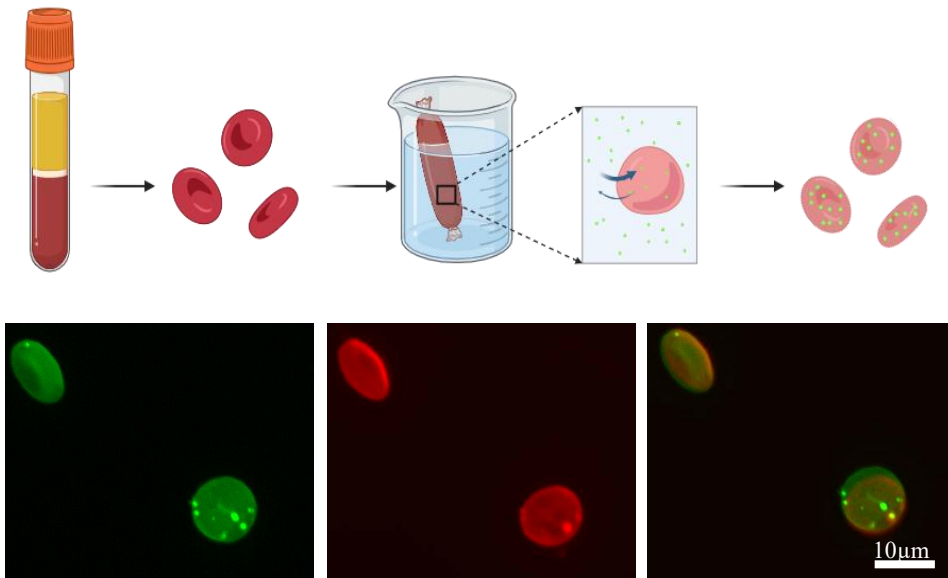
Brenner *et al.* nat.commun. 2018

SiNPs-DOX@RBCs



Jiang *et al.* nano.res. 2018

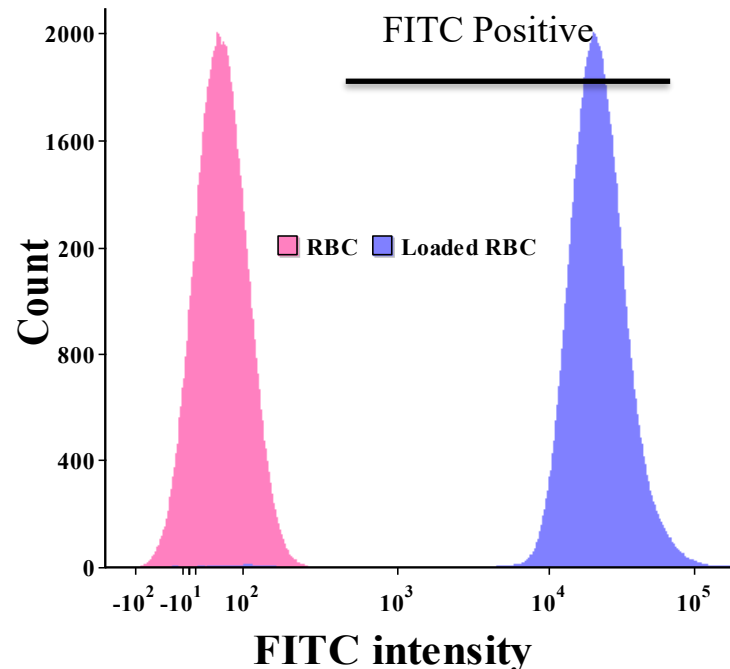
Deformable particles from mother nature



Nemcovsky *et al.*, in preparation

FITC-dex

Vybrant Dil



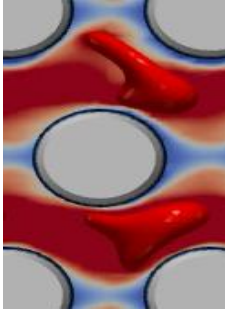
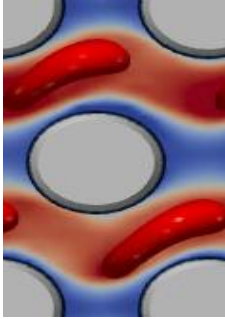
RBC-carriers in PCN microfluidic model- in silico



in vitro

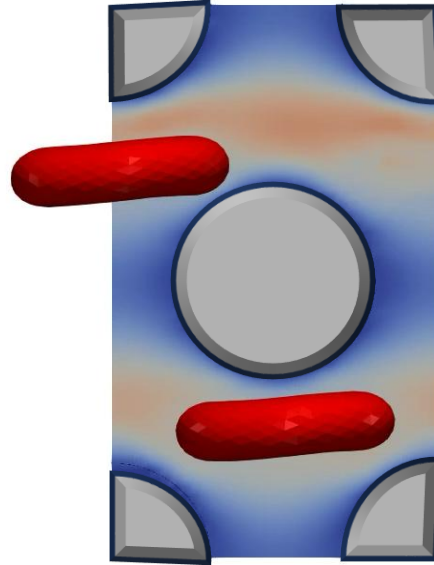


in silico

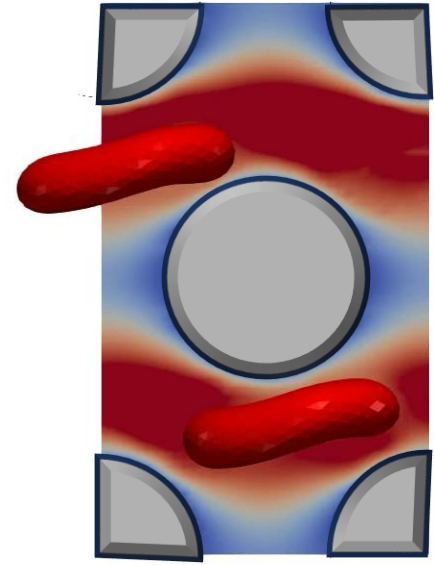


Nemcovsky *et al.*, in preparation

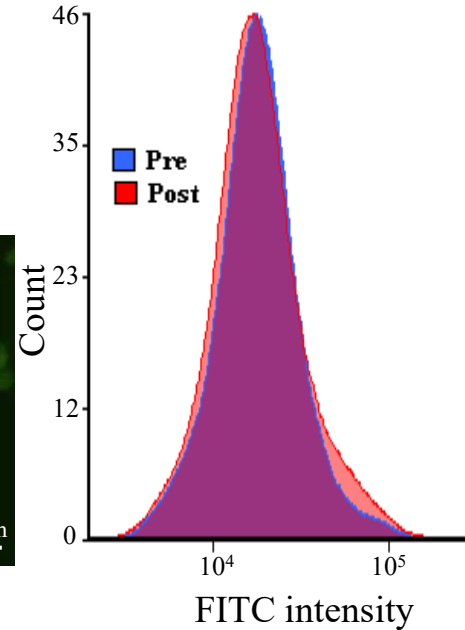
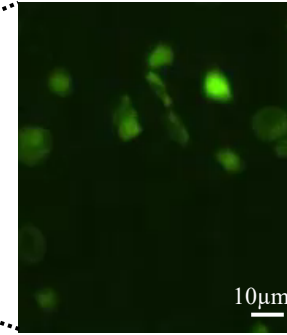
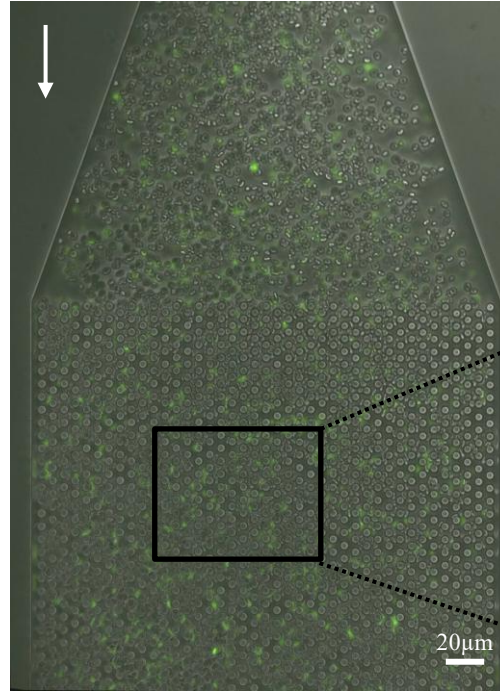
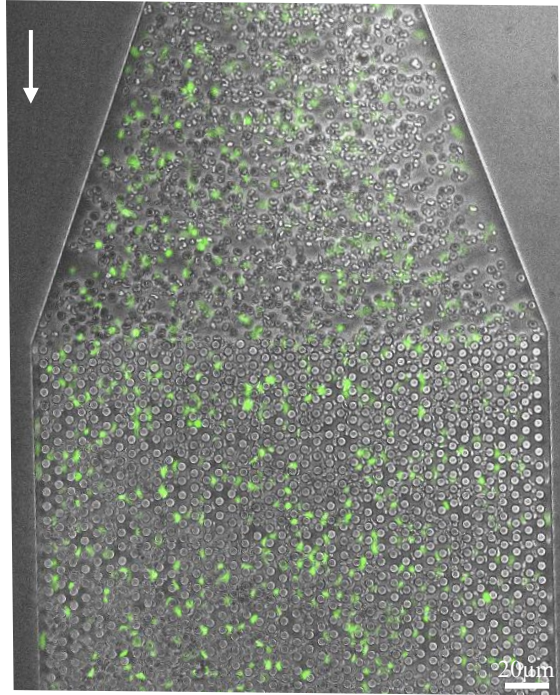
$U_{ave} \sim 0.5 \text{ mm/s}$



$U_{ave} \sim 1 \text{ mm/s}$



RBC-carriers in PCN microfluidic model

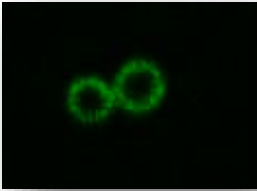


Nemcovsky *et al.*, in preparation

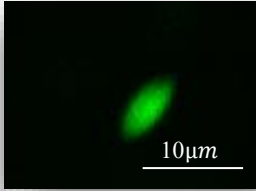
Conclusion and Future Work

- Organ specific microfluidic device
- RBC flow dynamic
- Screening for RBC & VTC

RBCs' mechanical alteration

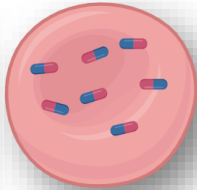


0.1% GA+



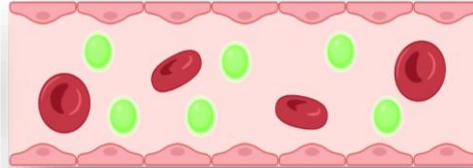
0.1% GA-

RBC as VTC



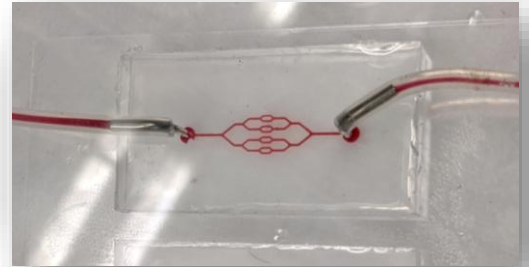
Created with BioRender.com

Endothelialized models



Created with BioRender.com

Additional organ-on-chip



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Korin Lab - Technion