In vitro vascular invasion assay for the study of (the role of cellular forces in) sprouting angiogenesis

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Organisation

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SCOPE OF THE METHOD

The Method relates to	Human health
The Method is situated in	Basic Research
Type of method	In vitro - Ex vivo
Specify the type of cells/tissues/organs	Endothelial cells

DESCRIPTION

Method keywords

endothelial cells
live optical microscopy
extracellular matrix
hydrogel
Image analysis
matrix mechanics
traction force microscopy

Scientific area keywords

microvascular biology
angiogenesis
cell mechanics
mechanobiology
bioengineering
biomechanics
biomaterials

Method description

The method enables to quantitatively assess the invasion of endothelial cells in extracellular-matrix mimicking hydrogels, such as collagen or polyethylene glycol, and to measure the forces exerted by the cells that enable them to invade. Endothelial cells are seeded on the side of a hydrogel and cultured in pro-angiogenic medium to induce sprouting angiogenesis. Live cell imaging of endothelial cells is performed by means of confocal laser scanning microscopy. Fluorescent nanobeads are incorporated in the hydrogel to track the deformations of the hydrogel during endothelial invasion. Mechanical (elastic) properties of the hydrogel are measured. Cellular forces applied by the endothelial cells during invasion are inferred from the measured hydrogel deformations and mechanics.

Lab equipment

Biosafety cabinet ;
Incubator ;
Confocal microscope.

Method status

Published in peer reviewed journal

PROS, CONS & FUTURE POTENTIAL

Advantages

High resolution imaging of cell dynamics ;
Unique method to quantity cellular forces.

Challenges

Extension to long-term imaging (several days) ;
More complex extracellular matrix environments (including co-culture systems) ;
Medium-to-high throughput screening is still challenging.

Future & Other applications

The method enables to screen different micro-environments for their effect on vascular invasion / sprouting angiogenesis, which is among others, relevant for regenerative medicine and diseases that affect angiogenesis. It offers a unique way of exploring the role of (abnormal) cellular forces in the etiology of diseases that affect microcapillaries.

REFERENCES, ASSOCIATED DOCUMENTS AND OTHER INFORMATION

References

Vaeyens, M-M., Jorge Peñas, A., Barrasa Fano, J., Steuwe, C., Heck, T., Carmeliet, P., Roeffaers, M., Van Oosterwyck, H. (2020). Matrix deformations around angiogenic sprouts correlate to sprout dynamics and suggest pulling activity. Angiogenesis. doi: 10.1007/s10456-020-09708-y

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