Cancer intravasation-on-a-chip (CIChip) : towards tumor tissue engineering
Eslami Amirabadi, H.; Frimat, J.M.S.; Luttge, R.; den Toonder, J.M.J.

Published: 01/01/2014

Document Version
Accepted manuscript including changes made at the peer-review stage

Please check the document version of this publication:

• A submitted manuscript is the author's version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

Citation for published version (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 13. Dec. 2018
Cancer intravasation-on-a-chip (CIChip)  
Towards tumor tissue engineering

Hossein Eslami Amirabadi*, Jean-Philippe Frimat, Regina Lüttge, Jaap den Toonder  
Department of Mechanical Engineering, Eindhoven University of Technology  
Institute for Complex Molecular Systems (ICMS), Eindhoven University of Technology

Motivation
Bio-microfluidics is an emerging field which helps scientists to study biological processes in a controlled environment. Using microfluidic technologies, disease models on chips form a recent development that will enable us to circumvent the limitations of conventional disease models (figure 1).

Inspired by advances in this area, our goal is to engineer the tumor micro-environment in a controlled microfluidic system. In this work, our aim is to study the effect of extracellular matrix (ECM) stiffness on the invasive properties of the tumor cells.

Microfluidic chip
We have successfully fabricated a microfluidic chip which replicates the Transwell migration assay (figure 2). The fabrication method and the chip design were modified, comparing to the one reported in the literature, towards a smaller chip and easier fabrication.

Cell culture
We have seeded a monolayer of two invasive breast cancer cell lines (MDA-MB-231 and MCF-7) in our chip and compared the cell proliferation with conventional culture dishes (figure 3).

Conclusion
We have fabricated a microfluidic chip and seeded tumor cells to study chemotaxis and migration assays. The next step is to promote the design to a 3D model to account for more complexity of the tumor micro-environment.

Future prospect
Our future task is to combine our microfluidic technology with the electro-spun scaffolds to create a 3D cancer intravasation model on a chip. Invasive properties will be related to the intravasation characteristics of the tumor. As shown in figure 5, intravasation (invasion of cancer cell into the blood stream) is a complex process which involves many environmental factors. The effect of the matrix stiffness on the invasive properties of the tumor cells (embedded in a matrix) will be investigated.

Figure 1 – Classification of technologies, complexity vs. cost.

Figure 2 – Microfluidic chip to test the tumor cell invasiveness. (a) Different layers of the chip. (b) A real micro-fabricated chip connected to a pump. Fluids with different colors mix only at the intersection of the micro-channels.

Figure 3 – (a) MCF-7 cells on the porous membrane, and (b) fluorescent picture of the same cells (blue: nuclei, green: cytoskeleton). (c) MCF-7 cells in a culture flask.

Figure 4 – A SEM picture of electro-spun Poly Capro Lactone microfibers (a) and a fluorescent picture of the seeded MDA-MB-231 cells on the microfibers (b).

Figure 5 – Vision of CIChip.


*heslami.amirabadi@tue.nl

Department of Mechanical Engineering