TERMIS EU 2019

termis®

Tissue Engineering Therapies:
From Concept to Clinical
Translation & Commercialisation

27-31 May 2019
Rhodes, Greece
Rodos Palace Hotel

Conference Chair:
Dimitrios I. Zeugolis, PhD

Conference Program Chair:
Maria Chatzinikolaidou, PhD

Find us at:

www.termis.org/eu2019

termis@nuigalway.ie

@termis_eu_2019

Organized by:

REMODEL
Regenerative, Modular & Developmental Engineering Laboratory

cúram

NUI Galway
OÉ Gaillimh

Laboratory of Biomaterials in Tissue Engineering
University of Crete

FORTH
Foundation for Research and Technology - Hellas

University of Crete

Organizing Secretariat:

convin

T: +30 210 6833600
E: congress@convin.gr
W: www.convin.gr

Fluid flow supported angiogenic sprouting into granular hydrogels

F. Stein[1], V.D. Trikalitis[1], J. Rouwkema[1]
Presenting Author: Fabian Stein, f.stein@utwente.nl
[1]Department of Biomechanical Engineering, Technical Medical Centre, University of Twente, 7522NB Enschede, The Netherlands

INTRODUCTION: The unique physical properties of granular hydrogels making them an increasingly promising tool for the field of tissue engineering [1]. Depending on the hydrogel material used, it has been shown that granular hydrogels support cell survival, cell growth, and network formation of single cells and multicellular spheroids [2,3]. Herein, we analyzed the first time the effect of fluid flow in combination of the angiogenic growth factor $VEGF_{165}$ in granular hydrogels on vascular sprouting in a microfluidic system.

METHODS: A five-channel microfluidic plat-form was designed and fabricated, with a channel height of 100 µm. Human umbilical vein endothelial cells (HUVECs) were seeded in one of the two outer fluid flow channels at $6*10^6$ cells/mL to obtain a confluent monolayer. Collagen type I from rat tail (Sigma Aldrich) at a concentration of 6 mg/mL was used to create a barrier to entrap the granular hydrogel suspension made of agarose-collagen in the middle channel. The remaining second outer channel was used as a source of $VEGF_{165}$ in a concentration of 50 ng/mL to stimulate angiogenesis and proliferation. Cells were pre-labelled with the cell tracker CMFDA (Thermo Fisher Scientific) to allow for imaging of the formation of vascular sprouts into the granular hydrogels over a period of 7 days using confocal microscopy. Images were subsequently analysed using ImageJ. To characterize the diffusion of growth factors added into the microfluidic device through the solidified hydrogel and hydrogel suspension, diffusion experiment were performed using FITC-conjugated dextran.

RESULTS & DISCUSSION: The results obtained showed that the granular hydrogels could indeed be isolated and stabilized in the central microfluidic channel by the incorporation of a collagen hydrogel barrier. Furthermore, by instituting a pressure difference over the two side channels, a fluid flow over the hydrogel compartment could be instituted. By addition of soluble exogenous angiogenic growth factor $VEGF_{165}$ an increased vessel growth into the granular hydrogels could be observed. The extent of vessel growth could further be controlled by varying the composition of the hydrogel suspension.

CONCLUSIONS: One of the main limitations in tissue engineering is the lack of a sufficient blood vessel system. By showing that granular hydrogels can facilitate the formation of a capillary bed in combination with fluid flow and gradients of growth factors, we have developed a promising platform to further investigate the creation of larger vascularized tissue constructs based on granular hydrogels.

ACKNOWLEDGEMENTS: This work is supported by an ERC Consolidator Grant under grant agreement no 724469.

REFERENCES

[1] Loebel C. et al. Nat Protoc 2017; 12: 1521– 1541
[2] Trikalitis V. D et al. 5th TERMIS World Congress 2018, Kyoto, Japan
[3] Sideris E. et al. 2016. doi:10.1021/acsbiomaterials.6b00444.