Master Project

3D Artificial Round Section Micro-vessels to Investigate Human Trophoblasts and Fetal Endothelial Cells

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Introduction/Aims:

Serving as the interface between the maternal and fetal environment, the human placenta is centrally involved in the nutritional, excretory and respiratory exchanges between the mother and fetus, as well as in hormone synthesis and immune protection. It provides a highly specialized structural barrier in direct contact with maternal and fetal blood. In terms of maternal-fetal communication, active transport processes and passive diffusion across this trophoblast barrier are the principal transfer mechanisms for supplying selected nutrients into the fetal blood and removing waste products back to the maternal blood circulation.

This project will be focused on the assessment of the anti-coagulant and anti-inflammatory proprieties of human trophoblasts and fetal endothelial cells. The objectives of the present study are i) to develop an *in vitro* 3D micro-vessel model to cultivate trophoblasts and fetal endothelial cells ii) to assess complement and cell activation processes in the presence or absence of complement inhibitors by high-end microscopy and iii) to detect pro-inflammatory cytokines as well as soluble complement component in recirculating fluid phase after human serum perfusion.

Research work:

This master project offers the opportunities:

1) To isolate primary trophoblasts and fetal endothelial cells from donated human placentas in collaboration with the Lindenhofspital Bern
2) To use an innovative *in vitro* system to cultivate and investigate both human cells types under physiological, pulsatile flow conditions, simulating micro-vessels

This study is in accordance with the 3R principles – reduce, refine and replace animal experimentation.

Relevance:

The present study aims to establish a new *in vitro* model for trophoblasts and fetal endothelial cells to assess their anti-coagulant and anti-inflammatory properties in the placenta. Novel findings in this context are relevant to specific pregnancy diseases like preeclampsia which is characterized by an excessive maternal inflammatory response to placental dysfunction.

Selected references:

Huang, X., et al. Establishment of a confluent monolayer model with human primary trophoblast cells: novel insights into placental glucose transport. Mol Hum Reprod 2016, 22:442-456.

Sfriso, R., et al. 3D artificial round section micro-vessels to investigate endothelial cells under physiological flow conditions, Scientific Reports 2018, 8:1-13

Tangerås, L. et al. Placental inflammation by HMGB1 activation of TLR4 at the syncytium. *Placenta* 2018, 53–61

Requirements:

High interest in learning new cell biology techniques; basic skills in biology/cell biology, biochemistry and molecular biology

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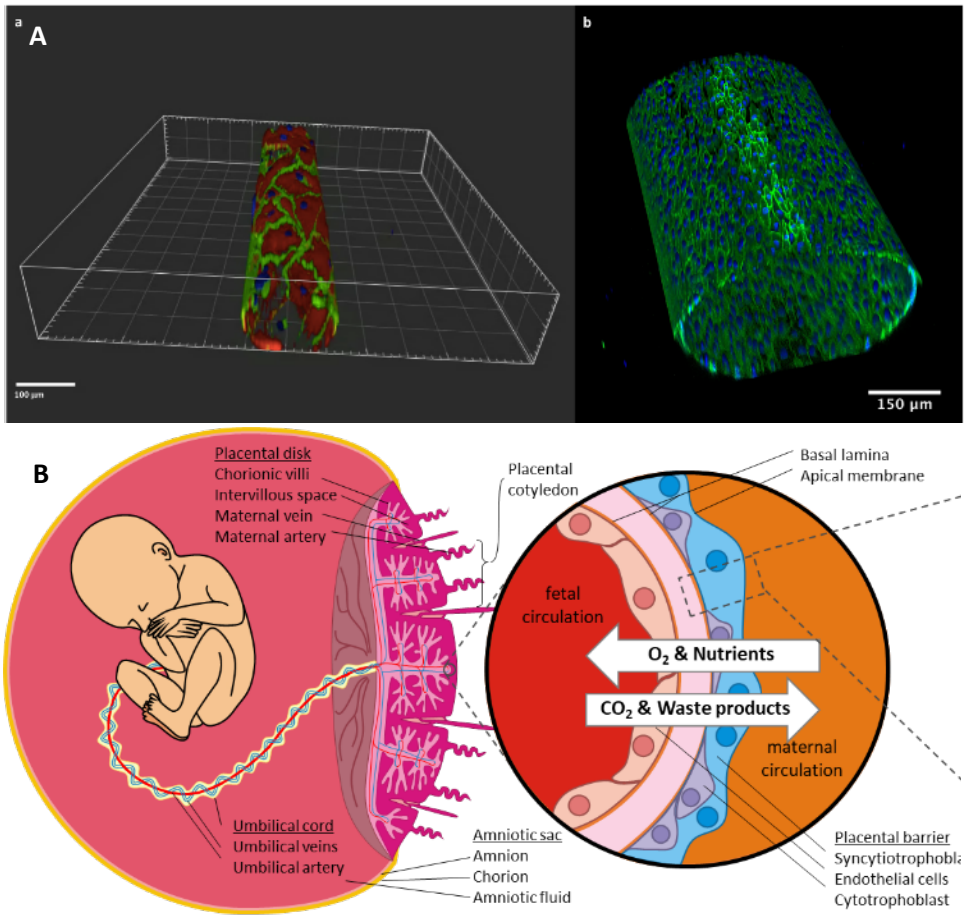

Fig. 1: A) *Confocal microscopy images of EC coated microchannels (Sfriso, R. et al, 2018)* ***B)*** *Overview on placental structure and cell types involved in the formation of the placental barrier between the mother and the fetus*