Developing Placenta-on-a-Chip Model to Test Drug Transfer at the Maternal-Fetal Interface

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Despite the large number of women who report taking drugs throughout the course of pregnancy, the transfer of drugs from mother to fetus is largely understudied. Due to the limitations and ethical concerns of testing drugs in pregnant women as well as the structural and functional constraints of existing in vitro and animal models, it is hard to gain an understanding of placental transfer. To this end, a physiologically relevant in vitro model of the human placenta is required. In this project, an organ-on-a-chip model of the placental barrier was engineered using Draper's PREDICT96 platform. By capitalizing on this high throughput microfluidic system, the conditions to establish the placental barrier were optimized. To improve upon the model, the flow rates on either side of the barrier were controlled independently with the maternal trophoblast cells receiving low flow while the fetal endothelial cells had a higher flow rate. The BeWo trophoblasts became more confluent when treated with forskolin which improved barrier function. We are currently testing glucose transfer across the barrier for comparison to in vivo measurements. From there, the transfer of Tylenol from maternal to fetal side can be assessed using liquid chromatography - mass spectrometry. Our studies point to the feasibility of using the PREDICT96 platform to optimize the in vitro organ-on-a-chip model of the placenta barrier and conduct high throughput drug testing.