Integration of Microphysiological Systems with Organ-on-a-Chip technology for Disease Modeling

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The pharmaceutical industry relies heavily on in vivo animal models and in vitro 2D cell cultures to develop therapeutic strategies. There are many ethical issues surrounding animal studies and serious concerns also exist regarding their biological relevance to humans. Particularly, current 2D tissue models often do not simulate complex cell-cell and cell-matrix interactions, which are crucial for regulating cell behaviours in vivo. Due to these shortcomings, there is now substantial interest in developing fully functional 3D tissues that mimic the in vivo system closely as possible for the disease modelling and chemical testing. Recent advances in miniaturizing microfluidic systems and advanced tissue fabrication procedures have enabled researchers to create multiple organs-on-a-chip with a high degree of control over experimental variables for high-content screening applications. However, there is a gap in the integration of these potential platforms to sensing modules, capable to monitor in real-time fast metabolic behaviours subjected to external stimuli, like stress or drugs.
In our work, three 3D engineered tissues (liver, pancreas and skeletal muscle)[1–4] are integrated with new real-time sensing technology on a single platform to obtain a reliable model to study diabetes type II disease and related metabolism, detecting and monitoring real-time cellular responses to external stimuli. Bringing this together coherently will deliver the prize of a deep understanding of the metabolic system with applications spanning drug development, diabetes related medical devices and increased prognosis of metabolic system related conditions.

REFERENCES

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FIGURES

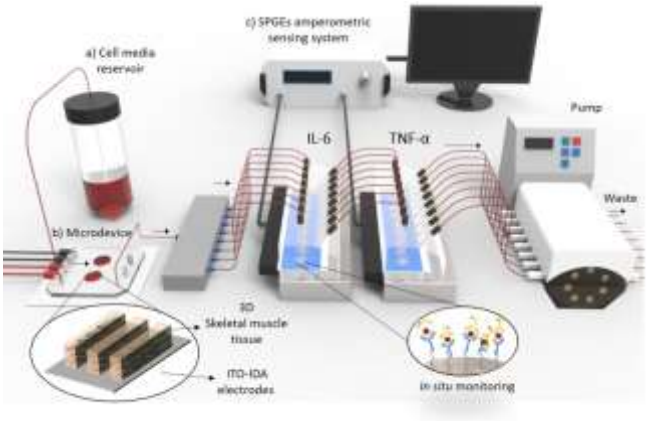

Figure 1: Schematic overview of the configuration and function of the muscle-on-a-chip[4].