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Conception of a micro vascularized tissue on a microfluidic chip

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Tissue engineering aims at developing *in vitro* functional tissues or organs in order to provide *in vitro* test platforms or transplants. However, the majority of tissues are perfused by a blood capillary network to supply cells with nutrients and oxygen coming from the blood. Because of the oxygen diffusion limit inside tissues, cells are at most 200µm away from a capillary. Therefore, difficulties to build a vascularized network inside tissues is a limitation to the development of thick matured tissues. That is why for now only non-vascularized tissues like skin or cartilage, or "flat" tissues like interfaces have successfully been built. Microfluidic devices are increasingly used to build vascular systems and control the microenvironment on chip. A technique to build *in vitro* 3D microvasculature lies on the patterning of hollow channels covered with endothelial cells to form 3D lumenized microvasculature. However, the channel of capillaries diameter (~20µm) is difficult to obtain. Moreover, this dimension often makes the scaffold containing hollow channels collapse during conception. Another technique consists in the self-assembly of endothelial cells into capillaries by applying specific physicochemical cues. Despite its strength, this technique cannot be used to perfuse a thick tissue. The capillary auto-assembly indeed takes several days, so cultured cells could not be supplied during the vasculature formation. This technique is especially used to study angiogenesis and vasculogenesis mechanisms. An innovative technique to form a thick tissue with a micro-vasculature will be presented. This device presents three main advantages; First, capillaries are grown inside a biocompatible material while supplying the cells embedded in the tissue, which lasts several days. Second, different types of cells can be cultured depending on the tissue wanted. Third, the system is versatile, the final architecture of the tissue can be customized by modifying the design of the microfluidic devices.

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