Controlling the oxygen microenvironment in 2D cancer cell monolayers on-chip

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The need to control oxygen in *in-vitro* cell culture is of significant importance. In the human body, the narrow normoxic range varies between and within organs [1]. Microfluidic chips provide useful tools for cell culture by offering the ability to control the microenvironment from tissue level to sub-cellular level [2].

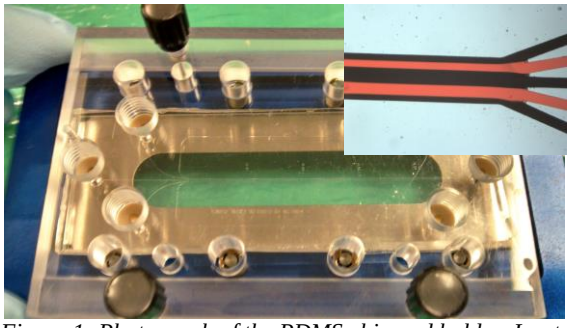

Figure 1: Photograph of the PDMS chip and holder. Inset: Visualization of laminar flow in the microchannel.

Laminar flow occurs at small Reynolds numbers where viscose forces dominate (see figure 1 inset). In the laminar regime chemical species have only diffusion available as a transport mechanism. These two features allow the micro-environment to be regulated with a large amount of flexibility on-chip.

It is well known that 3D tumour spheroids provide a more viable test environment than 2D monolayers. Spheroids display many of the metabolic functions as the environment *in-vivo*, such as tissue hypoxia, which is the main case of chemotherapeutic resistance [3]. However, growing compact tumour spheroids of the same size and shape is difficult and different cancer cell lines can produce varying densities of spheroids [4]. The proposed microfluidic chip addresses these issues by allowing close control of the oxygen microenvironment of simple 2D tissue models.

In the presented device, several laminar flow streams of varying oxygen tensions were combined in a main channel in which a 2D cancer cell monolayer was cultured. The microchannels were fabricated in polydimethylsiloxane (PDMS) using photolithography and replica moulding. For oxygen measurement, polymer sensor film stamps were fabricated in each inlet channel [5]. This study introduces a new toll to investigate the effect of local oxygen tension on anti-cancer drug efficacy in 2D cell monolayers of human endometrial cancer cell line; Ishikawa.

References:

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