MICROFLUIDIC CHIP FOR CULTIVATION OF LYMPHOCYTES IN SPACE CONDITIONS – A PRELIMINARY RESULTS

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Rising interest in space exploration leads to development of miniaturized diagnostic tools and dedicated protocols, which may be successfully applied in microgravity conditions. Lab-on-a-chip technology fulfills these requirements and new solutions of microdevices for cell cultivation research in space are being developed [1]. One of the interesting objects of such research are lymphocytes, which play crucial role in an adaptive immune response. Statistical investigation of cultivated lymphocytes, especially regulatory T cells (Tregs), provides important information on health condition and enable early detection of autoimmune disease.

In this paper, a glass microfluidic chip for cultivation and population research of Treg cells in microgravity conditions has been presented. The chip contains cell culturing microchambers and microfluidic channels for delivery of a cultivation medium (Fig. 1a). The all-glass construction of the microdevice provides chemically inertness and microscopic observation of the cells during cultivation process. The chip was fabricated utilizing wet etching and low-temperature bonding processes, described elsewhere [2-4]. As lymphocytes are non-adherent, dedicated cell traps were developed in order to immobilize the cells in the culturing microchambers. Circulation of the medium in the supply microchannels enables continuous supply of the cells with fresh nutrients and removal of metabolism products.

In the preliminary study, sorted $CD4^+$ T cells from the spleen of transgenic strain of mice C57BL/6-Tg(Foxp3-GFP)90Pkraj/J were suspended in buffer medium, introduced and trapped in the chip (Fig. 1b). In the cell culturing microchambers cells were induced into Tregs ($CD4^+Foxp3^+$; diameter: 7-8 µm). The buffer flow in a range of microliters per minute was performed using PTFE tubing and PEEK microfluidic connectors, and controlled utilizing a miniature peristaltic pump. The culturing microchambers were real-time observed using fluorescence microscope with a CCD camera. Such a solution eliminates manual operations (e.g. periodic buffer change, time-scheduled microscopic observation of the cell population by the staff) and reduces consumption of expensive reagents. In the full paper, design and properties of the chip, as well as results of Treg lymphocytes cultivation, will be presented.

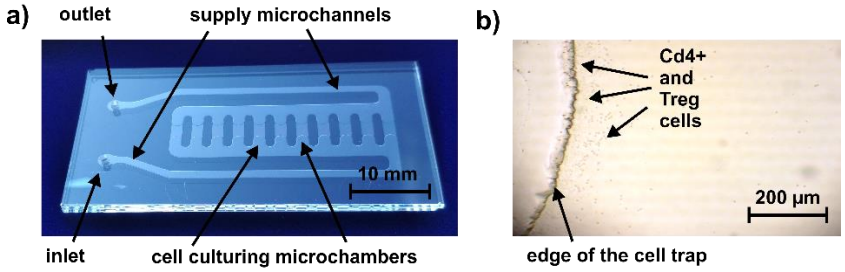

Fig 1. Results of the preliminary study: a) microfluidic glass chip at a glance, b) population of $CD4^+$and $CD4^+$ $Foxp3^+$ lymphocytes trapped in the culturing microchamber in the chip

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