Artificial membranes tuning for lymphatic wall repair

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INTRODUCTION: Chylothorax is an uncommon form of pleural effusion, which generally occurs after cardiac surgery and almost any surgical operation in the chest. The aim of this project is to develop a bioresorbable vascular patch for lymphatic wall repair [1]. Here, we project to develop new materials (i.e. membranes) having two different levels of porosity [2]. First short tests made with Polycaprolactone (PCL) membranes and PCL was blended with different biocompatible, bioresorbable membranes. It shows that human dermal lymphatic endothelial (HDLEC) cells can bind and spread on certain membrane and not on others suggesting that the chemical structure and the morphology of the membranes is important.

METHODS: The membranes were prepared using a modified phase inversion technique [2]. A polymer solution was prepared by dissolving PCL in N-methyl-2-pyrrolidone (NMP) at 60^0C during 24h. The concentration of PCL was set to 15% (wt). The polymer solution, at 20^0C, was casted with a thickness about 250 μm covered by the polyester track etched membrane (Sterlitech,USA). Two types of porosity were prepared in the same condition. The part of the final membrane in direct contact with water presented a homogeneous microporous structure and the other part, which was covered by the track etched membrane, formed large macropores due to the localized arrival of non- solvent.

RESULTS: *Fig 1 (left)* the asymmetrical structure of double porosity membrane presented macropores which were largely open towards the active surface. The macrochambers displayed on a length of about 70-100 μm for a diameter in the order of 30–40 μm. The macrochamber wall possessed a highly porous, sponge-like structure with interconnected micropores [2] of a diameter in the range of 1-8 μm.

In *Fig 1 (right)* HDLEC were cultivated on the PCL membranes with double porosity.

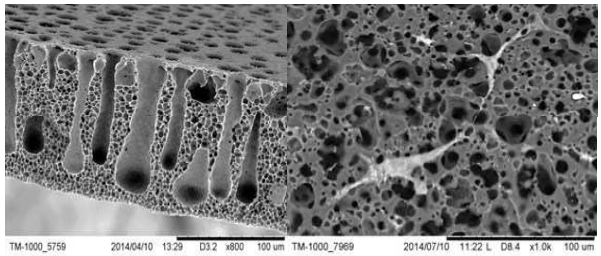

Fig. 1: ESEM micrographs of membranes, Right; membrane with double porosity, Left; HDLEC colonization after 24h of incubation.

And mesenchymal stem cells were cultivated inside the macropores to provide in situ growth factor for the cellular distribution, morphology and physiology over 9 days. The viability was measured by live/dead cell staining assay and lactate dehydrogenase (LDH) assay.

DISCUSSION & CONCLUSIONS: A well organized monolayer of polygonal HDLEC cells on PCL double porosity membrane obtained [1,2]; macro-porosities, opened at one membrane surface, allowing the colonization of 3D material by cells and micro-pores present in the walls of the macro-pores to ensure the transfer of compounds required for the development of cells or of compounds released by cells. The encouraging biological data obtained with flat sheet membranes with double porosity level can be integrated in vascular patch loaded with lymphatic cell to repair chylothorax.

REFERENCES: [1]B.G. Susini et al (2007) Method to study lymphatic vessel integrins, Methods in Enzymols 426, 415-438. [2]M. Dufresne et al (2013) Human Hepatic Cell Behaviour on Polysulfone Membrane with double Porosity Level, Journal of Membrane Science. 428, 454-461.

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