Nutrient transport properties of tissue engineering membranes and scaffolds

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This presentation will present part of our on-going work to determine scale dependent nutrient transport processes in hollow fibre membrane bioreactors (HFMBs) for bone tissue growth. The idea of growing artificial tissues in bioreactors such as HFMBs has started some time ago and preparation of biocompatible porous membranes and scaffolds has been attempted extensively. Also, there have been a number of studies on modelling glucose transport processes in HFMB. However, there is little information available that discuss specifically the glucose diffusivity across tissue engineering membranes or scaffolds and, importantly, its dependence on the properties of the materials (i.e., membrane and, scaffold). Using Fick's law and a diffusion cell constructed for use in this study, we have determined glucose diffusion coefficients for a number of porous membranes and scaffolds of different pore size and shapes, saturated with water and cell culture medium (CCM). We also derived the significance of the increase of diffusion coefficient with increasing pore size of the materials. We observed that glucose diffusion coefficients through membrane and scaffold pores saturated with CCM are significantly reduced at a given temperature which is contrary to what have been assumed in the previous studies on glucose transport processes in HFMB or similar bioreactors. Porosity and tortuosity of the used materials were determined and consequently correlated to the glucose diffusion coefficient values.