Methodology and evaluation of nanomechanical changes of endothelium in model of hyperglycemia: from in vitro to ex vivo experiments

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Most of the vascular complications in diabetes are related to hyperglycemia and result from the impairment of endothelium [1,2]. Endothelial cells (ECs) lining the lumen of every blood vessel are directly exposed to the action of high glucose concentration. Resulting endothelial dysfunction, can cause changes of mechanical properties of ECs. In this work we used Atomic Force Spectroscopy to measure nanomechanical properties of ECs during hyperglycemia and after normalization of the glucose levels. ECs were exposed to short (5 min - 24 h) and long-term (1 day – 1 month) hyperglycemic conditions. It was observed that hyperglycemic conditions result in a significant stiffening of the ECs and that elastic changes are anti-correlated with NO production, that is the main parameter used for the description of ECs phenotype. For very short-term hyperglycemia (45 min), it was observed that changes in the nanomechanical properties of ECs are reversible, i.e. ECs return to their initial state after glucose normalization. For longer duration of hyperglycemia (up to 3h), ECs elasticity parameter slowly returns to the reference value, but for 24 h exposures the changes are already irreversible, which can be interpreted as the onset of "stiffness memory" observed for long term hyperglycemia [3]. The studies carried out on the ECs in vitro model was verified ex vivo on the mouse diabetic model (db/db mouse model).

References


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