Ion Channel Expression Regulation by Sodium and Potassium in Vascular Endothelial Cells

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Introduction: Changes in the expression of ion channels, and of genes involved in membrane potential (Vm) homeostasis and Ca^{2+}signaling have been associated with pathological conditions such as hypertension (1,2,3,4). Little is known, however, for the mechanisms that regulate the expression of the approximately 400 genes encoding for subunits of the 200-250 ion channels. There is evidence that a feedback system exists, capable of sensing changes in cell electrophysiology (5) that leads to altering ion channel transcription levels. The variable(s) that are sensed and controlled have not been established although Na^+/K^+ sensitive transcriptome has been reported in different cells, including in vascular cells (6).

Hypothesis: In this study, we will evaluate gene expression changes in cultured endothelial cells exposed to stresses that induce changes in V_m and intracellular Na^+ and K^+ concentration levels. The Na^+/K^+ sensitive ion channel transcriptome will be evaluated.

Materials and Methods: Rat aorta endothelial cells (RAoECs; Cell Application, San Diego, CA) cultured in standard media are divided into three groups and placed in PBS for three hours containing: 5mM extracellular K^+ (Control), 50mM extracellular K^+, or K^+-free plus Ouabain (3mM). RNA isolation was performed using RNeasy Micro RNA isolation kit (Qiagen) and RNA integrity was assessed. Gene expression level is assessed with RNAseq (30M reads, single-end 75 base pair) and qPCR (82 genes x 3 biological replicates).

Innovation: Due to the uncertainty of finding the fundamental ion channels in endothelial cells, most studies have not focused on the effect of one ion channel on the entire genome [5]. It is important to study the ion channels themselves in addition to looking at the entire genome of endothelial cells in order to understand how they would react under different environmental conditions, which would lead to a better understanding of the causes of vascular diseases and their solutions.