Identification of transient receptor potential channels in human atrial myocytes

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Introduction: Generation of cardiac arrhythmias, especially human atrial fibrillation underlying mechanisms, is not fully understood. Recent studies have demonstrated that transient receptor potential (TRP) channels play important roles in the regulation of physiological and pathological cellular function. Little information is documented about TRP channels in human hearts.

Methods: The present study was designed to investigate the expression of TRP channels in human atrial myocytes using whole-patch voltage clamp and molecular biological approaches.

Results: It was found that the previously reported background non-selective cation current was inhibited by the TRPC channel blocker La^{3+} in a concentration-dependent manner (IC50=46 μM), suggesting the contribution of TRPC channels. In addition, we recorded a current that is sensitive to inhibition by divalent cations, eg Mg^{2+}, Ni^{2+}, Ba^{2+}, etc. The current was enhanced by removing intracellular Mg^{2+} or extracellular Mg^{2+} ion, but blocked by Ni^{2+} or Ba^{2+}. This divalent cation-sensitive current was inhibited by 2-aminoethoxydiphenyl borate (2-APB, IC50=32 μM). The current increased when the bath medium pH was reduced from 7.3 to 4.0. These properties were similar to those of TRPM7 channels. RT-PCR and Western blot analysis, and immunocytochemistry revealed that mRNAs and proteins of TRPC1, TRPC3, and TRPM7 were significant in human atrial myocytes.

Conclusion: These results demonstrate the novel information TRPC1, TRPC3, and TRMP7 channels are present in human atrial myocytes. Activation of TRP channels likely contributes to the genesis of human atrial fibrillation, and therefore TRP channel may be a target for the development of anti-atrial fibrillation approach.

Characterisation of ion channels in human cardiac progenitor cells

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Background: Cardiac progenitor cells play an important role in cardiac repair and regeneration; however, cellular biology and electrophysiology are not understood. The present study was designed to investigate ion channels in human cardiac c-kit$^+$ progenitor cells.

Method: Cardiac c-kit$^+$ progenitor cells were isolated and expended from human atrial specimens from patients who had undergone coronary artery bypass surgery on the basis of written consent. Ion channel currents and their phenotypes were determined with whole-cell patch voltage-clamp and molecular biological approaches.

Results: Multiple ion channel currents were recorded in human cardiac c-kit$^+$ progenitor cells. These include a large conductance Ca^{2+}-activated K^+ current (BK_{Ca}) in most (93%) cells, an inwardly-rectifying K^+ current (I_{Kir}) in 87% of cells, a transient outward K^+ current (I_{to}) in 39% of cells, a voltage-gated tetrodotoxin-sensitive Na^+ currents ($I_{Na,TTX}$) in 76% of cells. RT-PCR and Western-blot analysis revealed the molecular identities (mRNAs and protein) of these ion channel currents, including KCa.1.1 (responsible for BK_{Ca}), Kir2.1, Kir2.2 (for I_{Kir}), Kv4.3 (responsible for Ito), $Na_V1.2$, $Na_V1.3$, $Na_V1.6$, $Na_V1.7$ (for $I_{Na.TTX}$).

Conclusion: Our results demonstrate for the first time that multiple ion channels are heterogeneously present in human cardiac c-kit progenitor cells. The potential physiological roles of these ion channels are being studied.