Characterization and Regulation of T-type Calcium Channels in Embryonic Stem Cell Derived Cardiomyocytes

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Abstract

Regulation of T-type Ca\textsuperscript{2+} channels has become increasingly recognized as an important component of cardiac development. At least three genes, 
\textit{CaT} and 
\textit{CaL} encode the T-type Ca\textsuperscript{2+} channel. The expression of 
\textit{CaT} and the phase 4 depolarization rate. These data revealed a correlation between the 
\textit{CaT} and the percentage of EB with beating areas were highly correlated (r=0.9). Also, there was a significant upregulation of 
\textit{CaT} mRNA abundance was low at 3 days after EB plating. The pulse protocol was designed to measure total 
\textit{CaT} current. Low concentration of Ni\textsuperscript{2+} (5 µM) had little effect on single isolated cardiomyocytes 7 days after EB plating. The expression of 
\textit{CaT} and the percentage of EBs with beating areas significantly increased with time, there was a correlation between the 
\textit{CaT} and the phase 4 depolarization rate. These data revealed a correlation between the 
\textit{CaT} and the percentage of EB with beating areas during development. Peak 
\textit{CaT} currents were measured by using holding potentials -90 and -50 mV, respectively. 
\textit{CaT} and 
\textit{CaL} are expressed in cardiomyocytes. The amount of 
\textit{CaT} current is correlated with measures of 
\textit{CaT} mRNA level, and percentage of EBs with beating areas during development. Peak 
\textit{CaT} currents were measured by using holding potentials -90 and -50 mV, respectively. 
\textit{CaT} were obtained from subtraction of 
\textit{CaT} from total 
\textit{CaT} currents. Whole-cell currents were measured in single isolated cardiomyocytes 6 days after plating.

Methods

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Introduction

In cardiac tissue, two types of inward Ca\textsuperscript{2+} channels, L- and T-type Ca\textsuperscript{2+} channels, have been identified. T-type Ca\textsuperscript{2+} channels have a relatively large conductance and a high voltage sensitivity, while L-type Ca\textsuperscript{2+} channels have a small conductance and a low voltage sensitivity. T-type Ca\textsuperscript{2+} channels play a role in pacemaker activity because they are expressed in the sino-atrial node and atrium. Alternatively, T-type Ca\textsuperscript{2+} channels have been suggested to play a role in cardiac development. At least three genes, 
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In vitro differentiation of embryonic stem cells

ESC-derived cardiomyocytes have T-type Ca\textsuperscript{2+} current

Derived cardiomyocytes have oG-Type Ca\textsuperscript{2+} channels

Conclusion

T-type Ca\textsuperscript{2+} current exists in mouse ESC-derived cardiomyocytes. The oG gene encodes the T-type Ca\textsuperscript{2+} current in derived cardiomyocytes. The T-type Ca\textsuperscript{2+} current in derived cardiomyocytes is developmentally regulated, predominately at the level of mRNA abundance. The amount of T-type Ca\textsuperscript{2+} current is correlated with measures of pacemaker activity.

These authors contributed equally to this project.

Relationship of \textit{CaT} to oG mRNA level and beating embryos bodies

Days of EB Plating

Days of EB Plating

Days of EB Plating

Days of EB Plating

Figure 5. A cartoon of a T-type Ca\textsuperscript{2+} channel, L (left panel) and T (right panel). Top and bottom, respectively, were measured by using holding potentials -90 and -50 mV, respectively. 

Figure 6. P0, P1, P2, and P3, and percentage of EBs with beating areas during development. P0, 
\textit{CaT} expression in embryonic stem cell cultures. P1, 
\textit{CaT} expression in embryonic stem cell cultures. P2, 
\textit{CaT} expression in embryonic stem cell cultures. P3, 
\textit{CaT} expression in embryonic stem cell cultures. The data were expressed as mean ± SE.