# Sulfur Dioxide Effects on Human Atrial Action Potential. In Silico Study

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**Background:** Human exposure to air pollutants agents, like sulfur dioxide ($SO_2$), has significant effects on the cardiovascular system. Studies have shown that $SO_2$ blocks the L-type calcium channel and increases the sodium channel ($I_{Na}$), the transient outward potassium current ($I_{to}$) and the inward rectifying potassium current ($I_{K1}$), which implies an action potential duration (APD) decrease, increasing the risk of initiation and maintenance of cardiovascular disease such as atrial arrhythmias.

**Aim:** This study aims to assess the effects of the $SO_2$ at different concentrations on human atrial action potential, using computational simulation.

**Methods:** Based on experimental data, we developed concentration-dependent equations to simulate the $SO_2$ effects on $I_{CaL}$, $I_{Na}$, $I_{to}$ and $I_{K1}$. They were incorporated in the Courtemanche model of human atrial cell in a unicellular environment and in a 2D model of atrial tissue. Pacing was applied at a basic cycle length of 1000 ms. The APD at 90% of the repolarization ($APD_{90}$) and the resting membrane potential (RMP) were measured. S1-S2 cross-field protocol was applied to initiate a rotor. $SO_2$ concentrations from 0 to 1000 μM were implemented.

**Results:** Our results in a human atrial cell model are in agreement with results from non-human in vitro and in vivo studies. The $SO_2$ causes the APD shortening and loss of plateau phase of the action potential in a fraction that increases as the concentration increases. For the highest $SO_2$ concentration (1000 μM), the $I_{CaL}$ peak decreases by 95%, the $I_{Na}$, $I_{to}$ and $I_{K1}$ peaks increases by 77%, 147% and 96%, respectively, and the $APD_{90}$ decreases by 81%. The RMP does not show significant changes. In the 2D model, a rotor can be generated from 100 μM of $SO_2$ concentration.

**Conclusion:** Our results show pro-arrhythmic effects of $SO_2$ expressed through APD shortening and a rotor generation, during normal electrophysiological conditions.