KSN 2021
FULLY VIRTUAL MEETING
September 02 (Thu) - 05 (Sun)

Abstract Submission No. : 1006

The Role of Transient Potassium Channels in Ureter Smooth Muscle Action Potential and excitability: A Computational Study

CHITARANJAN MAHAPATRA
Department of Cardio Vascular Research Institute, University of California San Francisco, United States

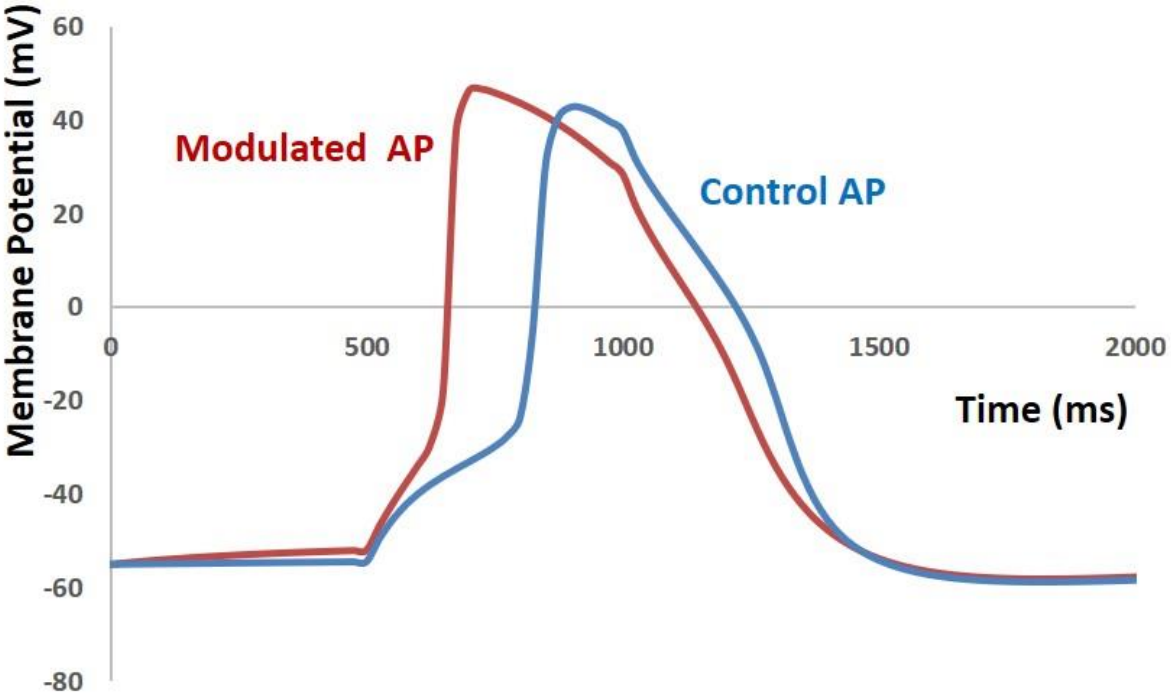
Objectives: Adequate abnormalities to kidney and upper urinary tract are strongly associated with renal failure. Abnormal peristaltic contraction of the ureter smooth muscle (USM) causes pathophysiological condition to the urinary system. It is demonstrated that the USM contractions are discretely initiated by the USM cell action potentials (APs). Transient Potassium channels (KA) are prevalent in different systems and hold immense importance for maintaining/performing selective functions. The present study investigates the role of KA current in modulating the USM cell APs.

Methods: The USM cell is described as an equivalent electrical circuit with a number of variable conductances representing two voltage-gated Ca^{2+} (T - type and L- type) channels, one voltage-gated fast potassium channels, one calcium-dependent large conductance potassium channels, and HCN channel. A drug model for the KA channel is simulated by multiplying the maximal conductance of the KA channel with a scaling factor between 0 and 1 to mimic the drug concentration.

Results: The resting membrane potential (RMP) of the USM is set at —52mV. The shape of the control AP (Blue solid line) is altered (Red solid line) due to substantially reduced outward current, which is shown in Figure 1. The results show that the KA channel plays an important role in generating APs and it is the major contributor to the total outward current. The experimental USM cell APs show a large variation in terms of AP duration. It is also observed that the inactivation time constant of the KA channel channels regulates the repolarization and depolarization phases and duration of the AP.

Conclusions: The KA channel activator can be used as a new pharmacological target for abnormal ureter contraction. The other modulating roles of KA channel in cellular signaling can also be investigated by future studies.

Figure 1: Simulated APs in USM cell


Membrane Potential (mV)
60
40
20
0
-20
-40
-60
-80
0
500
1000
1500
2000
Time (ms)
Modulated AP
Control AP