A Summary of Cardiac Action Potential Pacemaker Cells

Gengyao Yuan 20613016

Pacemaker cells is a special kind of cells that can keep the heart beats in a rhythm by depolarizing and repolarizing repeatedly. The presentation given by group 6 clearly explain how pacemaker cells signal other cells and how-to similarity this process with electrical circuits.

The presentation starting from introduce to Irons. Irons are particles with the different number of protons and electrons; they can move in and out of cells in a controlled manner. There are three key irons: Ca2+ Calcium ion, K+ Potassium ion and Na+ Sodium ion. They are unbalanced charged and keep transferring between the cells. There are two ways for irons get in/out the cell. Firstly, transports diffusion & passive transport, which is caused by a difference in electric potential, and the second is resting potential, which can drive diffusion ions one direction and by electrostatic force to drive ions the other way. By transfer between the cells, irons can communicate signals between cells to help the heart beat in sync (Desai, n.d.).

Pacemaker cells is a special kind of cells that can keep the heart beats in a rhythm by depolarizing and repolarizing repeatedly, and they don’t have resting membrane potential. De/re-polarization is a process that changes permeability to change potential, and by this way, it can control Ion channels open/close for specific ions, which means they are individual cells only designed for keep heartbeats rhythm and won’t get affected by any other irons.

The Pacemaker action potential can be dividied into 3 parts with 4 states. The Initial states when membrane potential starts low (-60 mV), after that in phase 4, Na+ flows in, at this time potential climb slowly to -40 mV. Then the Ca2+ flow in, since the Ca irons with more positive electrice(it has 2), this phase (called 0) will increase really fast to 10mV. In the end when K+ flows in during phase 3, Na+ and Ca2+ already flow out, so the total potential will decrease from 10mV to -60mV back to the initial states.

The whole Pulse propagation is starting from a SA node depolarize. It is a special kind of cell where the first pacemaker cell become abundant with positive ions. After that, positive ions constantly move to the neighboring cell. During the moving progress through gaps junctions, due to concentration difference and potential difference, the irons will always go to the lower electric potential side, which is always toward the side of the heart, this will make process repeated between neighboring cells to every part of the body.

Compare to the electrical circuits, SA nodes can be similar to voltage source since they both create a potential difference; Internodal tracts can be similar to wires because they both allow the irons pass with a low R; Cardiac myocyte can be similar to resistor since they both have high resistance and transfer to generate kinetic energy (squeezing).

Overall, this presents covered many excited facts about how the pacemaker cells pass the beat signal and also giving a clear explanation about the physic therom behind the facts. It seems like this presentation will help students have a better understanding about applied electric physics.

**References:**

Desai, R. (2012). Action potentials in pacemaker cells. Retrieved December 3, 2018, from <https://www.khanacademy.org/test-prep/nclex-rn/nclex-rn-circulatory-system/heart-depolarization-ddp/v/action-potentials-in-pacemaker-cells>