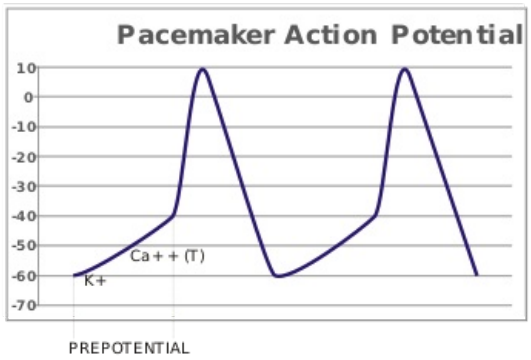
Pacemaker potencial

A **pacemaker** is a designation for cells that spontaneously generate an action potential. This ability is called **autorythmicity**. Pacemaker cells are a part of the cardiac conduction system and they are responsible for controlling the heart rhythm.

Spontaneous diastolic depolarization

Resting membrane potential **does not** occur in sinoatrial and atrioventricular node cells. Instead, each action potential is preceded by a gradual change of the membrane potential towards a threshold value. This process is called **spontaneous diastolic depolarization** and is regulated by the autonomic nervous system.



Pacemaker potential

The principle of the process is the movement of the following ions:

- **Na^+** moving intracellularly
- **Ca^{2+}** moving intracellularly
- Reduced **K^+** efflux

Na^+ ions pass into the cell through 'funny channels' and are less important in terms of overall depolarization. Ca^{2+} ions have contribute the most in the development of spontaneous diastolic depolarization. Ca^{2+} influx occurs through specific channels. The influx of calcium ions causes a gradual depolarization and subsequent formation of the action potential. The last of these ions contributing to this phase of pacemaker action potential is K^+, whose efflux is reduced. This gradual inactivation plays a crucial role in the development of spontaneous diastolic depolarization - in other cells, the K^+ current is responsible for maintaining the resting membrane potential.

Formation of the electrical impulses

Physiologically, **the sinoatrial (SA) node** is responsible for generating the electrical impulses. Of all the other parts of the transmission system, its membrane potential is closest to the threshold, and thus generates an action potential first. This node acts as a **primary (natural) pacemaker** and the rhythm it specifies is called a **sinus rhythm**. Under pathological conditions, the pacemaker is taken over by a **atrioventricular (AV) node**, or by a cell of the conduction system (most often **Purkinje fibers**) - the resulting pacemaker is called an **ectopic pacemaker**. The rhythm generated by the AV node is called **nodal rhythm**, while the Purkinje fibers generate the **idioventricular rhythm**.

Regulation of pacemaker potential

Pacemaker potential is primarily controlled by the autonomic nervous system. Sympathetic activity causes **increased influx of Ca^{2+} and Na^+ into the cell** and at the same time **inactivates K^+ channels** and thus prevents the efflux of ions from the cell - this leads to a faster course of spontaneous diastolic depolarization. The effect of parasympathetic system is exactly the opposite. Given that the SA node generates at rest approximately 100 stimuli per minute,[1] parasympathetic activity must predominate at a resting heart rate of 60-80 beats per minute.

Links

Related articles

- Heart
- Action potential in the heart
- Resting Membrane Potential
- Conduction system of the heart
- Electrocardiography

External links

- Akčný potenciál a Pacemaker (TECHmED) (https://www.techmed.sk/akcny-potencial/)
- Pacemaker potential (https://en.wikipedia.org/wiki/Pacemaker_potential)

Literature

- KITTNAR, Otomar, et al. *Lékařská fyziologie.* 1. vydání. Praha : Grada, 2011. 790 s. ISBN 978-80-247-3068-4.

- SILBERNAGL, Stefan a Agamemnon DESPOPOULOS. *Atlas fyziologie člověka.* 6. vydání. Praha : Grada, 2003. 435 s. ISBN 80-247-0630-X.

References

1. KITTNAR, Otomar and ET AL .. *Medical physiology.* 1st edition. Prague: Grada, 2011. 790 pp. 201. ISBN 978-80-247-3068-4 .