Baroreflex

Baroreflex (baroreceptor reflex) is a mechanism for the acute regulation of blood pressure. It is an autonomic reflex, mediated by baroreceptors and the autonomic nervous system.

Mechanism

Baroreceptors are found in the **arcus aorta**e and in the **sinus caroticus** (aortocarotic receptors). These are mechanoreceptors responding to rapid changes in arterial pressure. There is a depolarization and thus the emergence of an action potential.[1]

Carotid sine receptors are not stimulated at pressures up to 50-60 mmHg, with maximum stimulation occurring at 180 mmHg. In the case of receptors in the arcus aortae, the readings are 30 mmHg higher. An **increase in blood pressure** will translate into a higher frequency of action potentials.[2]

The pulse-pressure dependency curve is sigmoidal with maximum steepness in an area of about 100 mmHg, making the system most sensitive to pressure changes in this range.[2]

By way of *nervus glossopharyngeus* (from sinus caroticum) and *nervus vagus* (from arcus aortae) stimuli reach the **vazomotoric center** in the brainstem: reticular formation prolonged spinal cord, *nucleus tractus solitarii*, *nucleus ambiguus* and *area postrema*.[1]

The information is integrated in the *nucleus tractus solitarii*, from there the centre in *the caudal ventrolateral spinal cord* (CVLM) is activated, which goes on to:

- inhibits *the rostral ventrolateral spinal cord* (RVLM), resulting in inhibition of the sympathetic agent → vasodilatation, reduction of contractility;
- excites *the nucleus ambiguus*, the nucleus of *the vagus nerve*. The effect of parasympathy on SA slows the heart rate.

Both lead to **lower blood pressure**.[3]

Similarly, when blood pressure is lowered, sympathetic inhibition occurs while inhibiting parasympathy and thus vasoconstriction, increasing heart rate and contractility, which increases blood pressure again.[3]

The importance of baroreflex

The baroreflexive mechanism **compensates for short-term pressure changes** (serves as a buffer system). This keeps blood pressure in the mid-range in most common situations. If the baroreception reaction is not functional, the volatility increases by up to three times.[2]

Orthostatic reaction

Orthostatic reaction is the organism's reflex reaction to orthostatic hypotension - a decrease in blood pressure due to the change in position from lying down to standing. It is mediated by the baroreflex. A decrease in blood pressure causes a decrease in the activity of baroreceptors in the *sinus caroticus* and *arcus aortae*, which leads to parasympathetic inhibition and a decrease in sympathetic inhibition. This results in **vasoconstriction, increased heart rate and contractility**[2].

Hypertension

As a result of prolonged hypertension, reversible **baroreceptor remodelling** occurs, which in turn maintains increased blood pressure.[2][3] Such adjustment (reseting) occurs within one to two days. It is caused by a reduction in the number of pulses from the baroreceptors after a few minutes, even though the pressure is not adjusted. Related to this is the fact that baroreceptors respond primarily to changes in blood pressure. The response to rapidly increasing blood pressure is significantly greater than if the pressure is at such a high level in the long term.[2]

Baroreception sensitivity

Baroreception sensitivity indicates how many milliseconds the interval between two heartbeats changes RR, if blood pressure changes by 1 mmHg. Physiologically, this is between 10-15 ms → a drop in blood pressure of 10 mmHg will trigger an increase heart rate from 70 beats/min to 80.[4]

Baroreception sensitivity can be measured. Baroreflex oscillates with a frequency of 0.1 Hz due to delays in the regulatory circuit. Thus, by continuously measuring blood pressure and heart rate, we can calculate the baroreeptive sensitivity according to the formula:

$$BRC = \frac{S(f = 0.1Hz)_{RR}}{S(f = 0.1Hz)_{TK}},$$

where BRC is baroreception sensitivity, $S(f = 0.1Hz)_{RR}$ spectral performance (amount of rhythm) of the heart rate curve, $S(f = 0.1Hz)_{TK}$ spectral performance of the systolic blood pressure curve.[5]

Links

Related articles

- Blood pressure
- Regulation of blood pressure

References

1. YAMAMOTOVÁ, Anna. *Regulace krevního tlaku* [lecture for subject Fyziologie, specialization Všeobecné lékařství, 3. lékařská fakulta Univerzita Karlova]. Praha. 26. 7. 2011.
2. GUYTON, Arthur C – HALL, John E. *Textbook of Medical Physiology.* 11. edition. Elsevier, 2006. pp. 782–784. ISBN 978-0-7216-0240-0. **Cite error: Invalid <ref> tag; name "guyton" defined multiple times with different content**
3. GANONG, William F. *Přehled lékařské fyziologie.* 20. edition. Galén, 2005. 890 pp. pp. 495. ISBN 80-7262-311-7.
4. FRANĚK, Miloslav – VACULÍN, Šimon. *Fyziologie a klinická fyziologie : principy a praktická cvičení.* 1. edition. R.B.C, 2009. 132 pp. ISBN 978-80-254-5409-1.
5. STANČÁK, Andrej – STEJSKAL, Vítězslav. *Centrální ovlivnění barorecepčního reflexu : Praktické cvičení z fyziologie.* Praha : Ústav normální, klinické a patologické fyziologie, 3. LF UK, 1998,