

Nervous and Chemical Regulation of Heart Rate

- Heart Rate is the number of times the heart beats per minute.
- Heart rate can vary according to the body's physical needs
- Normal resting heart rate for adults is in the range of 60 to 100 beats per minute
- Normal heart rate depends on the individual, age, body size, heart conditions, use of medications, emotions, whether a person is sitting or moving etc
- An unusually high resting heart rate or low maximum heart rate may indicate an increased risk of heart attack
- When heart is not beating in a regular pattern it is referred to as arrhythmia.

Many factors regulate the heart rate, the most important are as follows:

(a) Nervous regulation of the Heart Rate

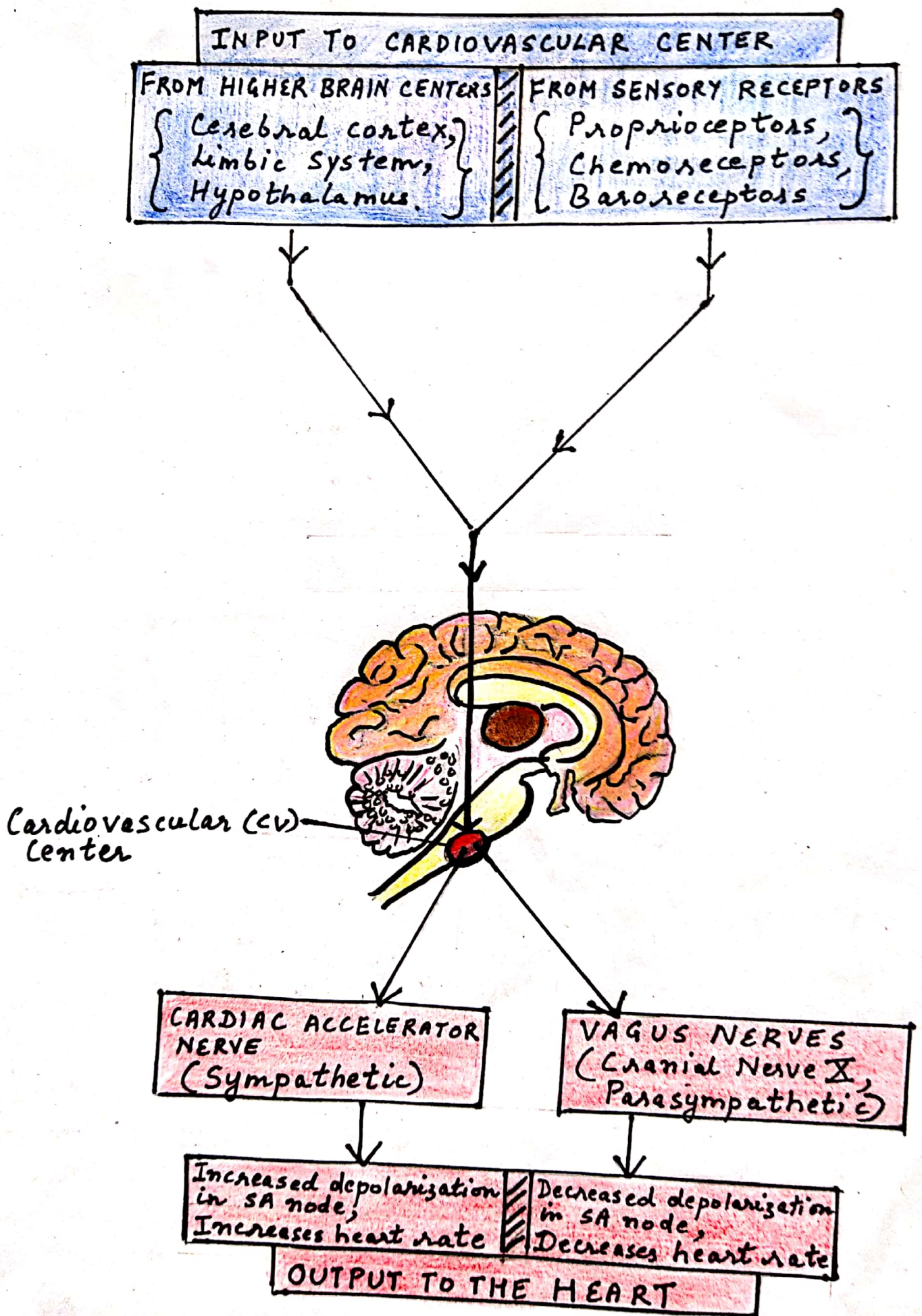
→ Cardiovascular center in the medulla oblongata is responsible for nervous system regulation of the heart rate.

→ The cardiovascular center receives inputs from higher brain centers (cerebral cortex, limbic system and hypothalamus) and from a variety of sensory receptors (proprioceptors, chemoreceptors and baroreceptors).

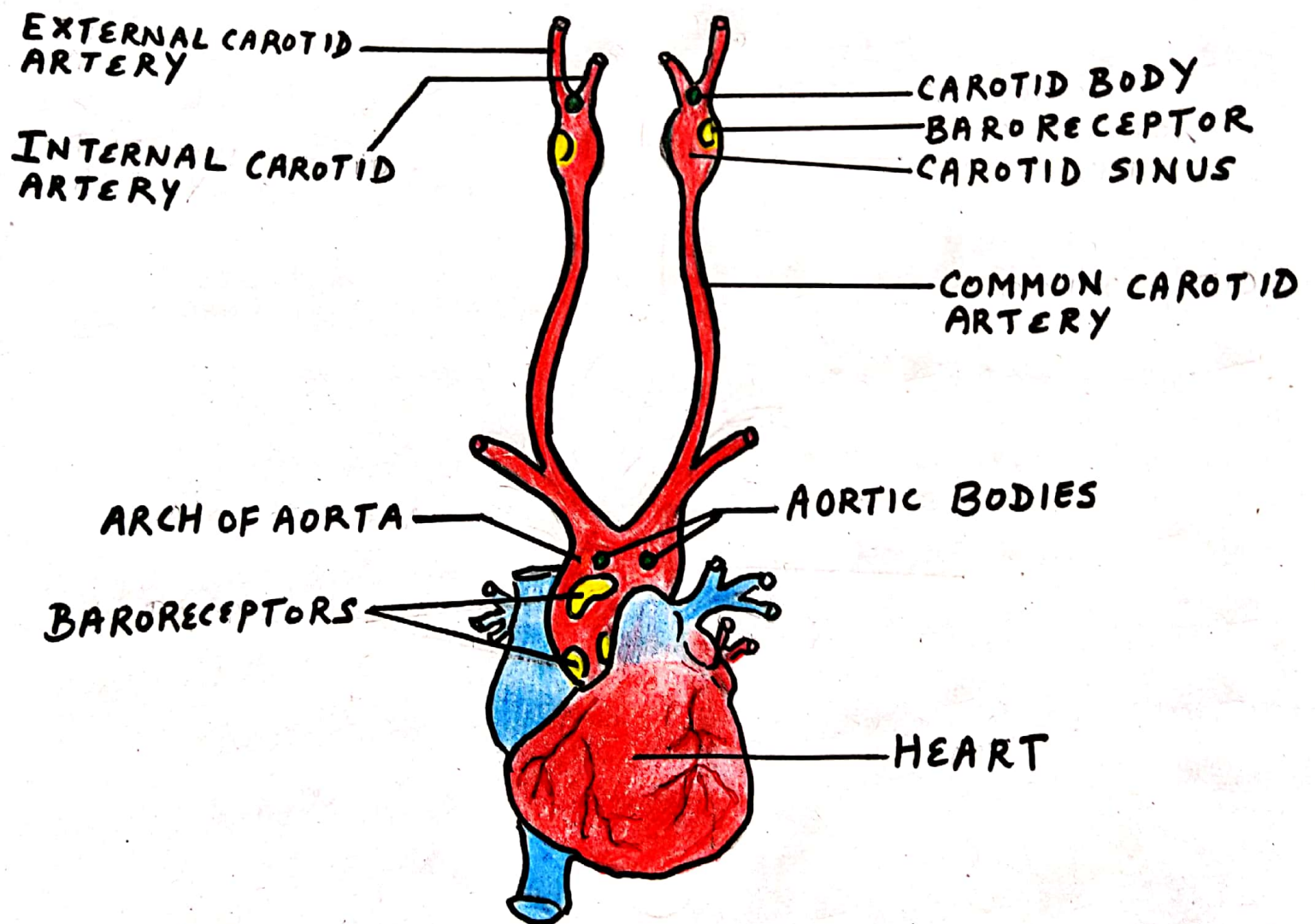
→ The cardiovascular centre then sends output to the heart via the

(i) Cardiac accelerator nerves (sympathetic) which increases depolarization in SA node and increases heart rate

(ii) Vagus nerves (cranial nerve X, parasympathetic) which decreases depolarization in SA node and decreases heart rate.



NERVOUS REGULATION OF THE HEART RATE



LOCATION OF BARORECEPTORS AND
CHEMORECEPTORS IN THE ARTERIES
OF THE HEART

(6) Chemical Regulation of the Heart Rate

Various chemical substances affect the heart rate

(i) Oxygen

- Low oxygen (hypoxia) stimulates heart rate
- Very low oxygen inhibits heart rate
- Prolonged low oxygen causes heart failure

(ii) Carbon dioxide

- High CO_2 causes inhibition of heart rate (Hypercapnia)
- Low blood CO_2 causes excitation of heart rate (Hypocapnia)

(iii) Transmitter substances and Hormones

- Acetylcholine causes inhibition of heart rate
- Norepinephrine and Epinephrine causes excitation of heart rate
- Thyroxine increases heart rate

(iv) Inorganic ions.

- K^+ causes inhibition of heart rate
- Na^+ causes inhibition of heart rate
- Ca^{2+} causes increase of heart rate
- Excess Ca^{2+} stops heart in contracted state called "Calcium Rigour"

(V) Drugs.

- Digitalis increases heart rate
- Atropin increases heart rate
- Muscarin inhibits heart rate
- Nicotine inhibits initially and then increases the heart rate

(VI) Acidosis

- Low pH decreases heart rate

(VII) Alkalosis

- High pH decreases heart rate

Note :-

Tachycardia : An abnormally rapid resting heart beat or elevated resting heart rate (over 100 beats per minute)

Bradycardia : A slow resting heart rate (under 50 beats per minute)

References

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