SNS COLLEGE OF ALLIED HEALTH SCIENCE

Affiliated to The Tamil Nadu Dr MGR Medical University, Chennai

DEPARTMENT OF CARDIAC TECHNOLOGY

COURSE NAME : Applied Physiology

UNIT : Overview of Cardiovascular system

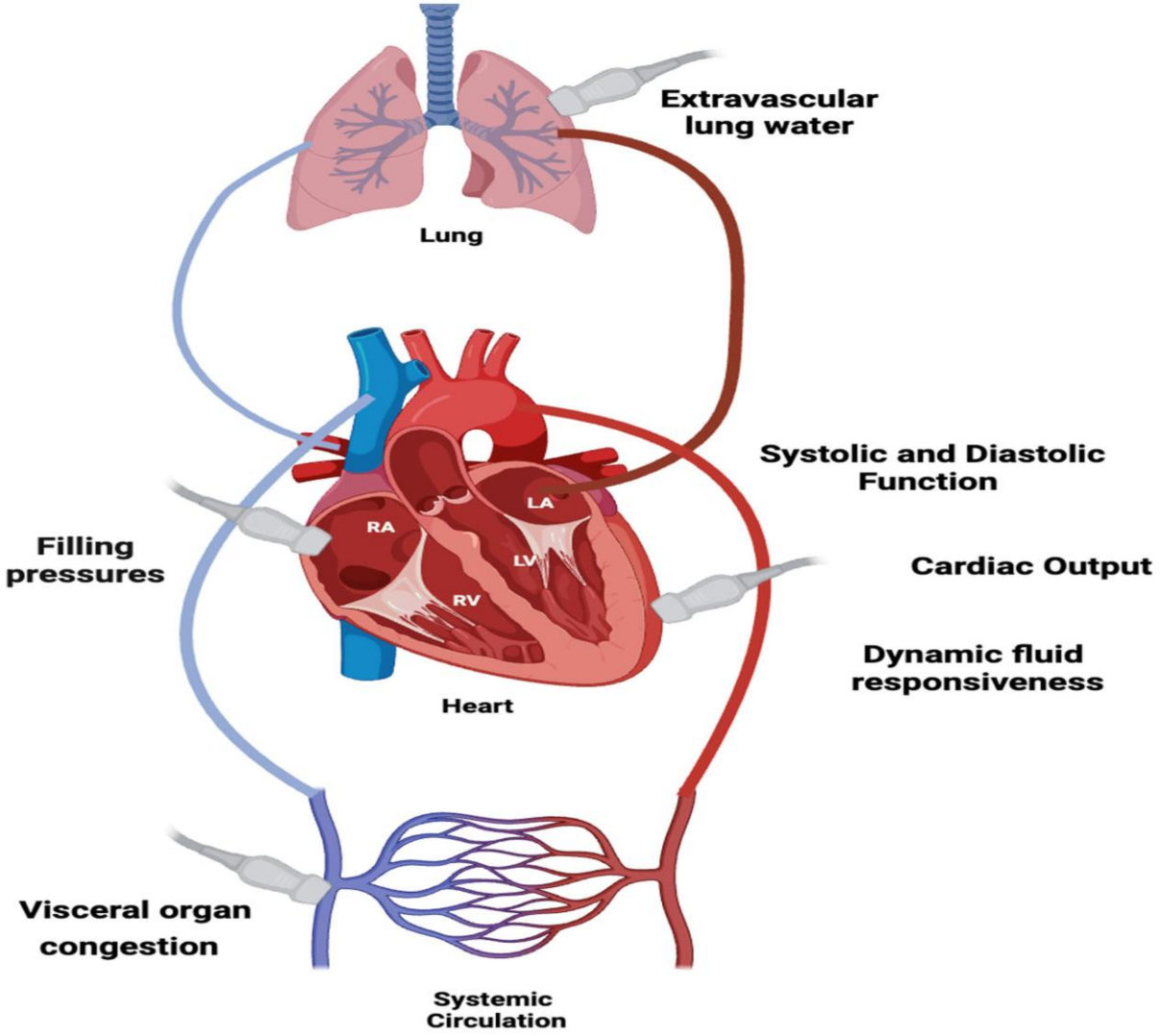
TOPIC : Central Control of the Cardiovascular System

FACULTY NAME: Kavipriya S

EMPATHIZE – Understanding the Clinical and Learning Need

The cardiovascular system must maintain:

1. **Constant blood pressure**
2. **Adequate tissue perfusion**
3. **Stable cardiac output**



2. DEFINE — Central Control Centers

A. Central Control Centres

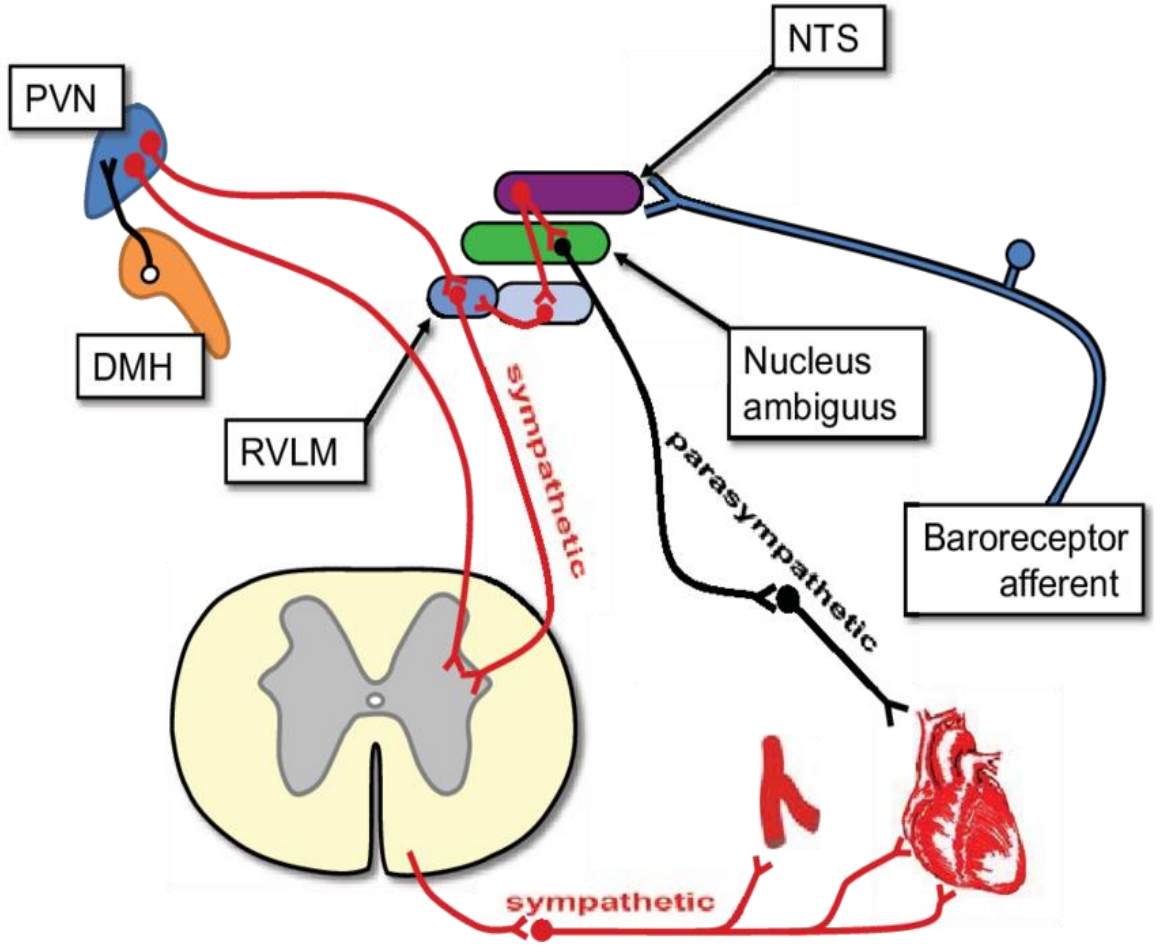
1.Medullary Centres (in Brainstem):

1. Located in **medulla oblongata**.
2. Major components:
    1. **Cardioinhibitory Centre (CIC):**

       → Activates **parasympathetic (vagus) nerves** → decreases HR.
    2. **Cardioacceleratory Center (CAC):**

       → Activates **sympathetic nerves** → increases HR and contractility.
    3. **Vasomotor Center (VMC):**

       → Controls vasoconstriction and vasodilation of blood vessels.
3. Together, they maintain **mean arterial pressure (MAP)** and **cardiac output**.



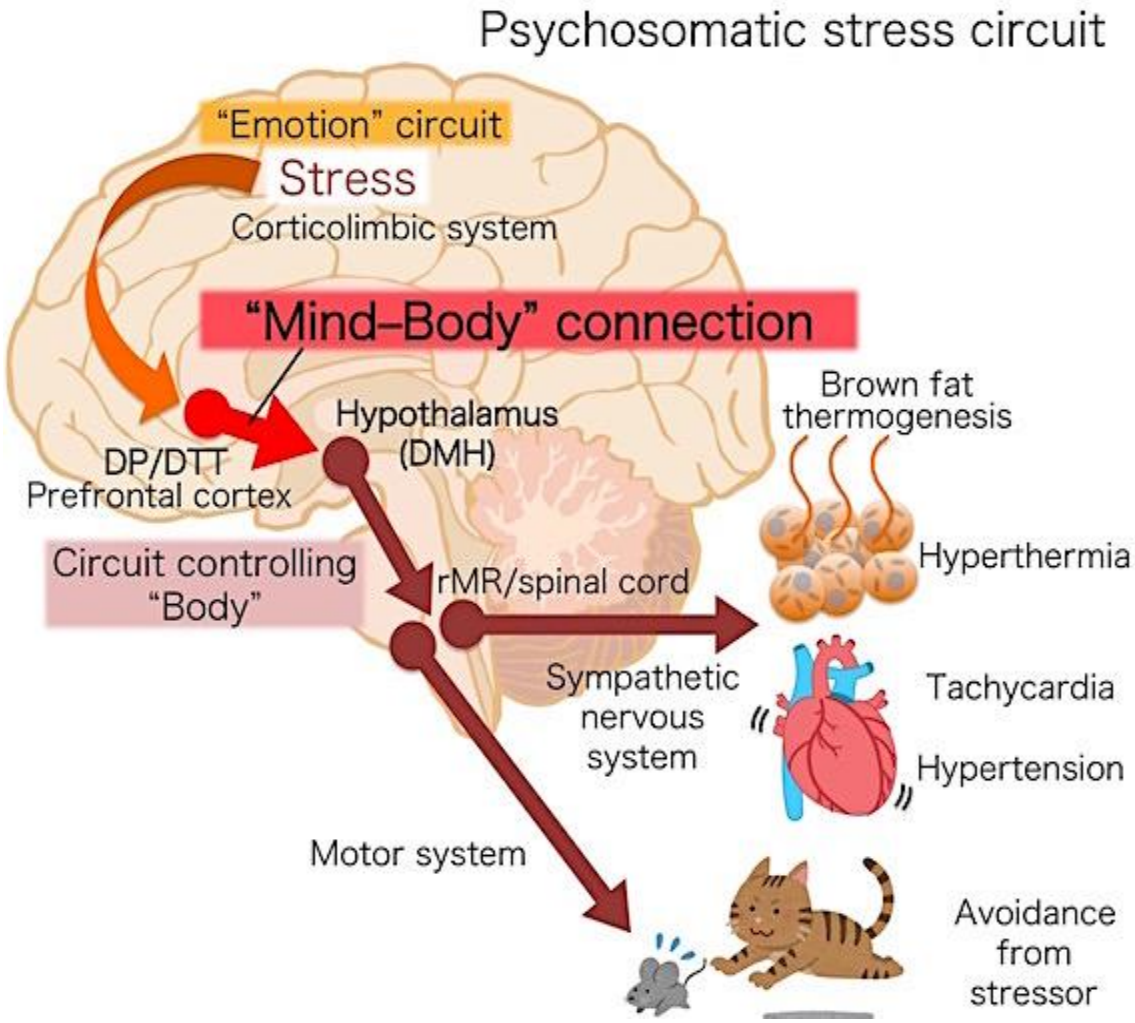
💡 2. DEFINE — Identifying the Core Concept

Hypothalamus:

- Integrates **emotional** and **temperature-related** influences.
- Stress → ↑ sympathetic tone.
- Heat → vasodilation (skin blood flow ↑).
- Cold → vasoconstriction (heat conservation).

Higher Brain Centers (Cerebral Cortex & Limbic System):

- Emotional states like fear, anger, anxiety affect HR and BP.
- Example: "Fight or flight" → tachycardia, ↑ BP.



Peripheral Input Pathways

Reflex	Receptor Location	Stimulus Detected	Effect
Baroreceptor Reflex	Carotid sinus & Aortic arch	Change in arterial pressure	↓BP → ↑HR & vasoconstriction; ↑BP → ↓HR & vasodilation
Chemoreceptor Reflex	Carotid & aortic bodies	↓O_2, ↑CO_2, ↓pH	Stimulates ↑HR & vasoconstriction
Bainbridge Reflex	Right atrium	↑Venous return	↑HR to pump excess blood
Bezold–Jarisch Reflex	Ventricles	Chemical/ischemic stimulation	Reflex bradycardia & vasodilation

💡 3. IDEATE — Mechanisms and Functional Integration

Goal: Maintain **blood pressure**, **heart rate**, and **tissue perfusion** dynamically.

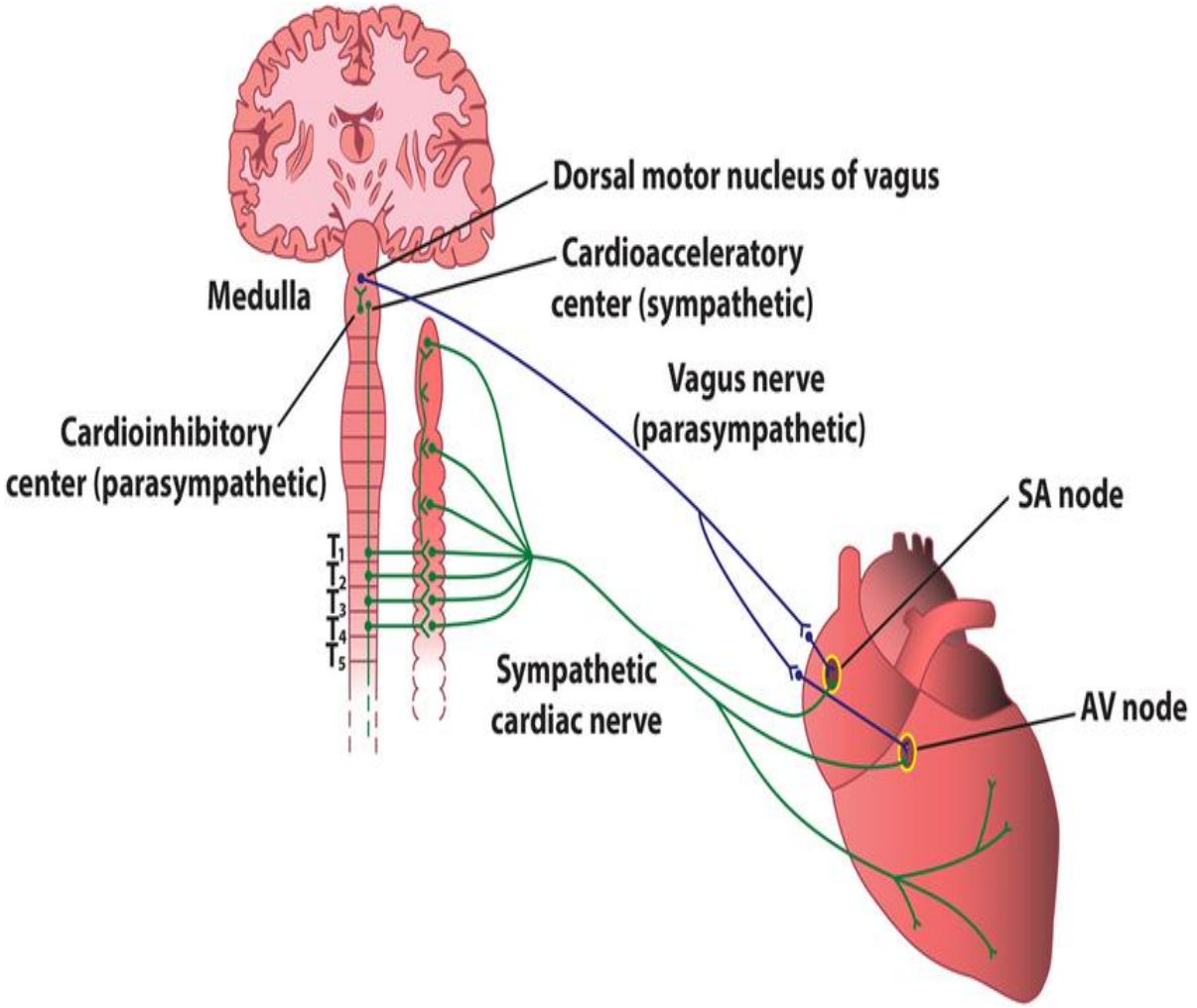
Sympathetic Control

Origin: Thoracolumbar spinal cord.

Neurotransmitter: **Norepinephrine (NE)**.

Effects:

- ↑ Heart rate (chronotropy).
- ↑ Contractility (inotropy).
- Vasoconstriction in most organs.
- Vasodilation in skeletal muscle during exercise.



🧠 Parasympathetic Control

Origin: **Vagus nerve** (cranial nerve X).

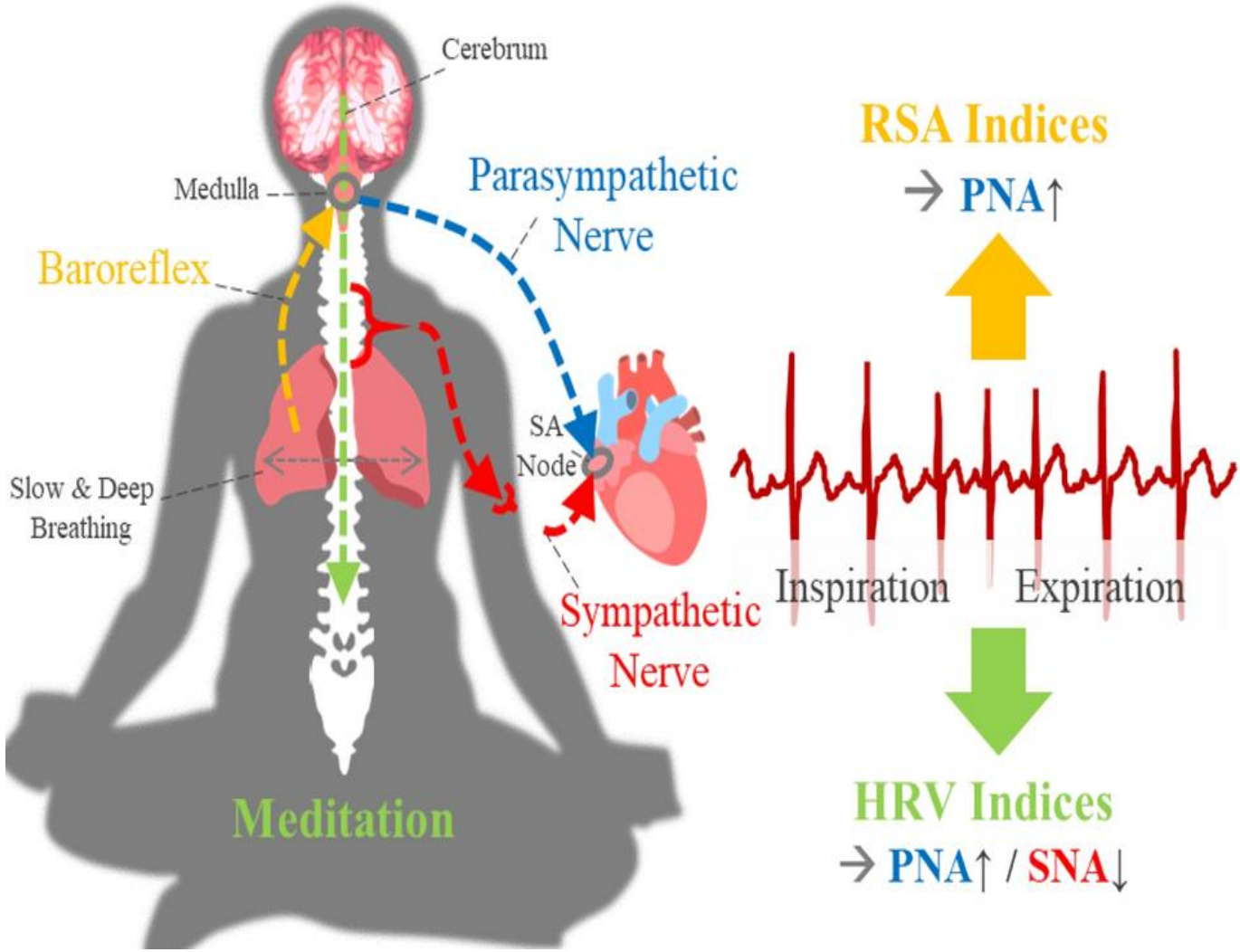
Neurotransmitter: **Acetylcholine (ACh)**.

Effects:

↓ Heart rate.

Mild ↓ contractility (mainly in atria).

Little effect on systemic vascular tone.



🔍 5. TEST — Evaluate, Monitor, and Reflect

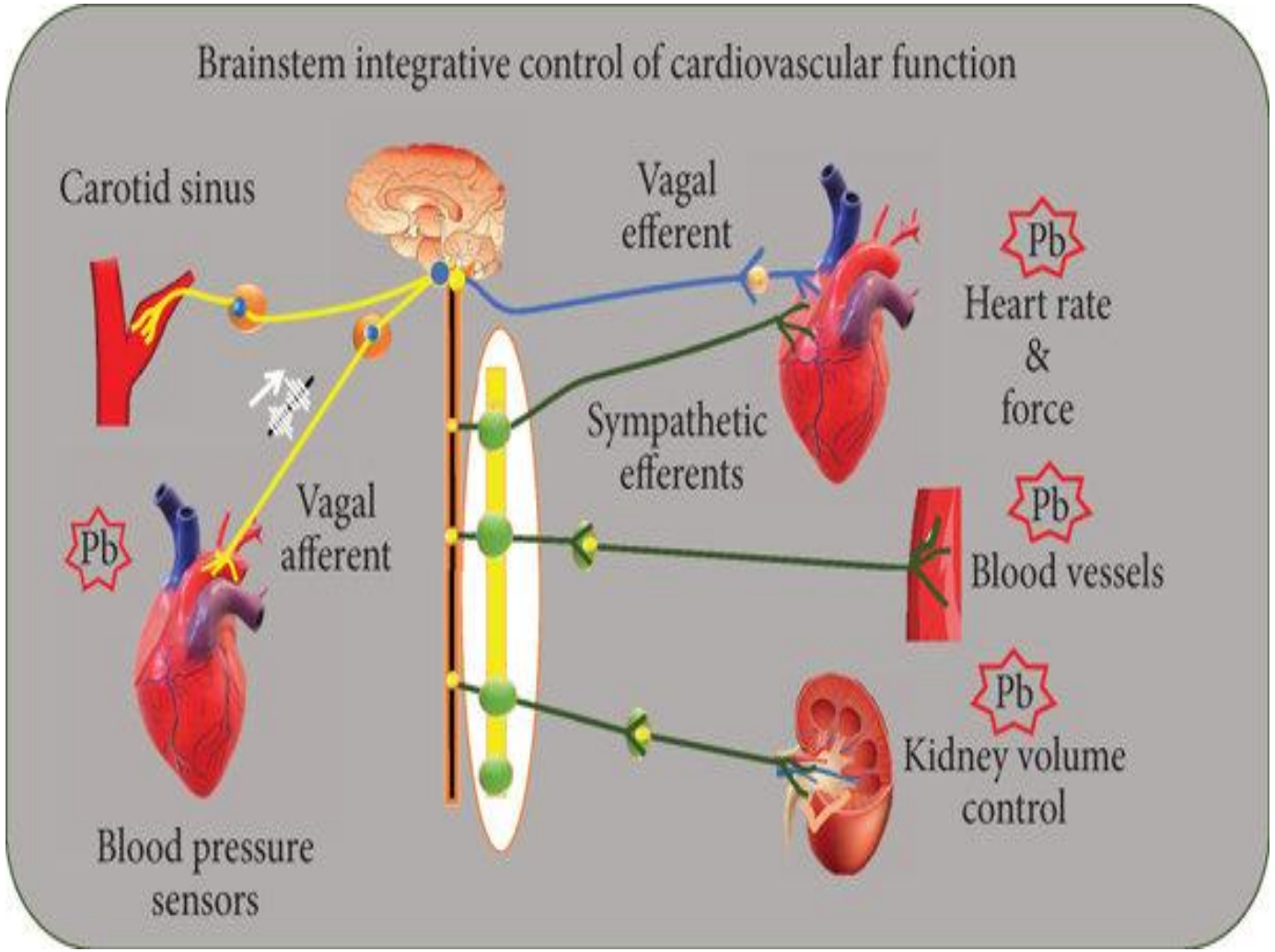
Assessment of Central Control Function

Measure:

- Resting HR and BP.
- HR response to posture or deep breathing.
- Reflex testing (Valsalva manoeuvre).

Abnormal findings:

- **Autonomic failure:** HR and BP don't change with posture.
- **Baroreflex impairment:** Fluctuating BP without compensation.



SUMMARY TABLE

Control Center / Reflex	Function	Neural Pathway	Clinical Relevance
Medullary VMC	Maintains BP	Sympathetic + Parasympathetic	Shock, Hypertension
Hypothalamus	Temperature, emotion regulation	Autonomic	Stress response
Baroreceptor Reflex	BP stabilization	Glossopharyngeal & Vagus nerves	Orthostatic hypotension
Chemoreceptor Reflex	Respiration–BP link	Carotid/Aortic bodies → Medulla	Hypoxia, acidosis
Higher Centers	Emotional influence	Limbic system → Hypothalamus	Anxiety-induced tachycardia

📚 Reference Books & Journals

Textbooks:

- *Cardiovascular Physiology* – Pappano & Wier (Mosby Physiology Series)
- *Guyton & Hall Textbook of Medical Physiology* – Elsevier
- *Cardiovascular Physiology Concepts* – Richard E. Klabunde
- *Human Physiology* – Lauralee Sherwood

Journals:

- *Circulation – American Heart Association*
- *Journal of Applied Physiology*
- *Autonomic Neuroscience: Basic and Clinical*
- *Nature Reviews Cardiology*