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 :1-Individual Circulations

TOPIC : Circulatory Control and Specialized Circulations

FACULTY NAME: Kavipriya S

Circulatory Control and Specialized Circulations

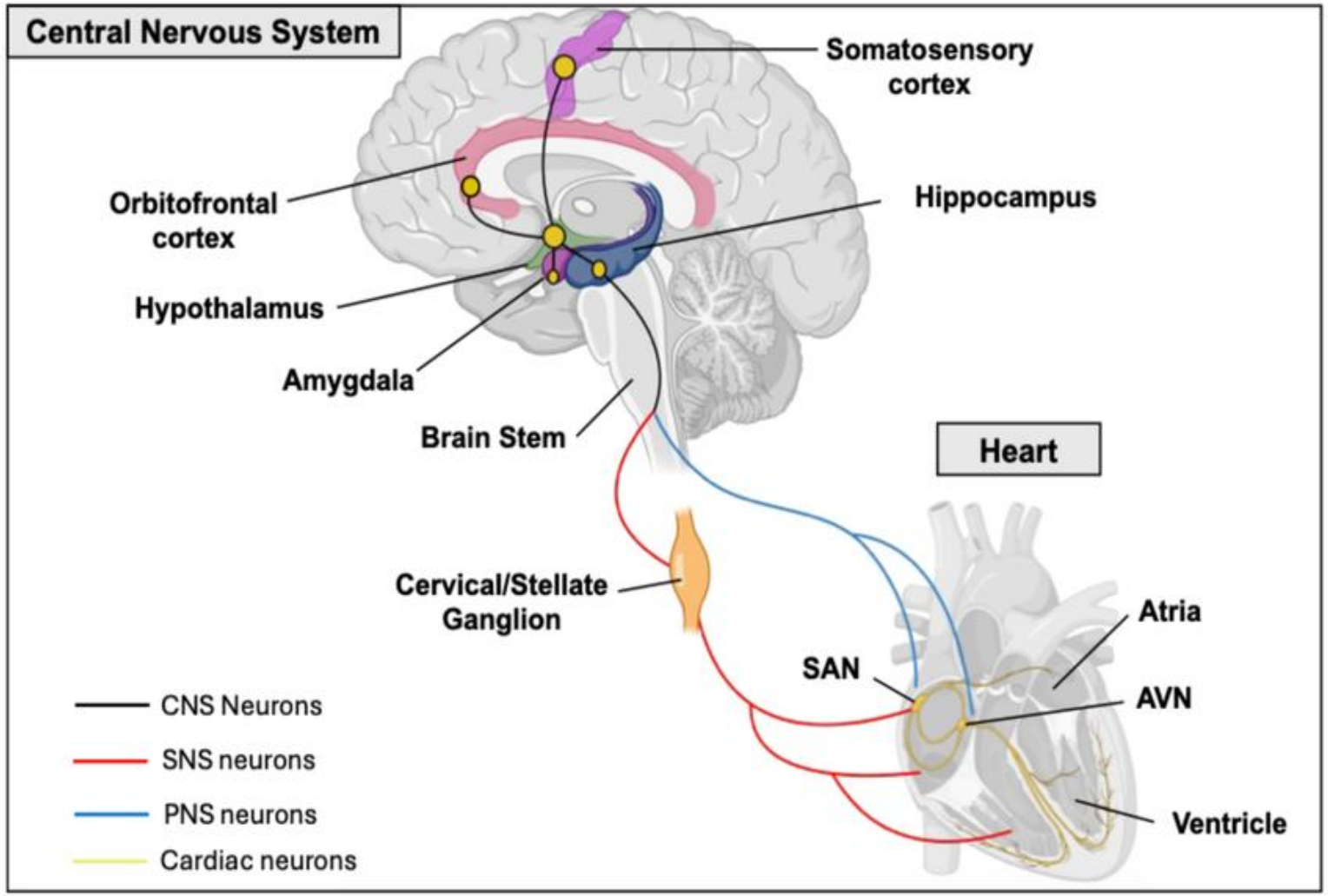
Case Example:

A 55-year-old male patient experiences dizziness, breathlessness, and chest discomfort during mild exertion.

The cardiologist suspects impaired blood flow control involving both **central mechanisms** and **regional circulations** (heart, brain, lungs, skin).

EMPATHIZE — Understanding the Problem

- The **cardiovascular system** must adapt blood flow to each organ's needs.
- During rest, stress, or exercise, **different organs demand different blood supply**.
- **Central nervous system (CNS)** and **local mechanisms** coordinate these changes.
- When control fails → symptoms like dizziness, angina, or breathlessness occur.



EMPATHIZE — Understanding the Problem

Chest pain → poor **coronary circulation**

Dizziness → poor **cerebral circulation**

Breathlessness → disturbed **pulmonary circulation**

Control Failure Symptoms

Control failure leads to symptoms like dizziness, angina, or breathlessness

Coordination

Central nervous system (CNS) and local mechanisms coordinate blood supply changes

Blood Supply Variation

Different organs require different blood supply during rest, stress, or exercise

Breathlessness Cause

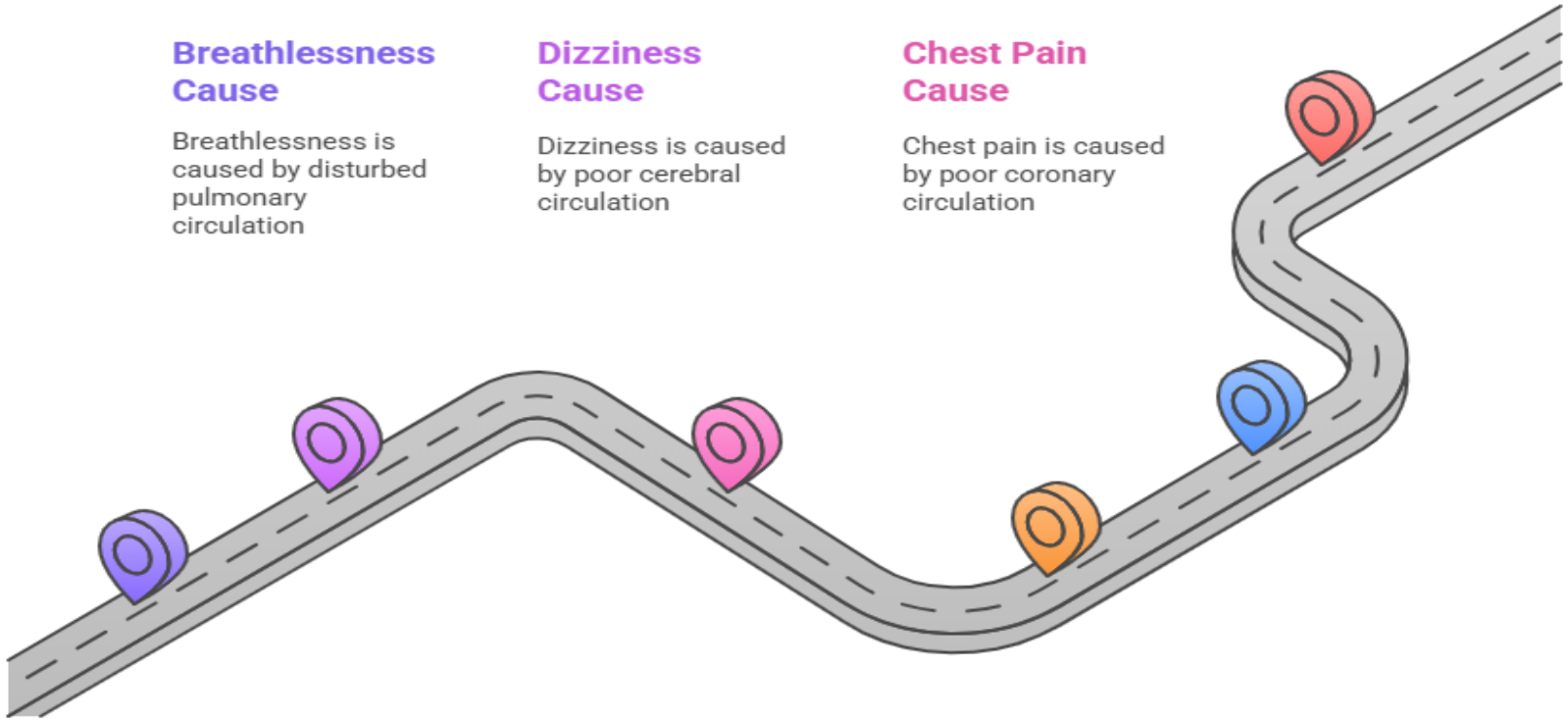
Breathlessness is caused by disturbed pulmonary circulation

Dizziness Cause

Dizziness is caused by poor cerebral circulation

Chest Pain Cause

Chest pain is caused by poor coronary circulation

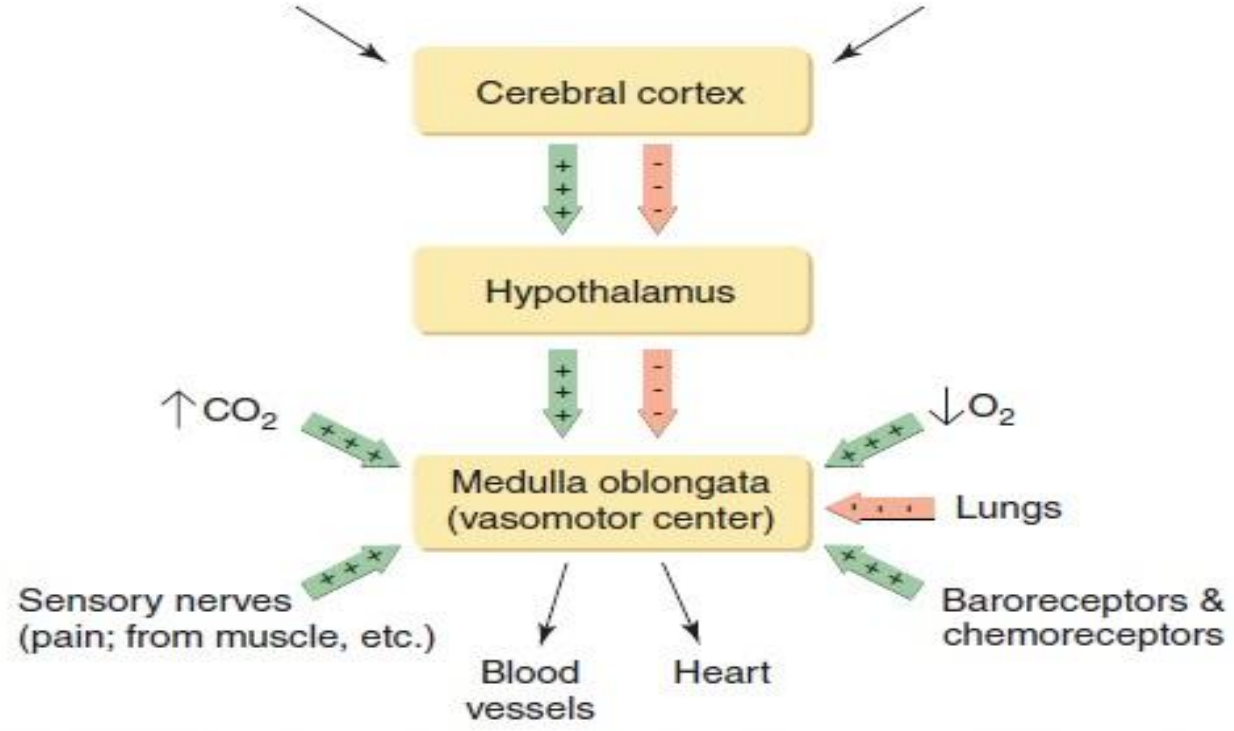


DEFINE — Identify Key Components

A. Central Control of Cardiovascular System

Centres involved:

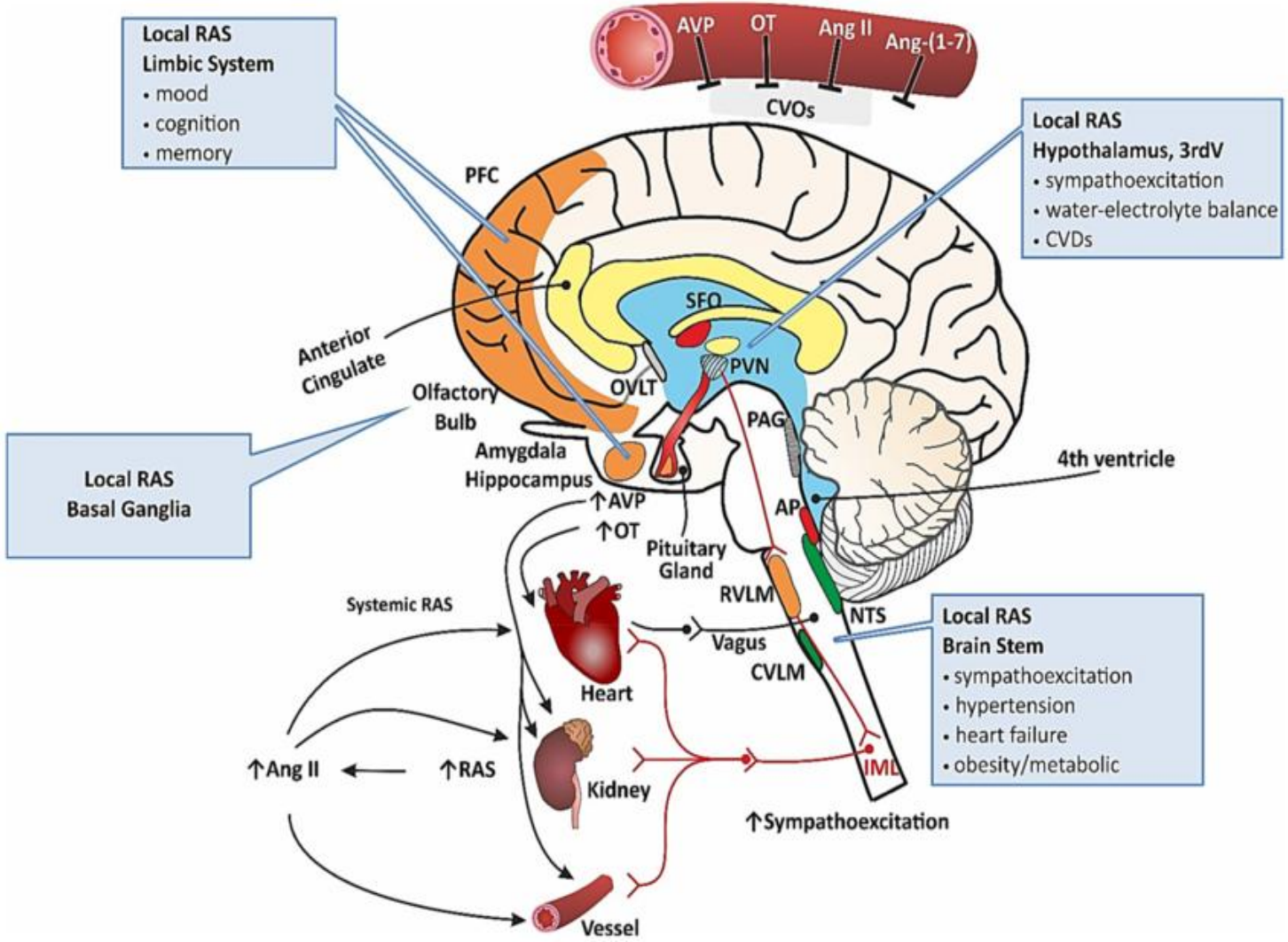
- **Medulla oblongata** → vasomotor & cardiac centres.
- **Hypothalamus** → emotional and thermal control.
- **Cerebral cortex** → stress, anxiety, or exercise effects.



DEFINE

Mechanisms:

- **Baroreceptor reflex:** detects blood pressure changes.
- **Chemoreceptor reflex:** responds to O_2, CO_2, and pH levels.
- **Sympathetic system:** ↑ heart rate, ↑ contractility, ↑ vasoconstriction.
- **Parasympathetic system:** ↓ heart rate, causes vasodilation in few areas.



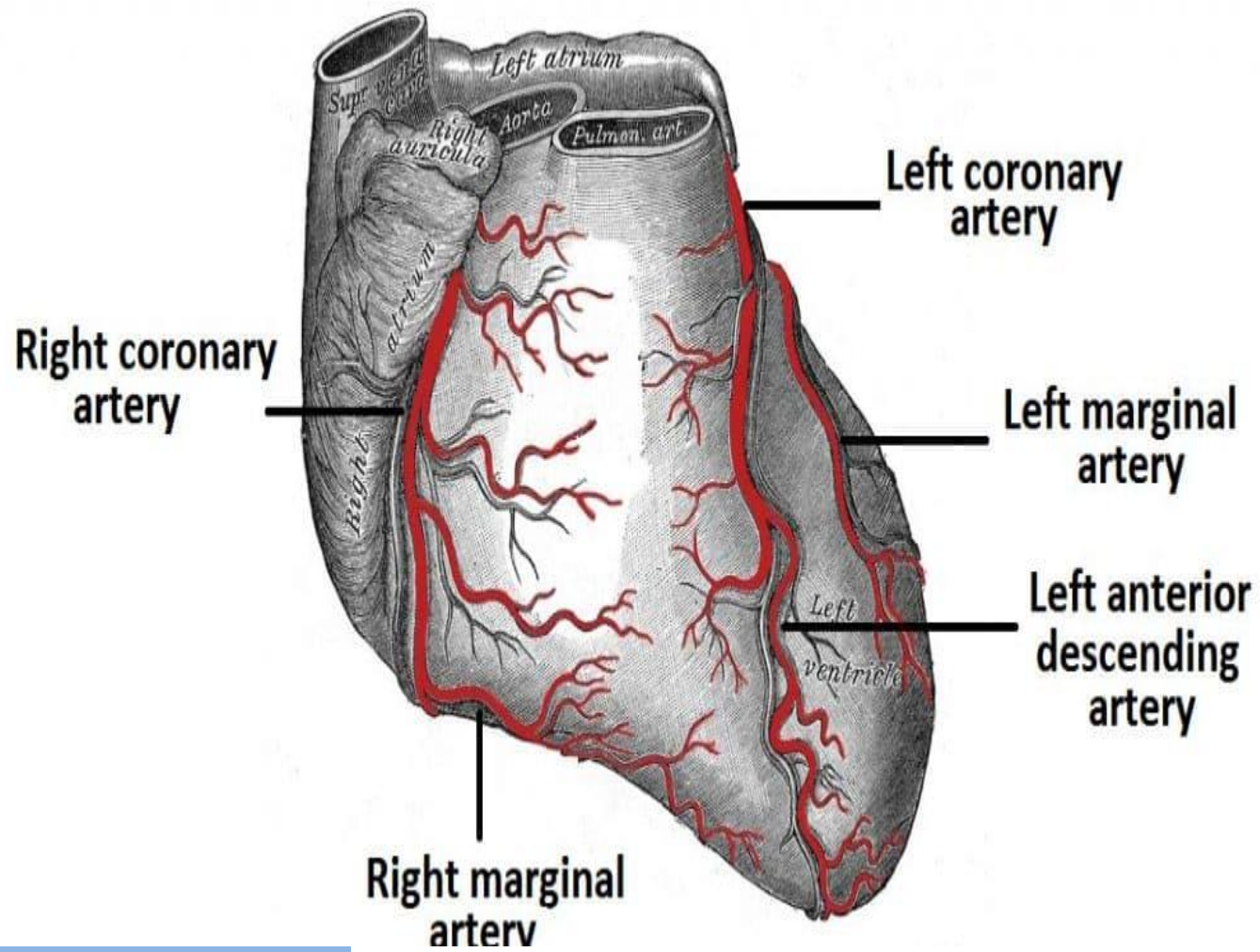
Specialized Circulations

Coronary Circulation

- Supplies **myocardium** (heart muscle).
- **Left coronary artery** → LV & interventricular septum.
- **Right coronary artery** → RV & conduction system.

Features:

- Maximal flow during **diastole** (opposite to other organs).
- **Autoregulation:** local metabolites (adenosine, O_2) adjust flow.
- **Clinical link:** blockage → **myocardial infarction (heart attack)**.



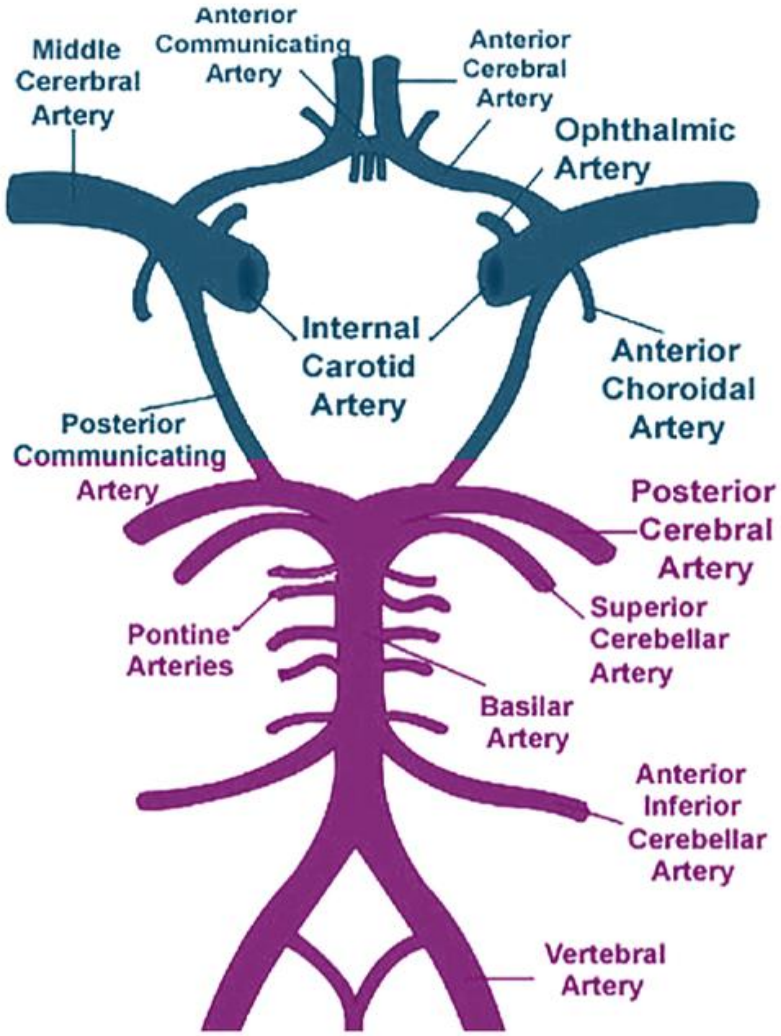
Cerebral Circulation

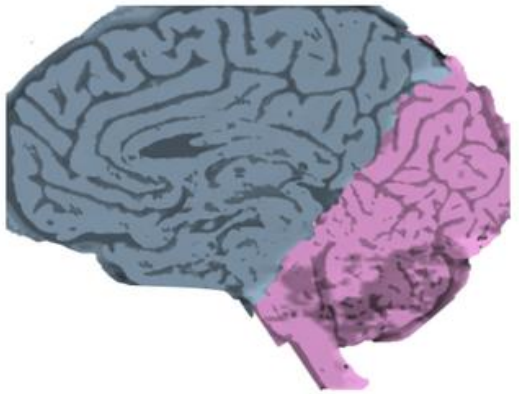
Provides **oxygen and glucose** to the brain.

Circle of Willis ensures collateral supply.

Features:

- Flow constant due to **autoregulation** (60–150 mmHg).
- Sensitive to **CO_2 and pH** changes → ↑CO_2 → vasodilation.
- **Clinical link:** impaired flow → **stroke / syncope**.





Anterior circulation

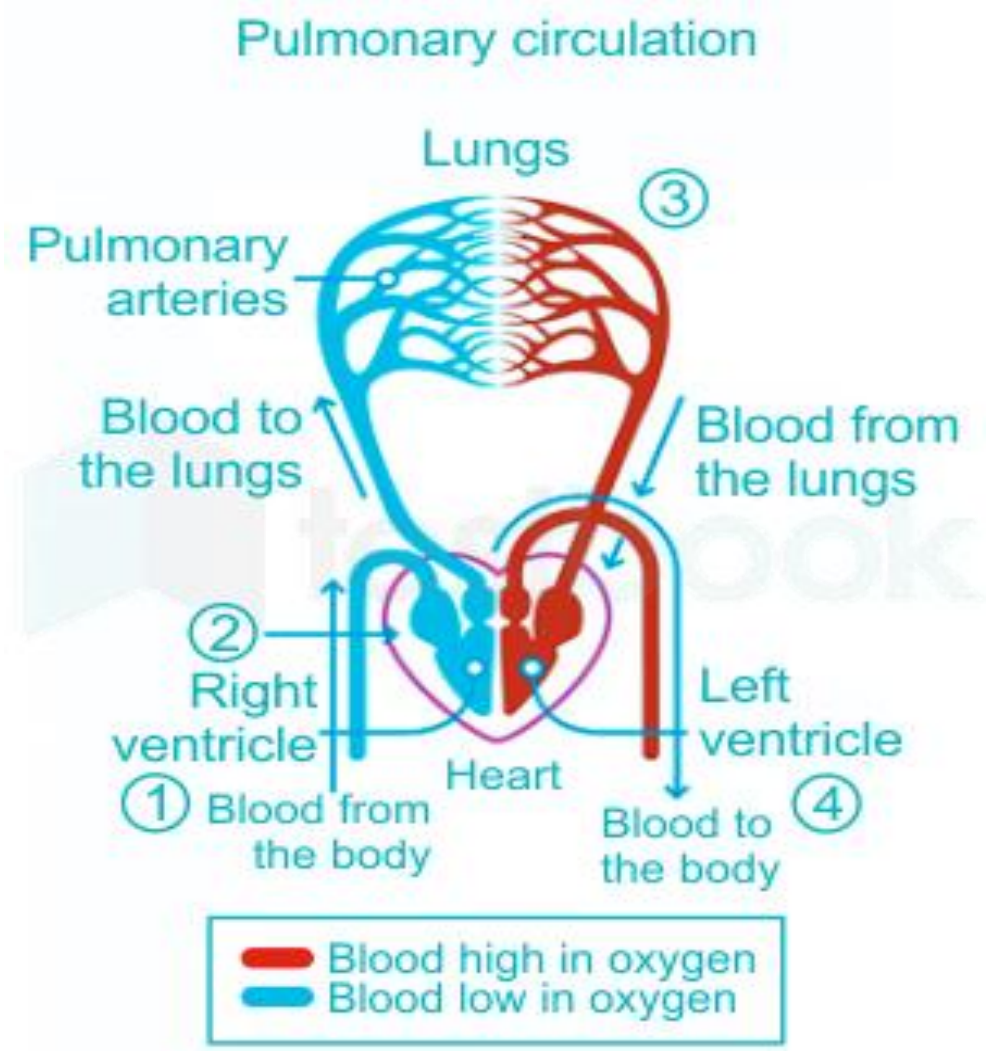
Posterior circulation

Pulmonary Circulation

- Carries **deoxygenated blood** from heart → lungs → oxygenation → back to heart.
- **Low pressure system** (mean 15 mmHg).

Features:

- **Opposite response** to hypoxia → causes vasoconstriction (to divert flow).
- Ensures efficient **gas exchange**.
- **Clinical link:** pulmonary hypertension if chronic hypoxia occurs.

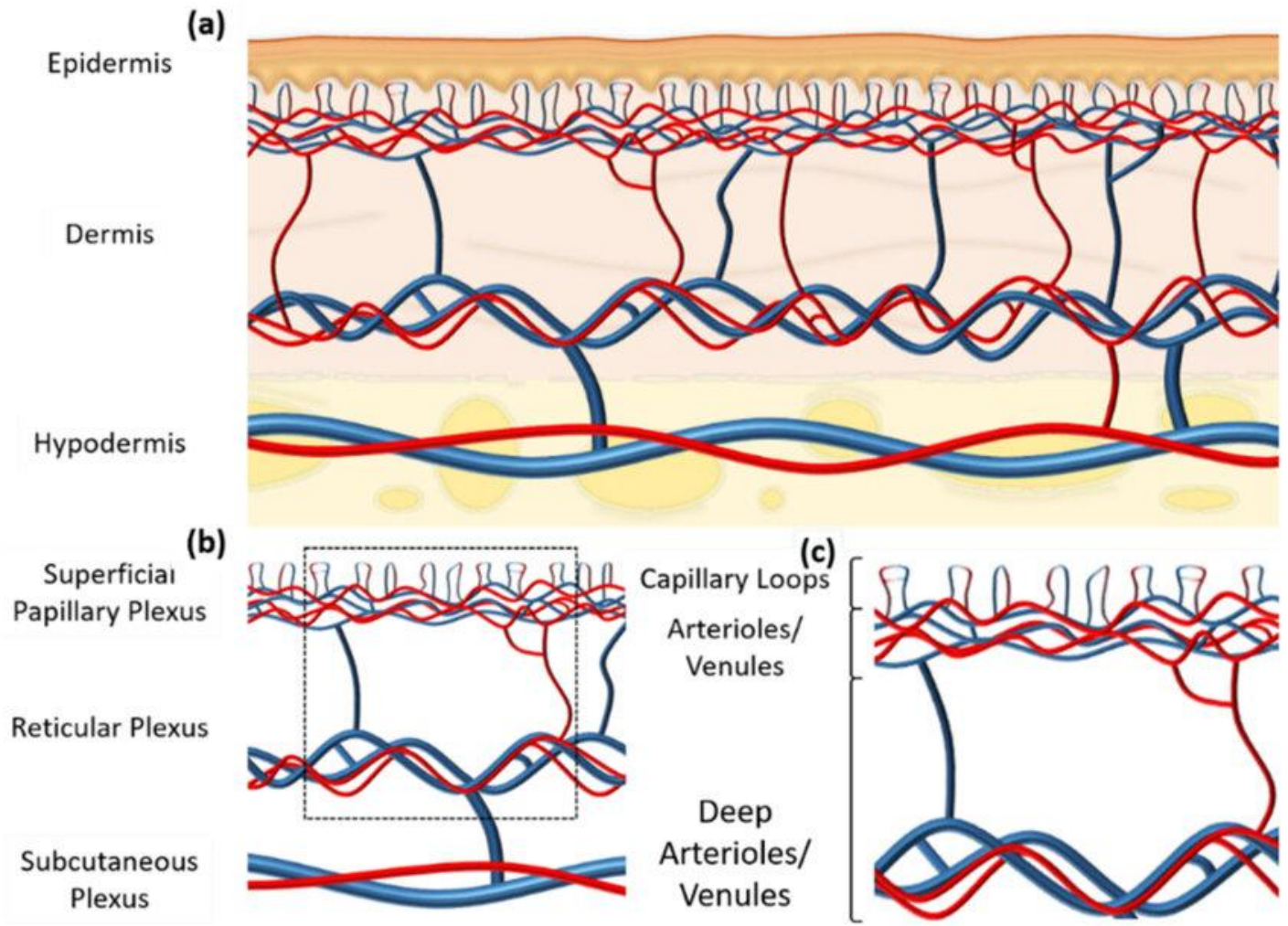


Cutaneous Circulation

- Supplies **skin**, primarily for **temperature regulation**.
- Controlled mainly by **sympathetic nerves**.

Features:

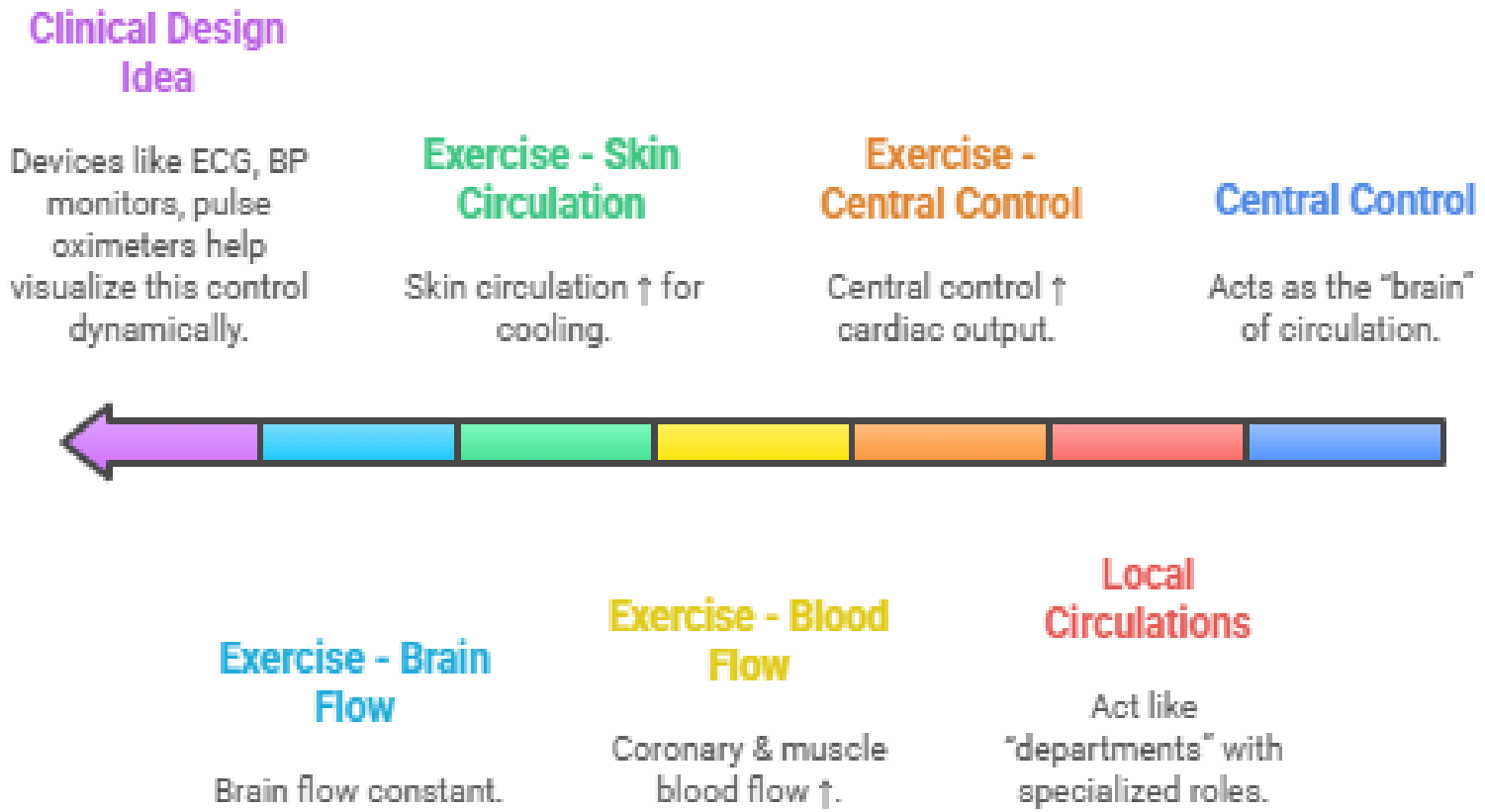
- Hot → vasodilation → heat loss.
- Cold → vasoconstriction → conserve heat.
- **Clinical link:** poor control → fainting in heat, cold injury.



IDEATE — Integrating Concepts

- The **central control** acts as the "brain" of circulation.
- **Local circulations** act like "departments" with specialized roles.

Clinical design idea: devices like **ECG, BP monitors, pulse oximeters** help visualize this control dynamically.



PROTOTYPE — Clinical Application

Monitoring tools used by cardiac technologists:

- ECG → detects ischemia due to coronary flow reduction.
- Doppler → evaluates cerebral or carotid blood flow.
- Echocardiography → measures cardiac output, pulmonary pressures.
- Plethysmography → checks cutaneous or peripheral flow.

Patient management:

- Oxygen therapy for low O_2 (pulmonary).
- BP regulation via drugs (central control).
- Cooling/warming therapy (cutaneous).

TEST — Evaluate and Reflect

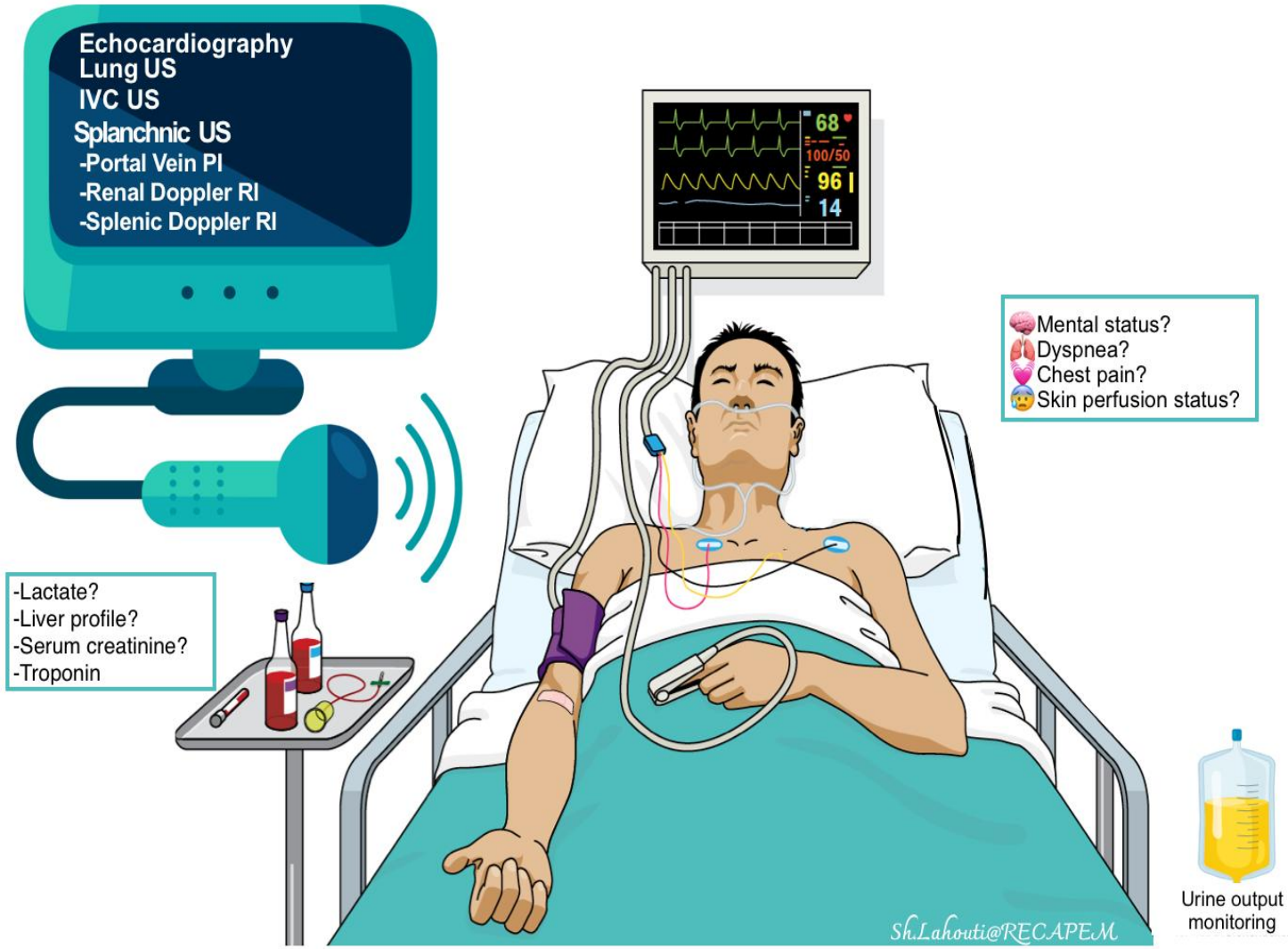
Assess outcomes:

- Is blood pressure stable?
- Is oxygenation adequate?
- Is heart perfusion restored?

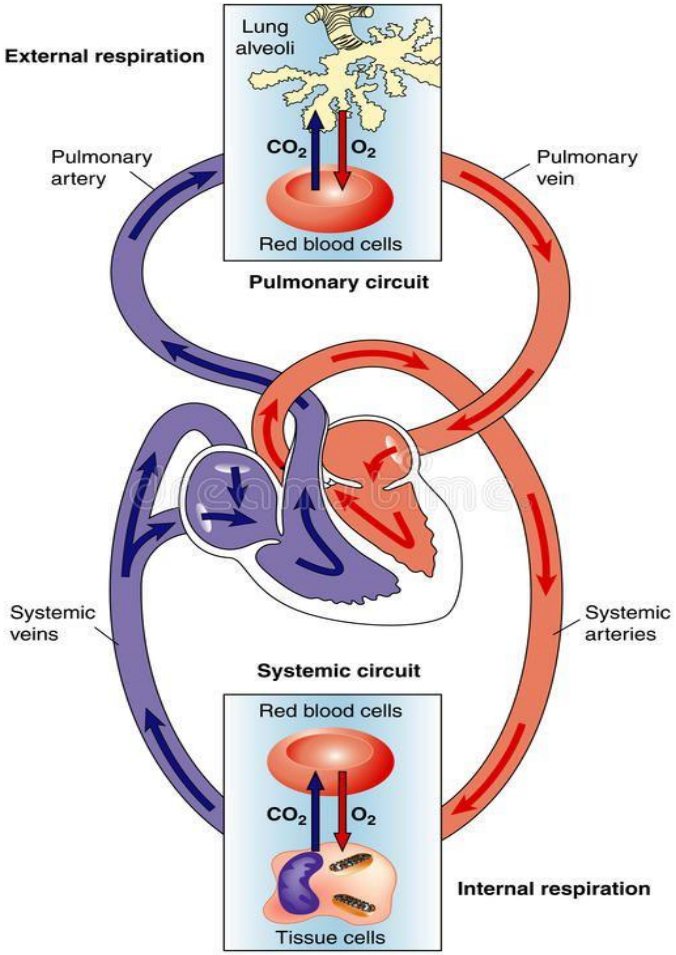
Feedback loop: learn from patient response → mo

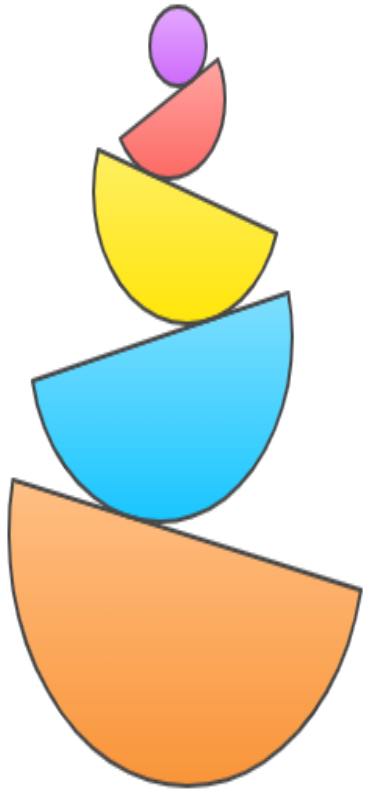
dify therapy → reapply control principles.

*(Demonstrates how understanding **neural and local control of circulation** is essential in **cardiac technology practice**)*



Summary





Central Control

Affects BP, HR regulation

Coronary Circulation

Myocardial ischemia results

Cerebral Circulation

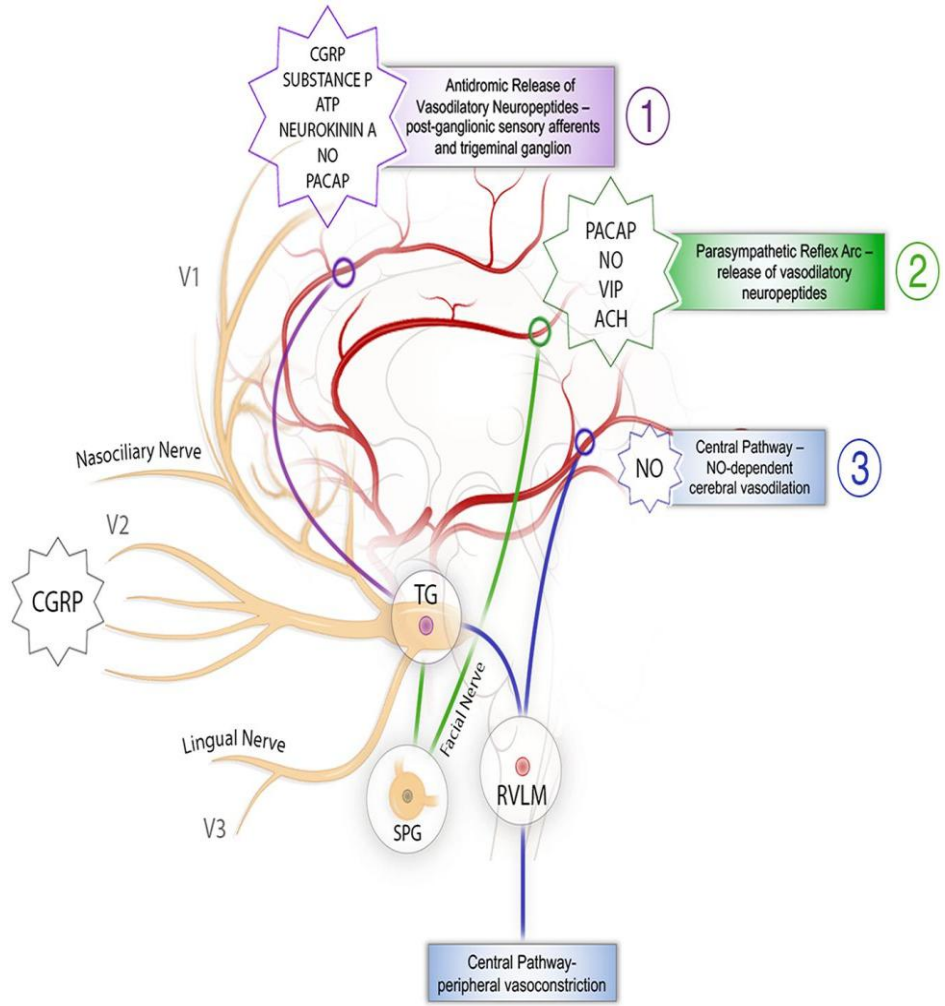
Stroke, dizziness result

Pulmonary Circulation

Pulmonary HTN results

Cutaneous Circulation

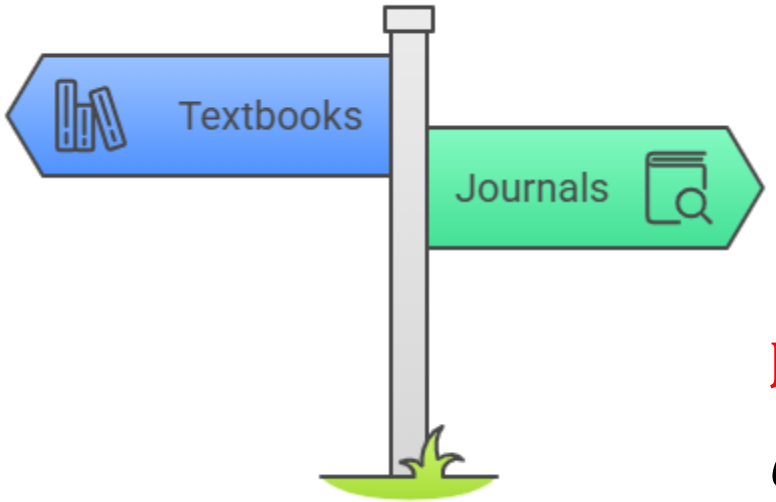
Heat/cold dysregulation



Reference Books & Journals

Textbooks:

- *Cardiovascular Physiology* — Pappano & Wier, Mosby Physiology Series
- *Cardiovascular Physiology Concepts* — Richard E. Klabunde
- *Guyton & Hall Textbook of Medical Physiology*, 15th Ed. — Elsevier
- *Human Physiology* — Lauralee Sherwood



Journals:

Circulation (AHA Journal)

Journal of Applied Physiology

Nature Reviews Cardiology

Progress in Cardiovascular Diseases