

Autonomic Nervous System

ANS

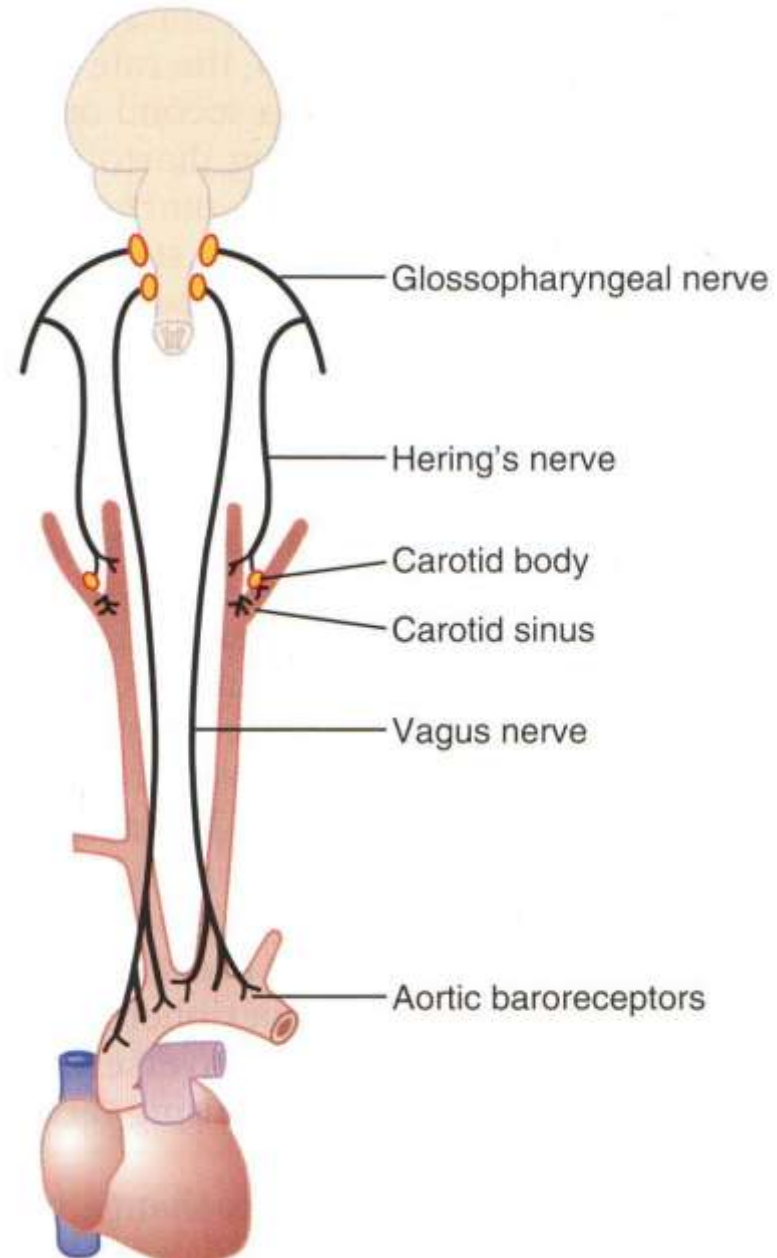
3

Autonomic Reflexes:

- Cardiovascular Autonomic Reflex

Baroreceptor reflex:

Location & innervation
of baroreceptors

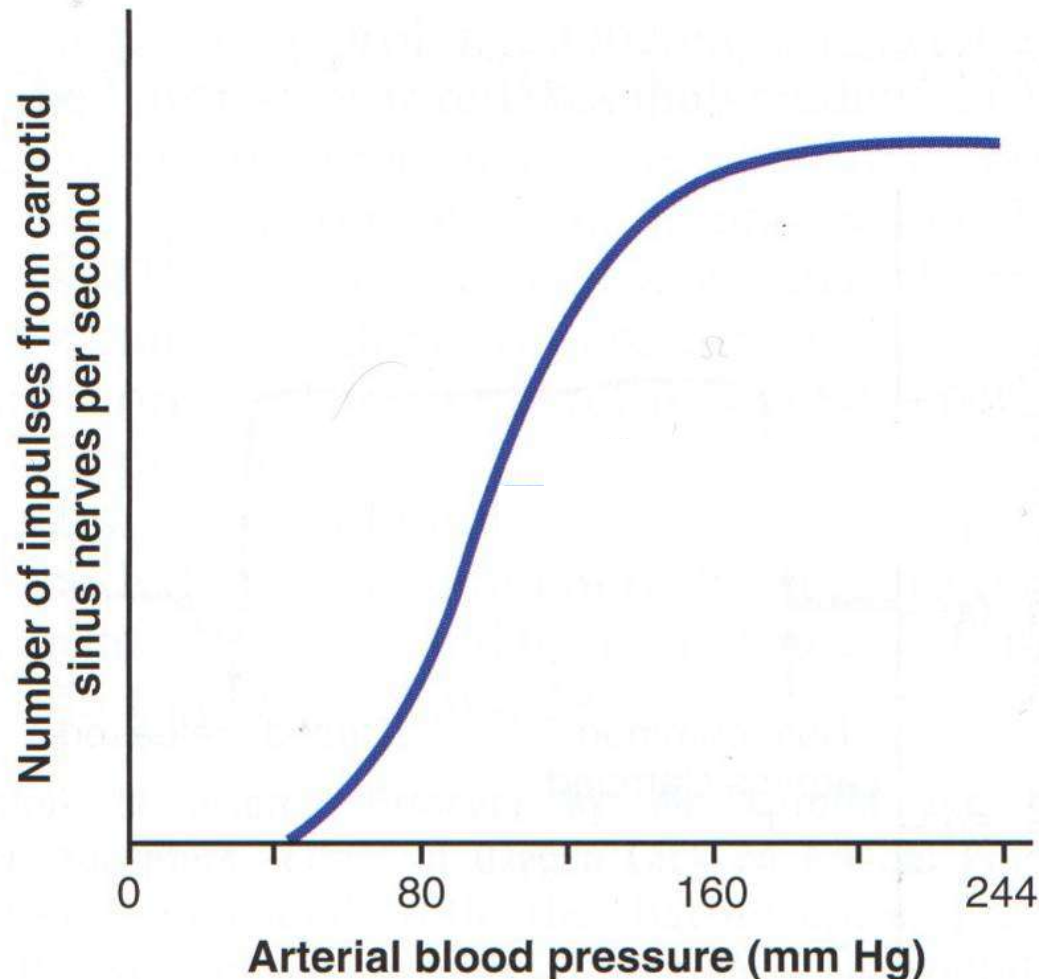


Response of baroreceptors to pressure

Carotid Sinus baroreceptors : no stimulation by pressure from 0 to 50-60 mm Hg

Maximum stimulation by pressure 180 mm Hg

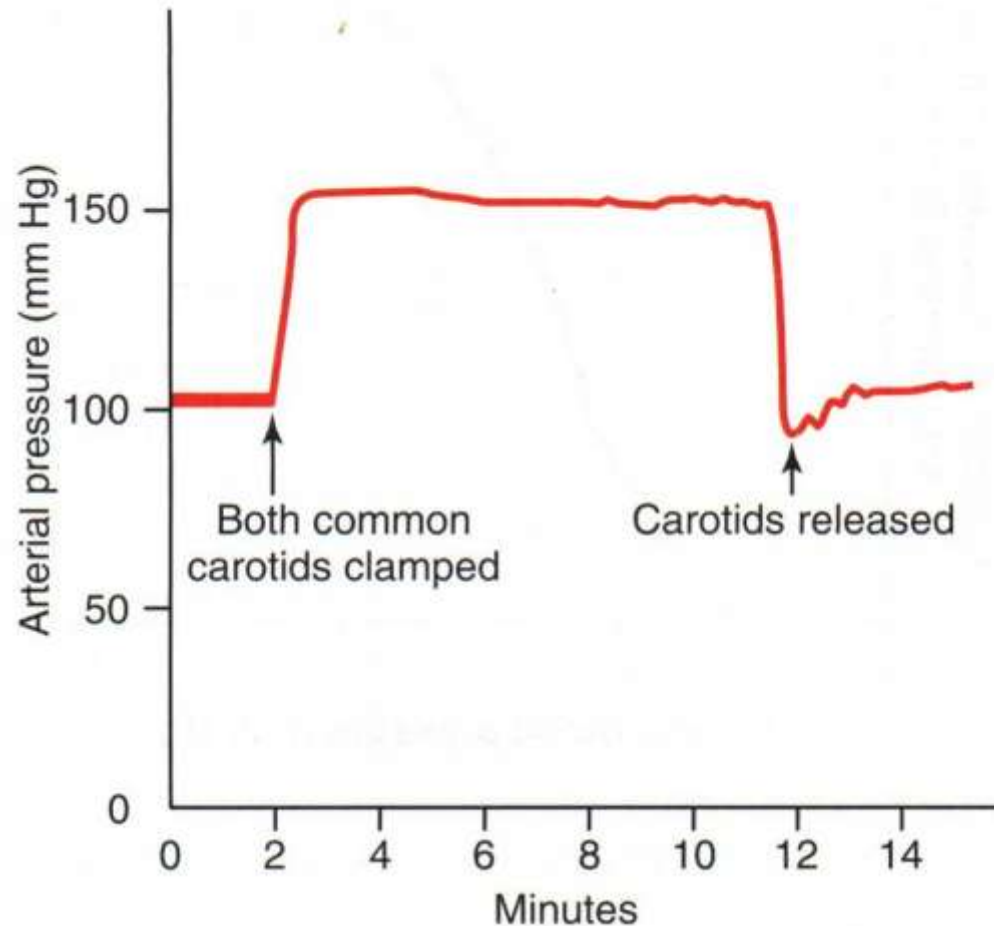
Note : **Aortic baroreceptors** stimulated from 30 mm Hg and higher



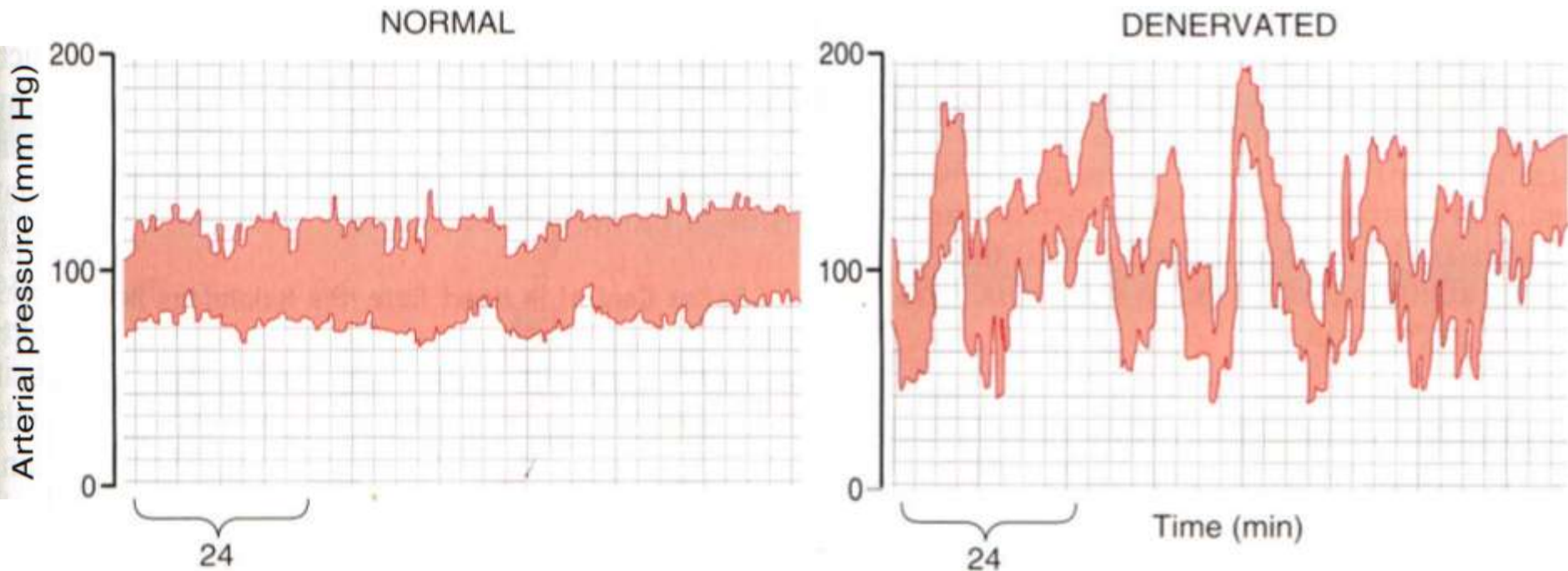
Circulatory Reflex initiated by baroreceptors

Signals to Tractus solitarius → Secondary signals → inhibit Vasoconstrictor center
→ excite Vagal parasympathetic center

1. Vasodilatation of veins & arterioles in peripheral circulatory
 2. Decrease heart rate & strength heart contraction
- } Decrease arterial pressure



Pressure “Buffer” function by baroreceptors



Two-hour records of arterial pressure in a normal dog (*above*) and in the same dog (*below*) several weeks after the baroreceptors had been denervated. (Redrawn from Cowley AW Jr, Liard JF, Guyton AC: Role of baroreceptor reflex in daily control of arterial blood pressure and other variables in dogs. *Circ Res* 32:564, 1973. By permission of the American Heart Association, Inc.)

- **Gastrointestinal Autonomic Reflexes:**

Smell of food & food presence in mouth

Fecal fill the rectum

- **Other Autonomic Reflexes:**

Emptying the urinary bladder

Sexual reflexes

Regulation of pancreatic secretion, gallbladder emptying, kidney excretion of urine, sweating, blood glucose concentration & other visceral functions

Stimulation of Discrete organs & Mass stimulation By ANS

- **Mass Discharge by Sympathetic System:**

Alarm or Stress response

Brain response (hypothalamus)

All portions of sympathetic system discharge at the same time **causing:**

1. Increase arterial pressure
2. Increase blood flow to active muscles & decrease it in visceral organs
3. Increase cellular metabolism
4. Increase glucose in blood
5. Increase glycolysis in liver
6. Increase muscle strength
7. Increase mental activity
8. Increase blood coagulation rate

- **Discrete Discharge by Sympathetic System:**

No brain response

1. **Heat regulation** : only affect Sweating & blood flow in skin
2. **Local reflexes** : heating part of skin —→ local vasodilatation & sweating
3. **Gastrointestinal sympathetic reflexes** : signals from Gut —→ paravertebral ganglia
—→ gut

- **Discrete Discharge by parasympathetic System:**

Highly specific

Parasympathetic cardiovascular reflexes, secretion in mouth glands,
secretion in stomach glands, rectal emptying reflexes .

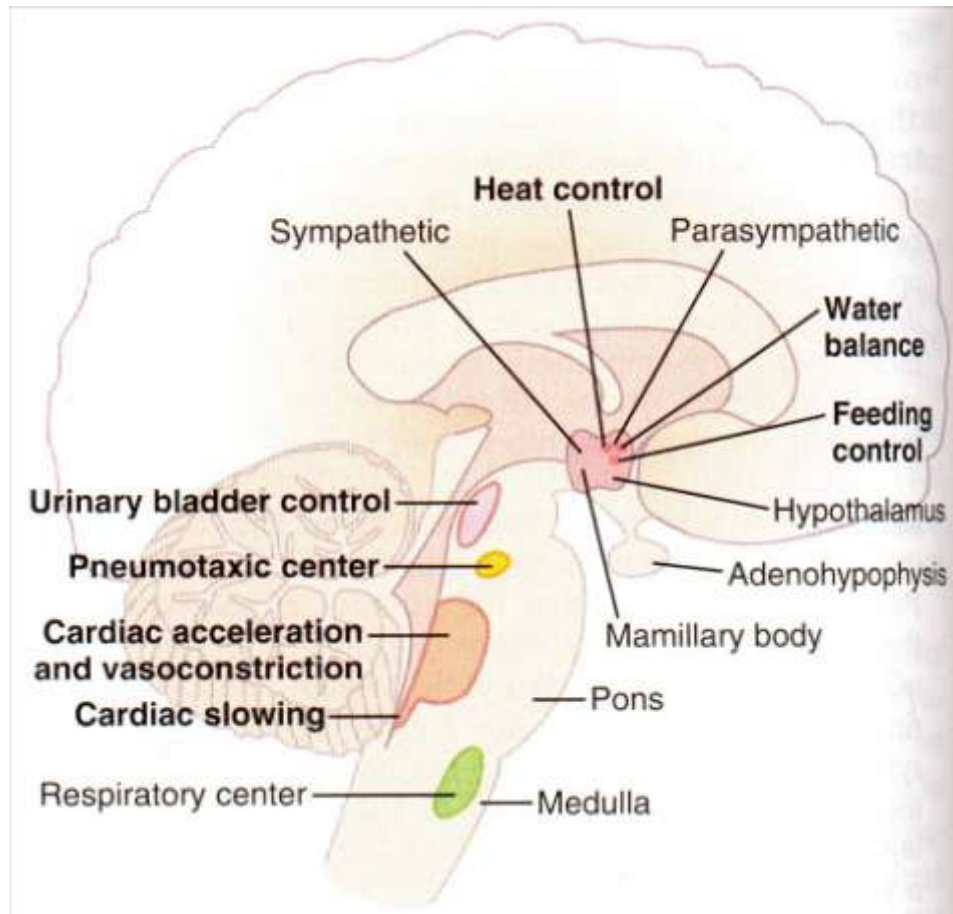
Association between allied parasympathetic functions.

Role of brain stem (medullary, pontine & mesencephalic)

Reticular substance in brain stem , Tractus solitarius in medulla, pons, mesencephalon & special nuclei Control:

Arterial pressure, heart rate, glandular secretion and movement in gastrointestinal tract & contraction of urinary bladder.

special nuclei



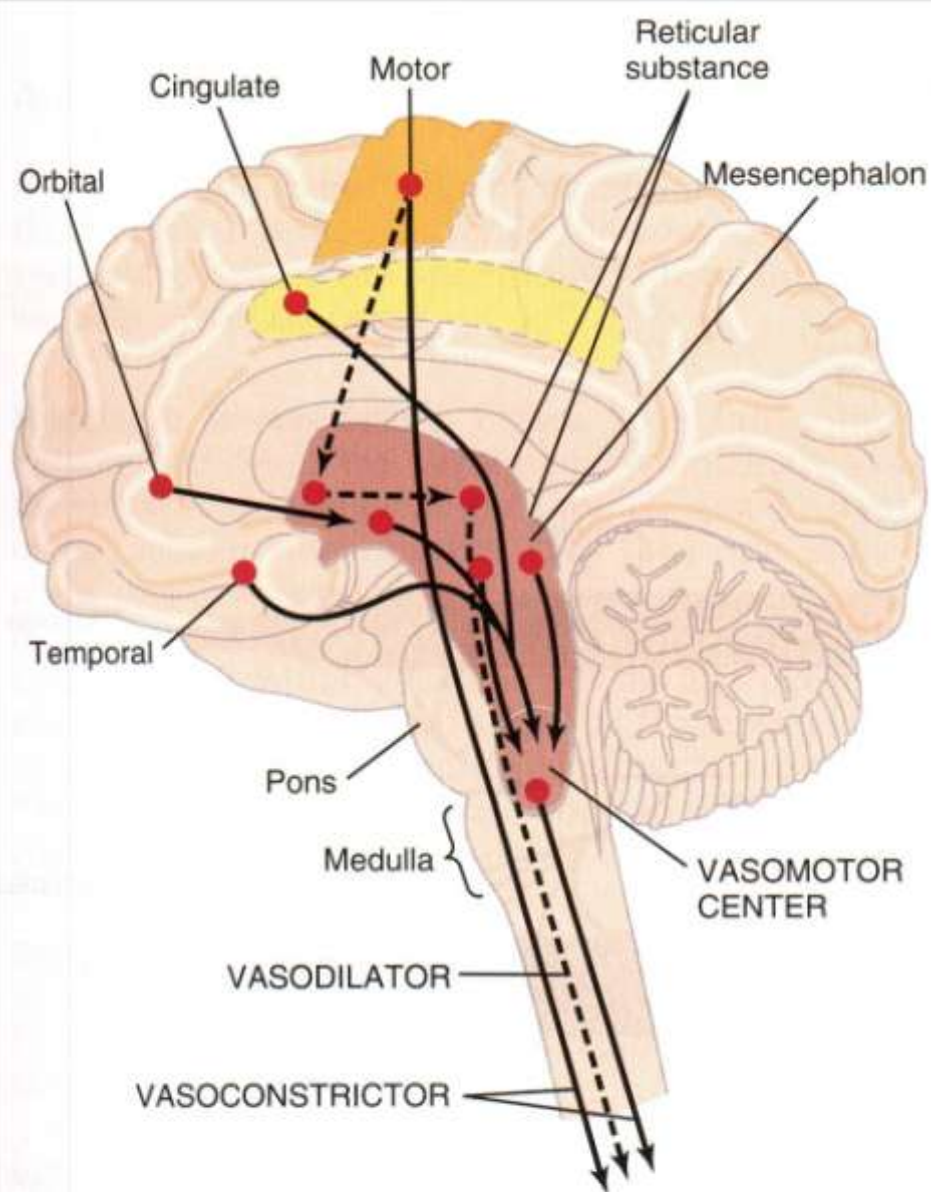
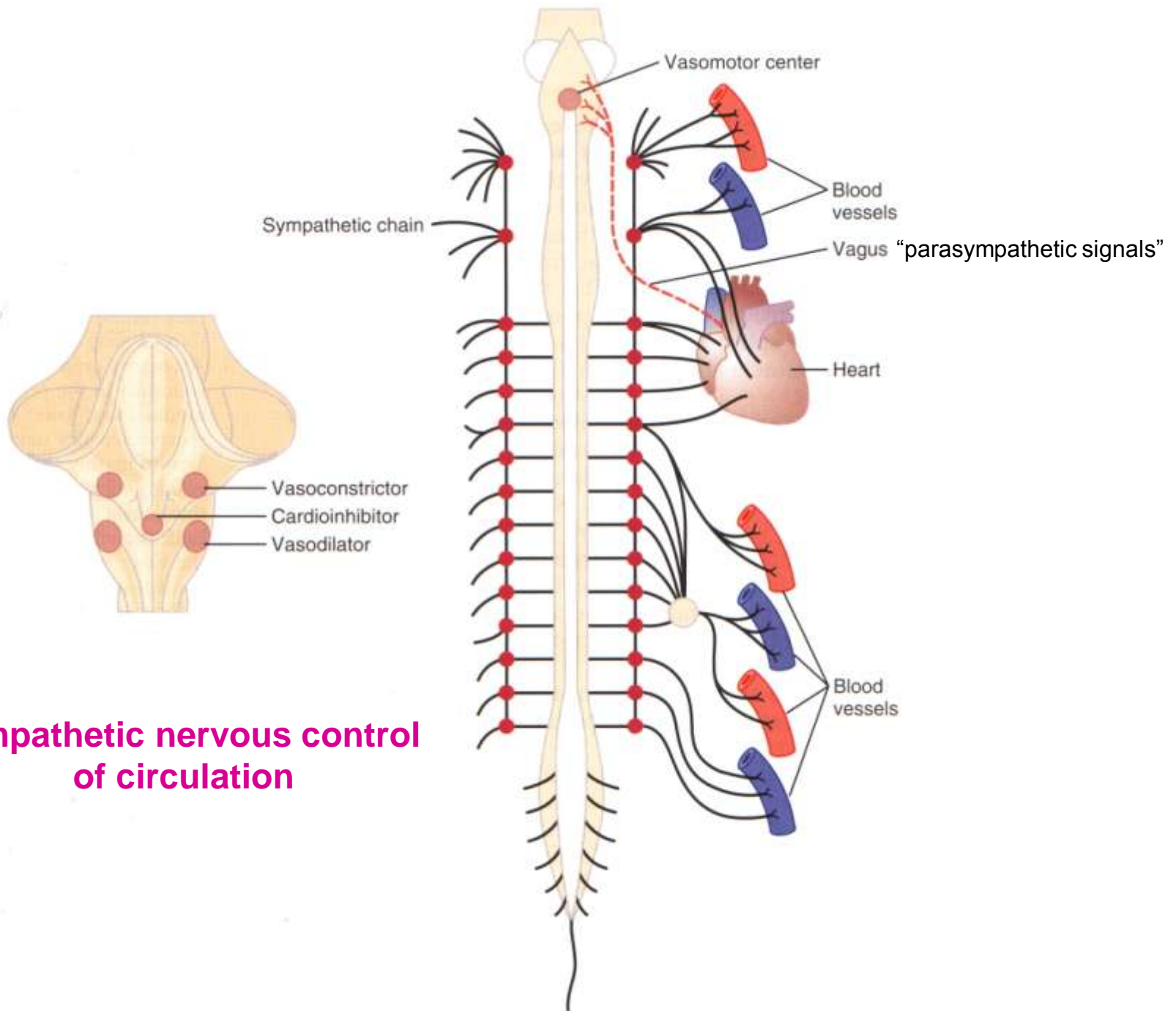


Figure 18-3

Areas of the brain that play important roles in the nervous regulation of the circulation. The dashed lines represent inhibitory pathways.



Sympathetic nervous control of circulation

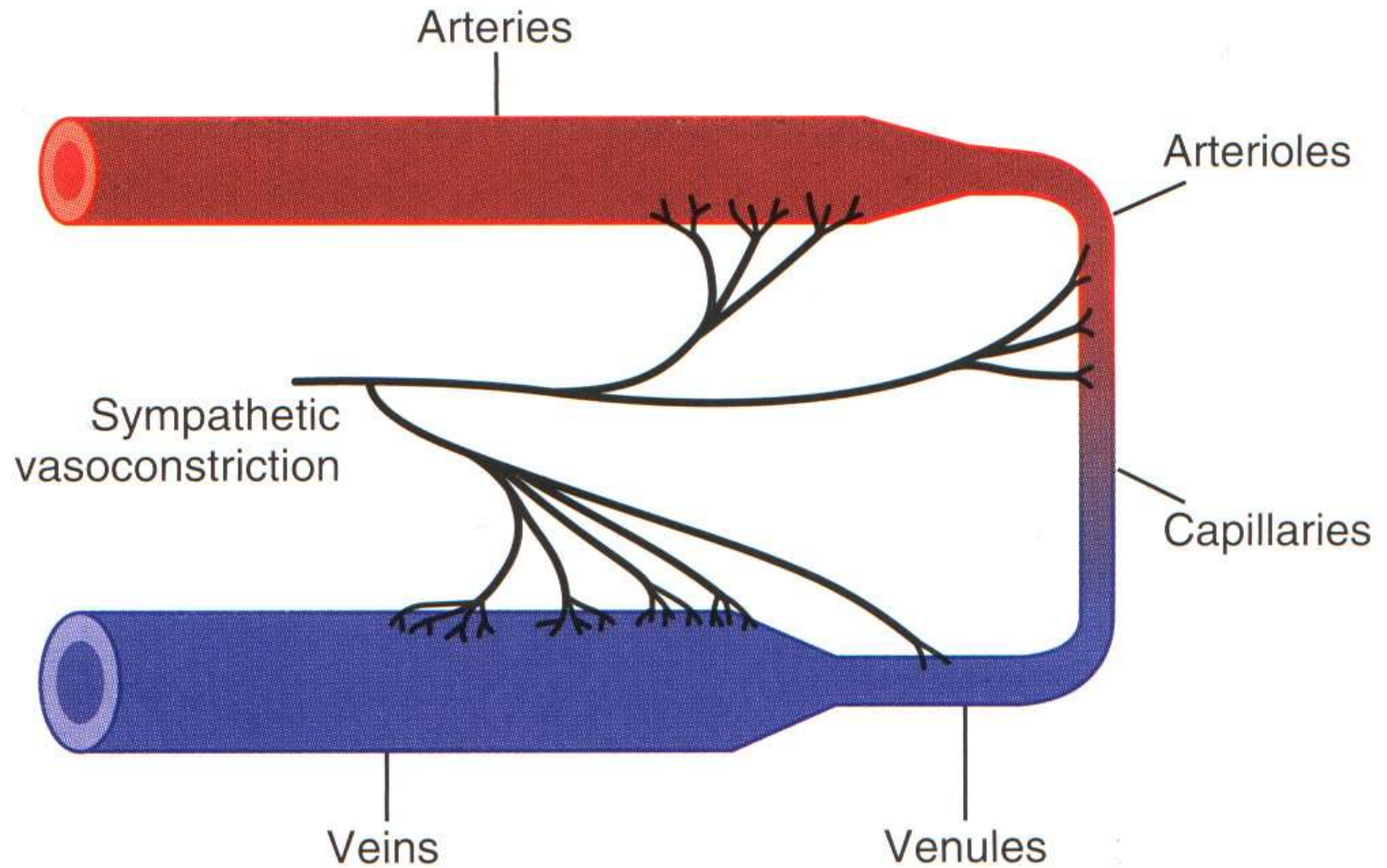


Figure 18-2

Sympathetic innervation of the systemic circulation.

Control of brain stem Autonomic centers by higher areas :

Signals from hypothalamus & cerebrum → brain stem autonomic centers.

E.g. Stimulation of **posterior hypothalamus** → activate **medullary cardiovascular center**
→ increase arterial pressure twice

Autonomic centers in brain stem are **relay stations**

Many behavioral responses mediated by:

1. **Hypothalamus**
2. **Reticular areas in brain stem**
3. **Autonomic nervous system**

Higher areas in brain can alter autonomic function → severe diseases:

Ulcer , constipation, heart palpitation & heart attack

Pharmacology of ANS

- **Sympathomimetic “Adrenergic” Drugs**

Epinephrine & methoxamine.

Affect Specific receptors: phenylephrine “Alpha”, Isoproterenol “Beta”, albuterol “Beta2”

- Release of Norepinephrine : ephedrine, tyramine, amphetamine

- **Drugs that block adrenergic activity**

1- block the Synthesis & storage of norepinephrine : reserpine

2- block release of norepinephrine: Guanethidine.

3- block alpha receptors : phenoxybenzamine

4- block beta receptors : propranolol “both”, metoprolol “beta1”

5- block transmission through autonomic ganglia : hexamethonium

- **Parasympathomimetic “Cholinergic” Drugs**

Pilocarpine & methacholine “Muscarinic”

Anti-cholinesterase drugs : neostigmine, pyridostigmine & ambenonium

- **Drugs that block cholinergic activity**

Block muscarinic receptors : Atropine, homatropine & scopolamine

- **Drugs Stimulate Autonomic postganglionic neurons**
“ Nicotinic Drugs” :

Nicotine (nicotinic Receptors),

Metacholine (muscarinic & nicotinic Receptors)

Pilocarpine (muscarinic Receptors).

- **Ganglionic Blocking Drugs**

block transmission through autonomic ganglia :

hexamethonium ion, tetraethyl ammonium ion & pentolinium

Used to reduce arterial pressure.

Affect both sympathetic and parasympathetic ganglia, but used to block **sympathetic** activity because blocking sympathetics overshadows blocking parasympathetics