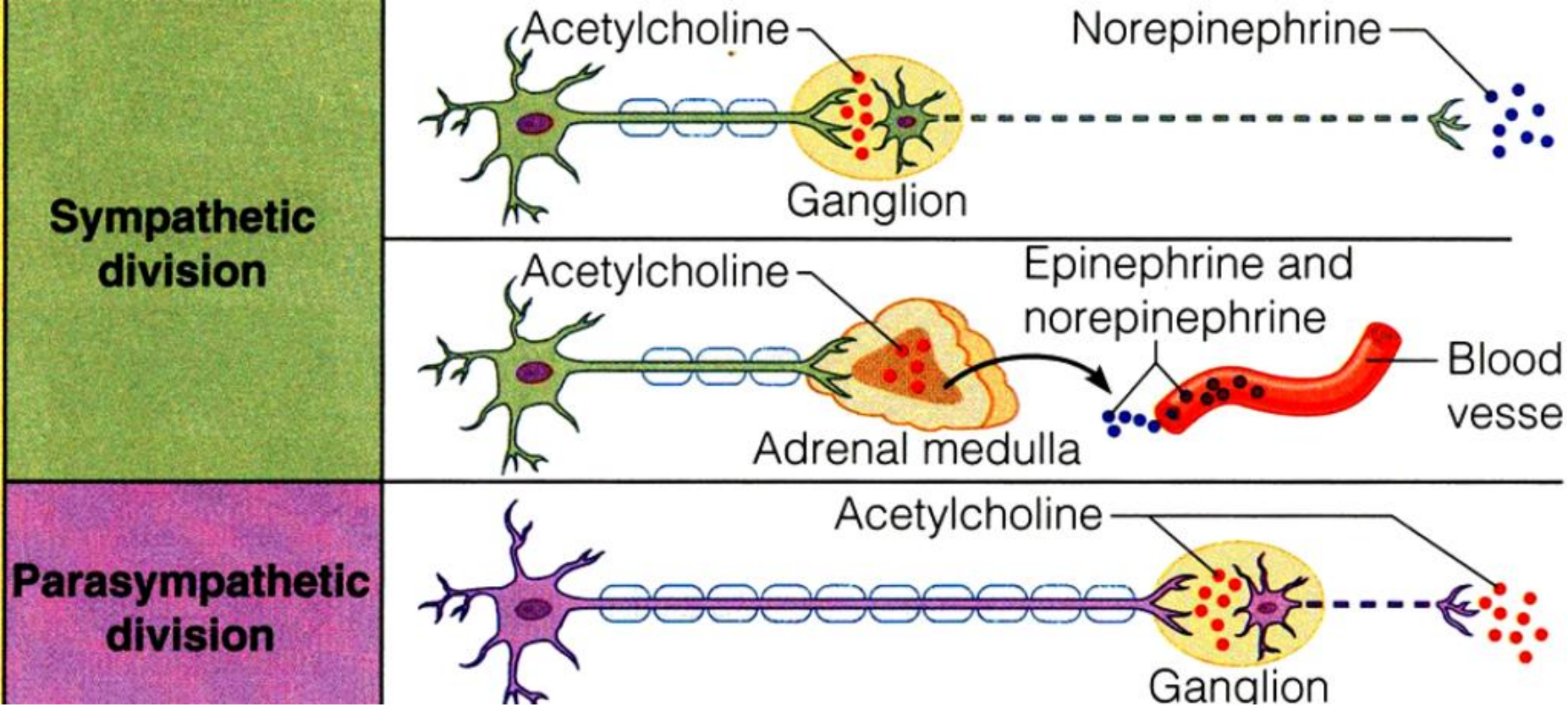


Aacetylcholine (Ach) is secreted by →❑

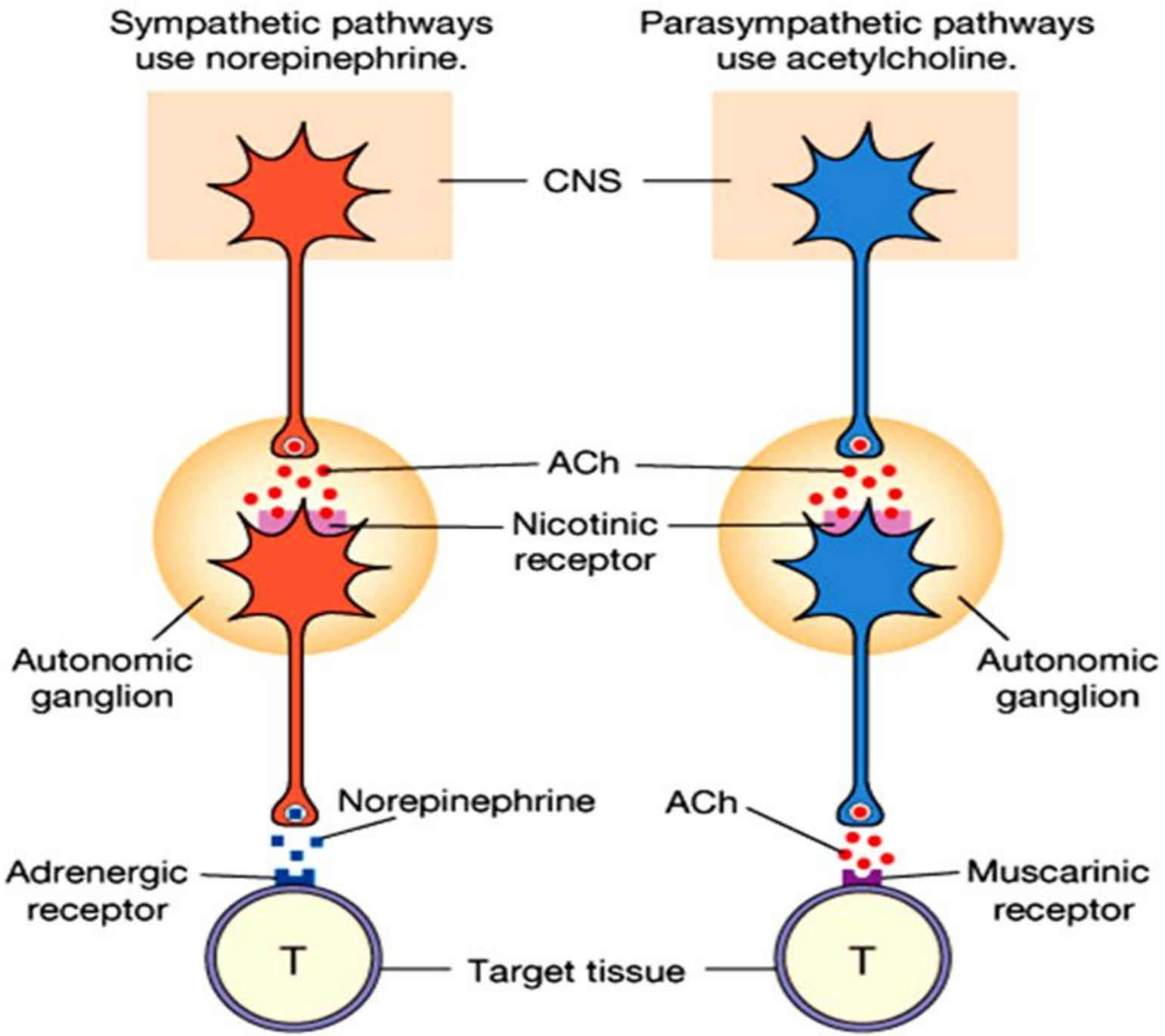
(1) all preganglionic nerves,

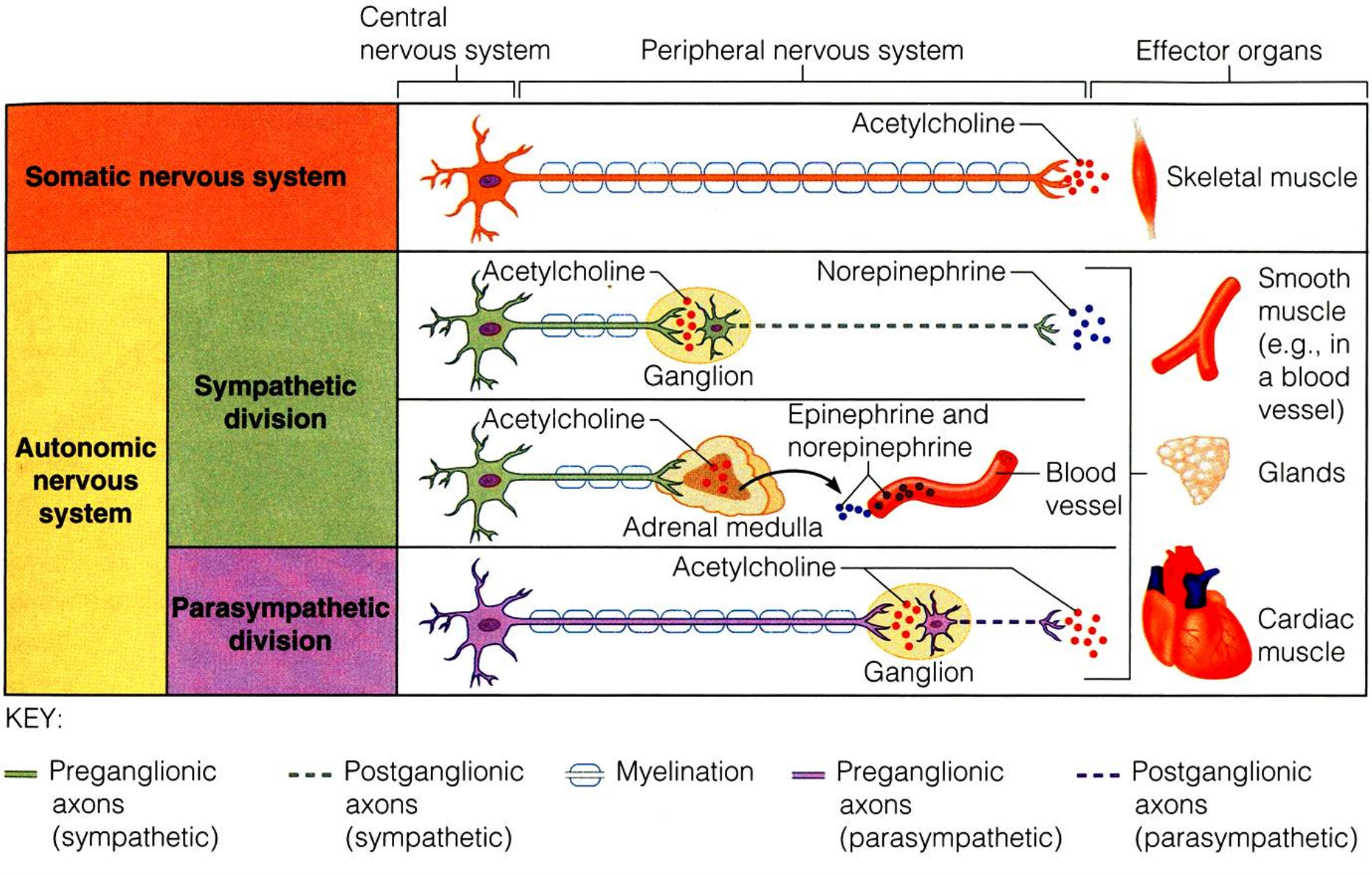
(2) all postganglionic parasympathetic nerves , &

(3) postganglionic sympathetic nerves that innervate sweat glands & blood vessels in skeletal muscle .

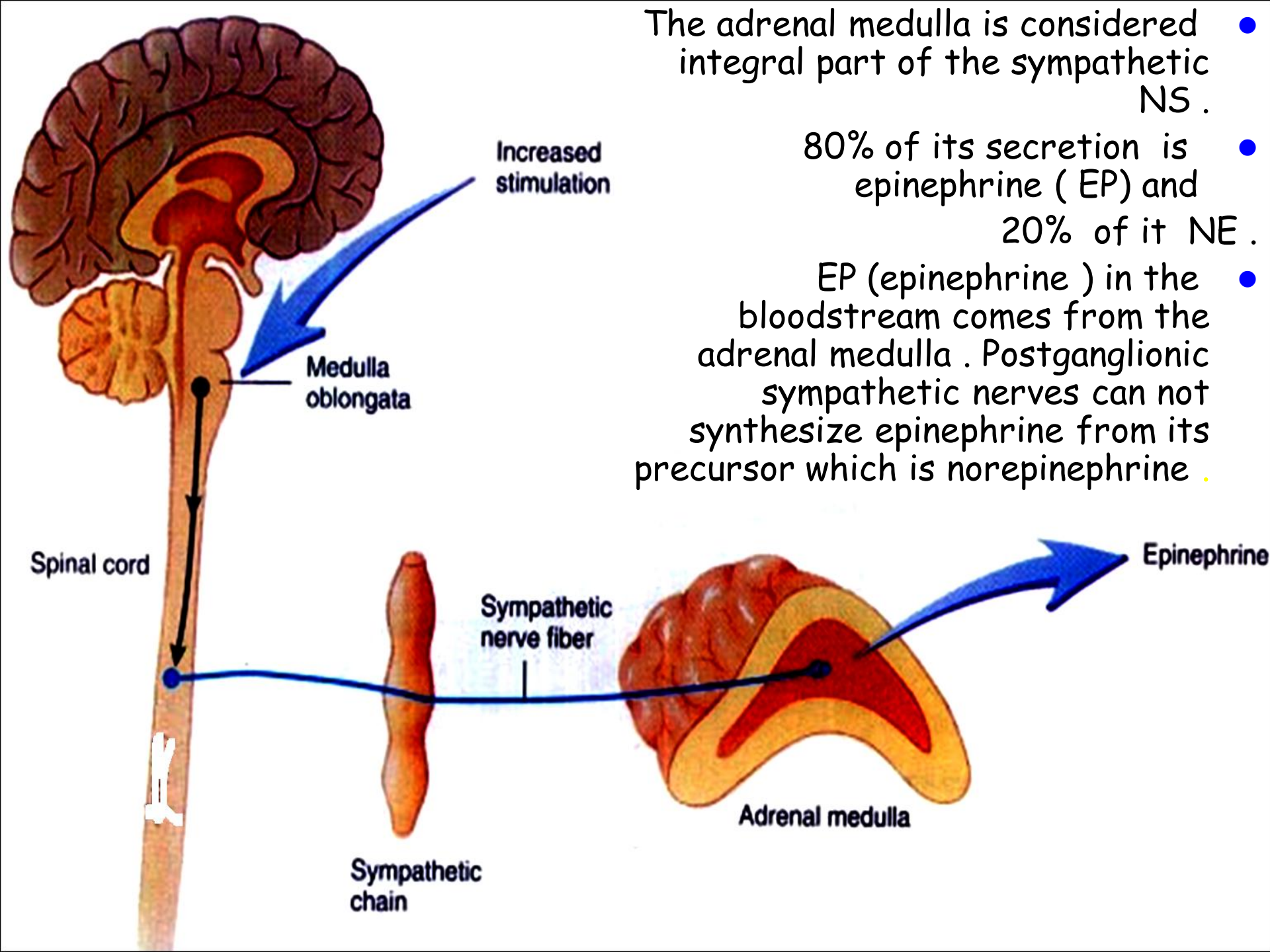
The rest of postganglionic sympathetic nerves secrete norepinephrine (NE) . ✓

Adrenal medulla secretes epinephrine (EP)) (80%) and norepinephrine (NE) (20%) .✓


Sympathetic pathways use norepinephrine.
Parasympathetic pathways use acetylcholine.
CNS
ACh
Nicotinic receptor
Autonomic ganglion
Autonomic ganglion
Norepinephrine
ACh
Adrenergic receptor
Muscarinic receptor
T
Target tissue
T


Central nervous system
Peripheral nervous system
Effector organs
Somatic nervous system
Acetylcholine
Skeletal muscle
Autonomic nervous system
Sympathetic division
Acetylcholine
Norepinephrine
Ganglion
Smooth muscle (e.g., in a blood vessel)
Acetylcholine
Epinephrine and norepinephrine
Blood vessel
Adrenal medulla
Glands
Parasympathetic division
Acetylcholine
Ganglion
Cardiac muscle
KEY:
Preganglionic axons (sympathetic)
Postganglionic axons (sympathetic)
Myelination
Preganglionic axons (parasympathetic)
Postganglionic axons (parasympathetic)

- The adrenal medulla is considered integral part of the sympathetic NS .
- 80% of its secretion is epinephrine (EP) and 20% of it NE .
- EP (epinephrine) in the bloodstream comes from the adrenal medulla . Postganglionic sympathetic nerves can not synthesize epinephrine from its precursor which is norepinephrine .



Effect of sympathetic & parasympathetic stimulation

Organ	sympathetic	parasympathetic
Pupil	Dilatation of pupil	Constriction of pupil
Heart	Increased heart rate Increased force of contraction	Decreased heart rate No effect
Systemic blood vessels	constriction	Little or no effect
Blood Pressure	Raised	Little or no effec
Lung (Bronchioles)	Dilation	Constriction

Organ	sympathetic	parasympathetic
<u>Glands :</u> Nasal, Lacrimal, Salivary , Gastric , Intestinal, Pancreatic ---------- ---------- Sweat Glands	Slight (small volume) secretion --------- Increased secretion	Copious (large volume) secretion --------- No effect
Digestive system muscles	Promotes retention (relaxation of wall muscles & contraction of sphincters)	Promotes emptying (contraction of wall muscles & relaxation of sphincters)
Urinary bladder	Promote retention (relaxation of wall & constriction of sphincter)	Promotes emptying (contraction of wall& relaxation of sphincter)
Blood sugar	raised	No effect

Gastrointestinal Tract (GIT) secretions	Decreased	Increased
GIT motility (contraction of muscles in walls , Peristalsis)	Decreased	Increased
Sphincters	Constricn Therefore , sympathetic system to GIT promotes retention	Relaxation Therefore , parasympathetic system to GIT promotes digestion & excretion

Blood vessels to skeletal muscles	Dilatation (cholinergic)	None
Genital System	Ejaculation	Erection
Adrenal medulla	Secretion of epinephrine & norepinephrine	No effect
Metabolism	Increased	No effect
Blood: Coagulation	Increased	No effect

Autonomic Neurotransmitter

- All preanglionic fibres (sympathetic and parasympathetic) secrete acetylcholine at the ganglia .
- All postganglionic parasympathetic fibers secrete acetylcholine at target organs .
- Most postganglionic sympathetic fibers secrete norepinephrine
- However → Postganglionic sympathetic fibers to sweat gland & blood vessels of skeletal muscles release acetylcholine
- All epinephrine in the bloodstream comes from the adrenal medulla . Postganglionic sympathetic nerves can not synthesize epinephrine from its precursor which is norepinephrine .

Adrenergic Receptors are either Alpha or Beta

- Alpha (α) adrenergic receptors are found in :
  - Iris –
  - Blood vessels –
  - GIT –
- Beta (β) adrenergic receptors can be beta one (β1) or beta 2 (β1) → found in :
  - Heart (β1) –
  - Bronchioles (β1) –
  - Skeletal muscle (β2) –
  - GIT (β2) –
- Norepinephrine mainly excite α (and β to a lesser extent)
- Epinephrine excites both α & β equally

Effects of Adrenergic Receptor Stimulation

Alpha (α) receptors	Beta (β) receptors
(1) Vasoconstriction (→ raised BP) (2) Pupillary dilatation (Mydriasis)	(1) Increased HR (β_1) (2) Increased myocardial contractility (β_1) 1 and 2 above lead to increased cardiac output andconsequently lead to increased BP (3)Vasodilatation (β_2) (4) Bronchiolar relaxation (β_2) (5) Intestinal wall relaxation (β_2) (6) Bladder wall relaxation (β_2)

Alpha (α) receptors	Beta (β) receptors
-Vasoconstriction -Iris dilatation -Intestinal sphincter contraction -Bladder sphincter contraction	-Vasodilatation (β_2) -Increased myocardial strength of contraction (β_1) -Intestinal relaxation(β_2) -Bladder wall relaxation (β_2)

Adrenergic receptors blockers

- α blockers:
  - Prazosin (α 1)
  - Yohimbine (α 2)
- β blockers:
  - Propranolol (β1 & β2)
  - Atenolol (β 1)

Cholinergic Receptors

- Are divided into
- (1) Nicotinic → found in all ganglia (i.e., the synapses between pre- & postganglionic of both sympathetic & parasympathetic divisions of the ANS
- (2) Muscarinic → found on all effector cells innervated (& stimulated) by →
- (1) postganglionic parasympathetic fibers , &
- (2) postganglionic cholinergic sympathetic nerves

- Drugs blocing cholinergic receptors:
  Hexamethonium (block both types)
  Atropine (block muscarinic receptors)

END •