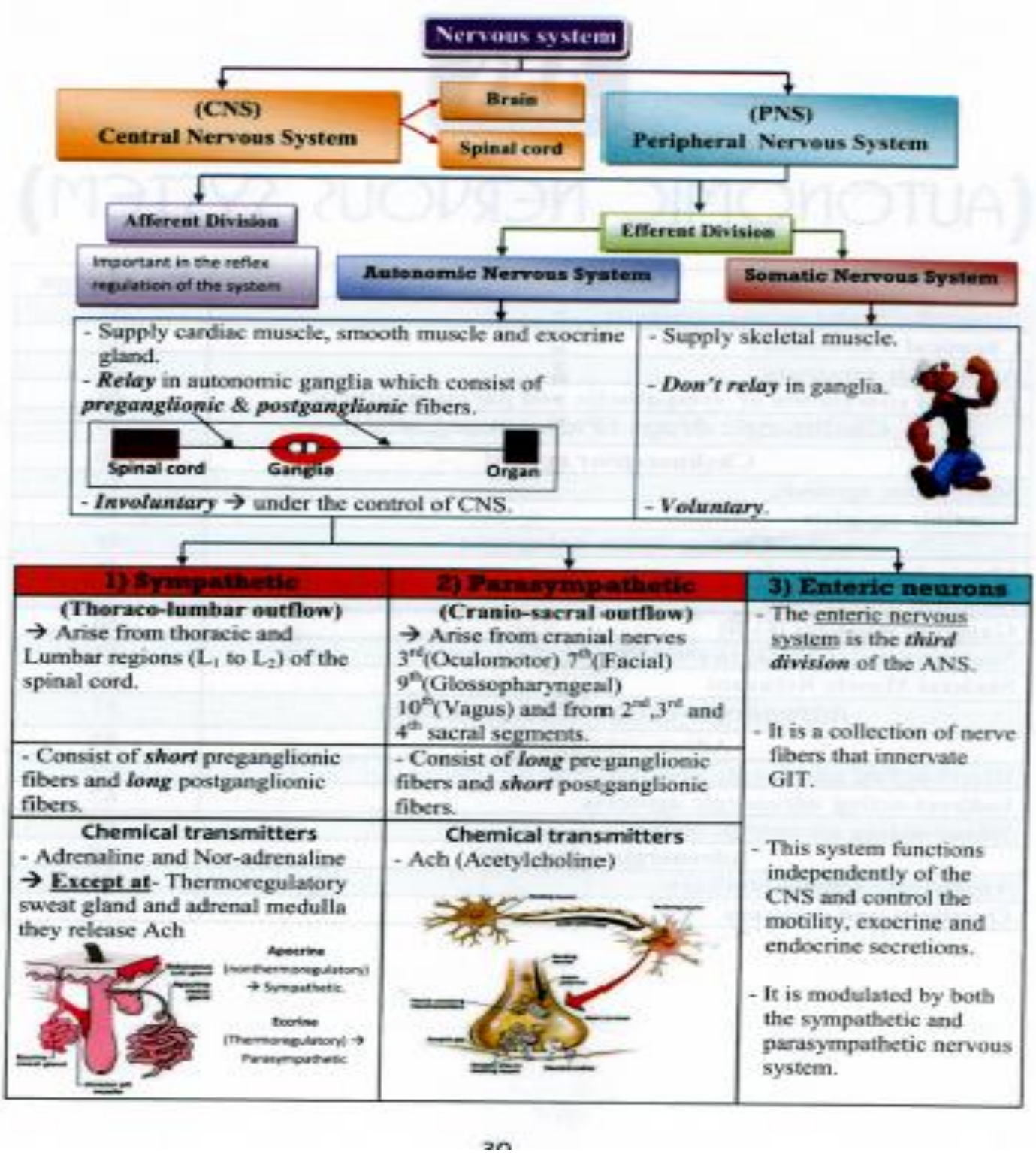
University of Mosul
Lecture No.: 1
College of Veterinary Medicine
Date:
Unit of Scientific Affairs
Website:

Lecture title: Drugs acting on the autonomic nervous system

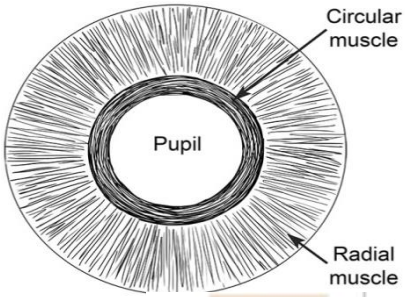
Lecturer Affiliation: College of Veterinary Medicine

Summary:

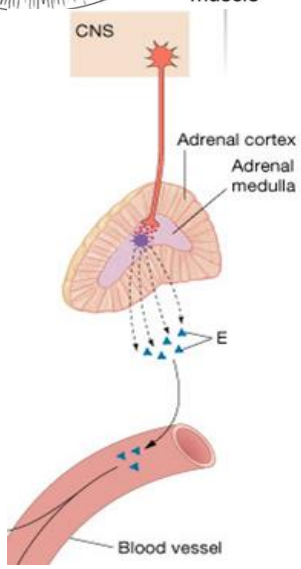

Nervous system
(CNS)
Central Nervous System
Brain
Spinal cord
(PNS)
Peripheral Nervous System
Afferent Division
Important in the reflex regulation of the system
Efferent Division
Autonomic Nervous System
Somatic Nervous System
- Supply cardiac muscle, smooth muscle and exocrine gland.
- Relay in autonomic ganglia which consist of preganglionic & postganglionic fibers.
Spinal cord
Ganglia
Organ
- Involuntary → under the control of CNS.
- Supply skeletal muscle.
- Don't relay in ganglia.
- Voluntary.
1) Sympathetic
(Thoraco-lumbar outflow)
→ Arise from thoracic and Lumbar regions (L1 to L2) of the spinal cord.
- Consist of short preganglionic fibers and long postganglionic fibers.
Chemical transmitters
- Adrenaline and Nor-adrenaline
→ Except at- Thermoregulatory sweat gland and adrenal medulla they release Ach
Apocrine
(non thermoregulatory) → Sympathetic
Eccrine
(Thermoregulatory) → Parasympathetic
2) Parasympathetic
(Cranio-sacral outflow)
→ Arise from cranial nerves 3rd(Oculomotor) 7th(Facial) 9th(Glossopharyngeal) 10th(Vagus) and from 2nd,3rd and 4th sacral segments.
- Consist of long preganglionic fibers and short postganglionic fibers.
Chemical transmitters
- Ach (Acetylcholine)
3) Enteric neurons
- The enteric nervous system is the third division of the ANS.
- It is a collection of nerve fibers that innervate GIT.
- This system functions independently of the CNS and control the motility, exocrine and endocrine secretions.
- It is modulated by both the sympathetic and parasympathetic nervous system.

Notes :

- ❖ Most organs are innervated by both division of the ANS (dual innervation)
- ❖ Some organs are supplied by one division



- Iris sphincter M. (circular M.): supply by parasympathetic M3 receptors
- Iris dilator M. (radial M.): supply by sympathetic α 1receptors
- Pilomotor M. : supply by sympathetic α 1receptors (hair erection)
- Thermoregulatory sweat gland: supply by sympathetic fiber but through M3 receptors
- Adrenal medulla: supply by sympathetic fiber through nicotinic receptors
- Blood vessels: are innervated by sympathetic indirect non – innervated by parasympathetic
  - Direct acting: innervated by sympathetic α 1 receptors → vasoconstriction
  - Indirect acting: non innervated parasympathetic M3 receptors → vasodilation via the nitric oxide.



Enteric nervous system

-The ENS is considered the third division of the ANS.

-It is a collection of neurons inside the wall of the GIT that control the motility, exocrine and endocrine secretions of the GI tract .

-This system function is independently of the CNS and is modulated by both SNS and PNS .

Neurotransmitters of the ANS:

1- Norepinephrine and epinephrine

They are catecholamines, having catechol ring

Biosynthesis of catecholamines:

- In the nerve ending, tyrosine is hydroxylated by tyrosine hydroxylase to form (dopa), dopa is then decarboxylated to form dopamine which is hydroxylated into Norepinephrine inside storage vesicles.

- In certain areas of the brain and in the adrenal medulla , NE is methylated to form epinephrine .

Storage and release:

- NE is stored in vesicles in nerve terminals.
- NE also exist in a non-vesicular cytoplasmic pool that is released by indirectly acting sympathomimetics (tyramine, amphetamine).

Termination :

1-Re-uptake (80%):**Tissue uptake mechanism**: remove the drug from the receptor site thereby decreasing the number of receptor being occupied and decrease the response

Uptake 1 (neuronal) : is the uptake the drug from the receptor into the presynaptic neurons.

Drugs that inhibit uptake 1 are cocaine, amphetamine and tricyclic antidepressant

Uptake 2(extra neuronal): is the uptake of catecholamine into the effector cell which contains MAO and COMT , cortisone inhibit it

These 2 enzyme metabolize catecholamine into inactive product

Metanephrine and vaniline mandilic acid VMA which can be detected in the plasma and urine, these end product increased in :

1. Stress
2. Adrenaline injected
3. Pheochromocytoma.

Uptake 3 (vesicular uptake): which inhibited by reserpine

2-Metabolism :20% of adrenaline is metabolized by COMT in the nerve space and MAO inside the nerve terminals

- MAO –MONOAMONOOXIDASE
- COMT –catechol-o-methyl transferase

-MAO-A: present in the brain and peripheral tissue (liver and intestine).

-MAO-B: present in the brain and more active on dopamine .It has little effect on norepinephrine and serotonin.

2- **Acetylcholine (Ach)**

-Ach is synthesized in the nerve terminals from acetyl co-A and choline , Ach is stored in vesicles in nerve terminals.

-Botulinum toxin blocks Ach release and causes skeletal muscle paralysis .

-The main fate of Ach is rapid hydrolyses by cholinesterase (ChE) enzyme , there are two isoform :

Note: Ach have no therapeutic uses because of:

- Short duration →destroyed by ChE enzyme rapidly during second.
- Non-selective drug.

True cholinesterase	**Pseudocholinesterase**
Present in CNS, NMJ, RBC	Plasma, liver
Specific for Ach.	None specific for Ach, it can metabolize heroin, procaine and succinylcholine
Metabolize Ach in synapse	Metabolize Ach in blood stream
Essential for life	None.

3-Co-transmitters:

A number of Non-adrenergic-Non-cholinergic (NANC) transmitters may be found in association with NA or Ach in the autonomic nerve terminals. they are released with a primary transmitter to play a **regulatory function**. Examples include (ATP, purines, histamine, serotonin and nitric oxide).