Autonomic Nervous System

ANS Definition	responsible for controllling bodily functions that are largely involuntary, or automatic, in a nature.
What functions ANS do	

Autonomic Nervous System

Functions of ANS	Control of BP, and other CVS functions, digestion, elimination, and thermoregulation.
Anatomy of the ANS:	* Two areas: Sympathetic and Parasympathetic
Parasympathetic or Craniosacral	Composed of neurons originating in the midbrain, brainstem, and sacral region of the spinal cord.
Enteric nervous system	Third ANS division -Comprised of GI tract that controls various aspects of GI function. IT has both Sypathetic and parasympathetic components.
Sympathetic nervous system	thoracolumbar- Arises from thoracic and upper lumbar regions of the spinal cord.

Sympathetic organization

Preganglionic Fibres	Short-myelinated-type B
Postganglionic fibres	Long-unmyelinated-type C
PreGanglionic	Arise from:Intermediolateral gray columns of the thoracis and upper lumbar spinal cord , Leave Spinal Cord: via ventral root of the spinal nerve, End in: sympathetic ganglion

Sympathetic organization (cont)

Sympathetic ganglia	Located in three areas:1)Chain ganglia/Paravertebral: both side of vertebral Column 2) Unpaired prevertebral ganglia: anterior to aorta 3) Terminal ganglia: in the tissue that is innervated - bladder and rectum
Ratio of preganglionic to post ganglionic fibres	1:15 to 1:20
Route of Sympathetic	PreGanglioninc Fibre-arise-end in sympathetic ganglia-meet post ganglion or more ganglion - leaves to the effector tissue that it supplies (heart, sweat gland etc)

Parasympathetic Organization

Preganglion	Origin: Midbrain-brainstem (cranial portion) or Sacrall region of Spinal cord
Cranial Portion	Exit: CNS via cranial nerves-3,7,9,10
Vagus nerve - cranial nerve 10	comprises of 75% of the efferent component of entire parasympathetic division

Function of Sympathetic and Parasympathetic

Organ innervated by both systems	physiological antagonism typically exists between these two divisions - both divisions innervate the tissue, one division increases function and the other decreases activity.

Function of Sympathetic and Parasympathetic (cont)

Function	Sympathetic: to mobilize body energy and Parasympathetic: tends to conserve and store the energy.
Sympathetic Discharge	Cause: increased cardiac output, decreased visceral blood flow(leave more blood available for skeletal muscle), increased cellular metabolism, several other physiological changes that facilitate vigorous activity.
Parasympathetic Discharge	opposite effect. Slows down heart rate, bring changes that encourage inactivity. Increase intestinal digestion, absorption, an activity thta stores energy for future needs.

Adrenal Medula

Function	Synthesizes and secretes (20%)norepinephrine and (80%) epinephrine directly into blood stream.
Epinephrine (EPI)	Increases Cardiac function and cellular metabolism Because higher affinity for certain receptors: Epi more readily binds to beta subtype of adrenergic receptors.
Where they release	In stress situation: Release directly into blood stream to reach everywhere

Autonomic Integration and Control

Autonomic reflexes	Homeostatic control of BP, Thermoregulation, GI function
Reflexes are based on strategies	Peripheral sensor- Monitors the change in a particular syste-inforation goes to CNS-integration of information-adjustment is made in the autonomic discharge in specific tissu/organ- alter activity to return physiological function back to normal level
Baro receptors location	neck and large arteries of thorax
Thermo receptors location	skin, viscera, hypothalamus
Hypothalamus function	Controll of - body temperature, water balance, energy metabolism
Higher involvement of the ANS	cortex, limbic system, brainstem

Neurotransmitters

Acetylcholine (Ach) and Norepinephrine (NorEpi)	Important Neurotransmitters of ANS
Ach	Synapse 1: Between Pre-post ganglionic neurons-Sympatheticdivision
Ach	Synapse 2: Synapse 1: Between Pre-post ganglionic neurons-ParaSympatheticdivision
Ach	Synapse 4: Parasympathetic-Postganglionic - Effector cell synapse

Neurotransmitters (cont)

NorEpi	Synapse 3: Sympathetic postganglionic neuron - effector cell
Cholinergic Neurons	Preganglionic and Parasympathetic postganglionic neurons - because Ach
Adrenergic Neurons	Most sympathetic postganglionic neurons
Exception	Some sympathetic post ganglionic use -Ach, as neurotransmitter. - innervate in sweat glands and certain blood vessels in face, neck, and lower extremities.

Other Neurotransmitters / Contratransmitters

Purinergic substances	Adenosine and Adinosine Triphosphate : possible transmission in the GI tract, CVS, other organs
Peptides	Neuropeptide Y, Vasoactive intestinal polypeptide, Calcitonin gene related peptide, orexin, cholecystokinin, and angiostenin II, --- Control of the organs and systems
Nitric Oxide	to regulate peripheral autonomic responses and CNS autonomic activity.

Autonomic Receptors

Cholinergic	Located at : acytylcholine synapses,
Adrenergic	Located at: norepinephrine synapses

ACH---> Cholinergic Receptor ---> 1) Muscurinic 2) Nicotinic

Norepinephrine NE---> Adrenergic Receptor ---> 1)Alpha -> alpha1, alpha2 and, 2) Beta -> beta-1,beta-2

Cholinergic receptors

Nicotinic	Located: Junction between preganglionic and postganglionic neurons in both sympathetic and parasympathetic pathways
Nicotinic	Effects: both divisions of ANS
Type 1 Nicotinic	Means: Located at ANS (Nn)
Type 2 Nicotinic	Means: Located at skeletal neuronmuscular junction (Nm)
Muscurinic	Located: all of the synapses between cholinergic postganglionic neurons and the terminal effector cell, including all the parasympathetic terminal synapses and the sympathetic postganglionic cholinergic fibers that supply sweat glands and some specialized blood vessels.
Subtypes of Muscurinic	M1, M2, M3, M4, M5 : Based on their characteristics (chemical and structural)
M1, M4, M5	CNS
M2	heart
M3	bladder detrouser muscle and to control pancreatic insulin release, and other peripheral metabolic responses

Adrenergic Receptors (Alpha)

Alpha 1	Located at: Smooth muscle- in various tissues thorughout the body
Subtypes of Alpha 1	Alpha 1A, Alpha 1B, Alpha 1D
Alpha 2 or Autoreceptors	Located at: Presynaptic termnal of certain adrenergic synapses

Adrenergic Receptors (Alpha) (cont)	
Alpha 2 work	decrease the release of norepinephrine and other chemicals. : overall serve as negative feedback that limits the amount of neurotransmitter released from the presynaptic terminal.
Alpha 2 Stimulation	Cause: Decreased neurotransmitter release and diminished stimulation of the interneurons that influence the alpha motor neurons.
Alpha 2 Stimuants	Agonists - tizanidine, -- decrease neuronal excitability in the spinal cord and so, decrease muscle hyperexcitability in spasticity conditions.
Subtypes of alpha 2	Alpha-2A, alpha- 2B, alpha-2C

Adrenergic Receptors (Beta)	
Beta1	heart and kidneys
Beta 2	located: smooth muscle of certain vasculatures, the bronchioles, the gallbladder, and the uterus
Beta 2	functional role in some tissues. Located at: Adipose tissue