The Autonomic Nervous System

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The Autonomic Nervous System - Overview

www.courses.vcu.edu/ptxed/m2

1. Tissues / Organs: receptors present, tissue / organ response
2. Transmitters: NE, Ach, synthesis, storage, release, regulation
3. Drugs: receptor selectivity, mechanism of action
4. Can predict: clinical application, side effects, toxicity, treatment of toxicity
6. General: learn by drug classes, important adverse reactions, not dosage

Summary Table

Autonomic Nervous System

Central Nervous System

Parasympathetic
Thoracolumbar
T1-12, L1-3

Craniosacral

“Flight or Fight”

T8, THR, JGIT

“Feeding & Breeding”

JBP, UHR, TGIT

FUNCTIONS CONTROLLED

Respiration
Body Temperature
Metabolism
Sweating
Secretions

Hypothalamus - Integration,
body temp & water balance
Medulla - BP, respiration
Cerebral cortex - somatic NS & ANS integration

ANATOMY

Central Nervous System

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ANATOMY
Fight or Flight

Activation of SNS and release of EPI & NE from nerve endings and adrenal gland

Increase blood flow, BP, HR, glucose, pupil dilation
Decrease activity of digestive & immune system

Exam Stress

Normal BP: 120 / 80 mmHg HR: 72 bpm
Before exam: 140 / 99 mmHg HR: 97 bpm
During exam: 179 / 149 mmHg HR: 110 bpm
End of exam: 111 / 74 mmHg HR: 76 bpm

Neurons of the ANS

Key Points
Preganglionic fibers – mylinated
Postganglionic fibers – non mylinated
SNS pre : post 1:20
PNS pre : post 1:1 (exception 1:10,000 Auerbachs plexus)
Key role of Ach
Motor fiber not part of ANS

Adrenoceptors

Key Points
Alpha \( \alpha_1 \) – Vascular smooth muscle
Alpha \( \alpha_2 \) – Nerve terminals
Beta \( \beta_1 \) – Cardiac muscle
Beta \( \beta_2 \) – Bronchial smooth muscle
Beta \( \beta_3 \) – Fat cells
Dopamine D Renal smooth muscle

Cholinoceptors

Key Points
Muscarinic
M1 – Ganglia cells
M2 – Cardiac muscle
M3 – Sweat glands
M4/M5
Nicotinic N – Ganglia cells
NM – Neuromuscular junction

ANS Diagram

Key Points
Division – Anatomical
Usually dual innervation
Usually antagonistic
Usually some ANS “tone”
Usually one dominates
Role of reflex responses
Raynaud’s Syndrome

- Excessive sympathetic tone in nerves supplying hands and feet. Minor cold, or even thought of cold, causes pronounced vasoconstriction that can be severe enough to cause necrosis of tissues.
- Discoloration of the fingers and/or toes when the patient is exposed to changes in temperature (cold or hot) or emotional events.
- Abnormal spasm of blood vessels causes diminished blood supply.
- Initially, the digit(s) turn white because of diminished blood supply.
- Then turn blue because of prolonged lack of oxygen.
- Finally turn red, the blood vessels reopen, causing a local “flushing”
- Three-phase color sequence (white to blue to red) is typical.
- Treatment: Ca++ blockers if severe.

Direct Actions

- Sympathetic
- Cardiovascular system
- Metabolic actions
- Sweat glands (M-receptors)
- Parasympathetic
- GI-Tract
- Urinary Tract
- Eye

Eye – Miosis, Mydriasis & Cycloplegia

- Miosis: pin point pupils
- Mydriasis: dilated pupils (bella-donna agents)
- Cycloplegia: loss of accommodation (focus)

Neurons of the ANS

- Cardiac and smooth muscle, gland cells, nerve terminals
- Parasympathetic
- Sweat glands
- Sympathetic
- Cardiac and smooth muscle, gland cells, nerve terminals
- Parietal vascular smooth muscle
- Skeletal muscle
- Somatic

Transmitter synthesis and release