The Autonomic Nervous System

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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

ANS – Overview Tissues/Organs

<table>
<thead>
<tr>
<th>Tissue / Organ</th>
<th>ANS</th>
<th>Function</th>
<th>Action</th>
<th>Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart</td>
<td>PVN</td>
<td>↑ HR</td>
<td>增加心率</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>PVN</td>
<td>↑ BP</td>
<td>增加血压</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>GIT</td>
<td>PVN</td>
<td>↓ GIT</td>
<td>减少胃肠道蠕动</td>
<td>交感神经抑制</td>
</tr>
<tr>
<td>Uterus</td>
<td>PVN</td>
<td>↑ Relax</td>
<td>放松子宫</td>
<td>交感神经抑制</td>
</tr>
<tr>
<td>Bronchial m.</td>
<td>PVN</td>
<td>↓ Relax</td>
<td>松弛气道平滑肌</td>
<td>交感神经抑制</td>
</tr>
<tr>
<td>Lipolysis</td>
<td>PVN</td>
<td>↑ Lipolysis</td>
<td>脂肪分解</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>Vascular muscle</td>
<td>PVN</td>
<td>↑ Constrict</td>
<td>血管收缩</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>Radial m.</td>
<td>PVN</td>
<td>↑ Mydriasis</td>
<td>瞳孔扩大</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>Ciliary m.</td>
<td>PVN</td>
<td>↑ Secretions</td>
<td>分泌增加</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>Circular m.</td>
<td>PVN</td>
<td>↑ Secretions</td>
<td>分泌增加</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>Organ</td>
<td>PVN</td>
<td>↑ Secretions</td>
<td>分泌增加</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>liver</td>
<td>PVN</td>
<td>↑ Glucose</td>
<td>升高血糖</td>
<td>交感神经兴奋</td>
</tr>
<tr>
<td>kidney</td>
<td>PVN</td>
<td>↑ Renin</td>
<td>升高血浆肾素</td>
<td>交感神经兴奋</td>
</tr>
</tbody>
</table>

Autonomic Nervous System

Thoracolumbar
T1-12, L1-3
Sacral S2-3

“Flight or Fight”
TP, THR, LGT

“Feeding & Breeding”
DBP, THR, T1G

FUNCTIONS CONTROLLED
Respiration
Circulation
Body Temperature
Metabolism
Sweating
Secretions

PARASYMPATHETIC
Craniosacral
Cranial N. III, VII, IX, X
Sacral S2-3

CENTRAL INVOLVEMENT
Hypothalamus - Integration, body reg & homeostasis
Medulla - BP, respiration
Cerebral cortex - somatic NS & ANS integration
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
  - \( \alpha_2 \) – Nerve terminals
- Beta
  - \( \beta_1 \) – Cardiac muscle
  - \( \beta_2 \) – Bronchial smooth muscle
  - \( \beta_3 \) – Fat cells
- Dopamine D – Renal smooth muscle

Cholinoceptors

Muscarinic M
- \( M_1 \) – Ganglia cells
- \( M_2 \) – Cardiac muscle
- \( M_3 \) – Sweat glands
- \( M_4/M_5 \)

Nicotinic N
- \( N \) – Ganglia cells
- \( N_M \) – 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.

Eye – Miosis, Mydriasis & Cycloplegia

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

Neurons of the ANS

Transmitter synthesis and release