Autonomic nervous System

Regulates activity of: Smooth muscle
Cardiac muscle
certain glands

Autonomic- illusory (convenient)-not under direct control

Regulated by: hypothalamus
Medulla oblongata

Divided in to two subdivisions: Sympathetic
Parasympathetic

Sympathetic: mobilizes all the resources of body in an emergency

Parasympathetic: maintains the normal body functions

Complimentary to each other.
ANS

Activity expressed
• Regulation of Blood Pressure
• Regulation of Body Temperature
• Cardio-respiratory rate
• Gastro-intestinal motility
• Glandular Secretion

Sensations
• General – Hunger, Thirst, Nausea
• Special -- Smell, taste
and visceral pain
• Location of ANS in CNS:
  1. cerebral hemispheres \((\text{limbic system})\)
  2. Brain stem \((\text{general visceral nuclei of cranial nerves})\)
  3. Spinal cord \((\text{intermediate grey column})\)
ANS Anatomy

• **Pathway:** Two motor neurons
  1. In CNS --> Axon --> Autonomic ganglion
  2. In Autonomic ganglion --> Axon --> effector organ

• **Anatomy:**
  Preganglionic neuron --> preganglionic fibre (myelinated axon) --> out of CNS as a part of cranial/spinal nerve --> fibres separate & extend to ANS ganglion --> synapse with postganglionic neuron --> postganglionic fibre (nonmyelinated) --> effector organ
ACh or NE: contraction of smooth or cardiac muscle, stimulation or inhibition of glandular secretion

ACh: contraction of skeletal muscle
Visceral effectors: smooth muscle of blood vessels, arrector pili muscles, and sweat glands of skin

Visceral effector: intestine

Prevertebral (collateral) ganglion (celiac ganglion)

White ramus communicans

Below L2

Sympathetic trunk (paravertebral) ganglion

Spinal nerve

Sympathetic chain (trunk)

Anterior ramus of spinal nerve

Posterior ramus of spinal nerve

Above T1
Sympathetic system

Components

• Pair of ganglionic sympathetic trunk
• Communicating rami
• Branches
• Plexuses
• Subsidiary ganglia – collateral, terminal ganglia
Sympathetic trunk (lateral ganglia)

- Paravertebral in position
- Extend from base of skull to coccygeal
- Both trunk unite to form – ganglion impar

**Total Ganglia**
- Cervical-3
- Thoracic-11
- Lumbar-4
- Sacral-4
Subsidiary ganglia

Collateral ganglia
- Coeliac
- Superior mesenteric
- Inferior mesenteric
- Aortico-renal
- Neurons of sup. hypogastric plexus

Terminal ganglia
- Chromaffin cells of suprarenal glands
Sympathetic System

Called Thoracolumbar outflow
Arises from T1 – L2-3 Segment

Motor Preganglionic Fibres
(White rami communicans)
Arise from lateral grey column
emerges through ventral rami and
connected to ganglia(lateral ganglia)
Of sympathetic chain or relay in
Collateral ganglia

Postganglionic fibres (Grey rami
Communcans) reach the organ of supply
i.e. – involuntary muscles of hairs,
blood vessels, sweat glands
Sebaceous glands
• Preganglionic fibres (white rami): Thinly myelinated; reach ganglia; terminate
1. Synapse in corresponding ganglia
2. Ascend or descend along symp. trunk and synapse accordingly
3. Pass uninterrupted through symp. trunk & synapse with collateral or terminal ganglia
- Postganglionic fibres: Nonmyelinated
  From symp. Ganglia to:
  1. Pass back to corresponding spinal nerve via grey rami
  2. Pass via medial branches to supply deeply placed viscera
  3. Some ascend/descend and join grey rami/medial branches
Sympathetic nerves are adrenergic in nature

**Functionally** – Vasomotor (vasoconstrictor), Sudomotor (Secretomotor to sweat glands and Pilomotor (Contract arrector pili muscle))
Parasympathetic System

- Craniosacral outflow
- 3, 7, 9, 10 cranial nerves and S2,3,4 segment
- Fibres emerge as part of cranial nerves or as part of anterior root of spinal nerve
- Preganglionic fibres are long and terminate in terminal ganglia and synapse with postganglionic neurons.
- Cranial outflow: Oculomotor - ciliary ganglion
- Facial – pterygopalatine & submandibular ganglion
- Glossopharyngeal - otic ganglion
- Vagus – in walls of target organ (80% of total parasympathetic outflow)
- Sacral component - synapse in terminal ganglia in the walls of viscera (pelvic splanchnic nerves)
- Postganglionic fibres short.
- Ganglia mostly on the viscera
<table>
<thead>
<tr>
<th>Sympathetic</th>
<th>Parasympathetic</th>
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<tbody>
<tr>
<td>Definite anatomical entity</td>
<td>Accompanies cranial &amp; spinal</td>
</tr>
<tr>
<td>Preganglionic neuron lies in 12 thoracic &amp; 3 lumbar segments of SC (thoracolumbar outflow)</td>
<td>nerves</td>
</tr>
<tr>
<td>Preganglionic fibre short</td>
<td>In the nuclei of four cranial nerves-3,7,9,10 &amp; 2-4 sacral segments of SC (craniosacral outflow)</td>
</tr>
<tr>
<td>Sympathetic ganglia prevertrbral ganglia</td>
<td>Long</td>
</tr>
<tr>
<td>Single preganglionic fibre synapse with 20 postgang. Neurons(divergence)</td>
<td>Terminal (intramural) ganglia</td>
</tr>
<tr>
<td>Postgang. Fibres innervate several visceral effectors</td>
<td>Single fibre synapse with 4-5 postgang. nerves</td>
</tr>
<tr>
<td>Widespread diffuse response</td>
<td>Postgang. fibres supply single visceral effectors</td>
</tr>
<tr>
<td>Is nerve of emergency; works during stress (fight or flight)</td>
<td>Localised &amp; accurate response</td>
</tr>
<tr>
<td></td>
<td>Nerve of tranquility; essential for life</td>
</tr>
<tr>
<td>Sympathetic</td>
<td>Parasympathetic</td>
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<td>------------------------------</td>
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<tr>
<td><strong>Actions:</strong></td>
<td></td>
</tr>
<tr>
<td>Conveys visceral pain</td>
<td>Conveys general visceral</td>
</tr>
<tr>
<td>sensations</td>
<td>sensations e.g. hunger, thirst,</td>
</tr>
<tr>
<td></td>
<td>thirst, nausea, sexual</td>
</tr>
<tr>
<td></td>
<td>sensations</td>
</tr>
<tr>
<td>Cutaneous bld. vs</td>
<td>Sensations for visceral</td>
</tr>
<tr>
<td>constricted, coronary and</td>
<td>reflexes e.g. cardiac reflex</td>
</tr>
<tr>
<td>skeletal vs. dilated</td>
<td></td>
</tr>
<tr>
<td>Heart rate accelerated</td>
<td>Conserves body resources</td>
</tr>
<tr>
<td>Blood pressure raised</td>
<td>Heart rate slowed</td>
</tr>
<tr>
<td>Pupils dilated</td>
<td>Blood pressure lowered</td>
</tr>
<tr>
<td>Peristalsis decreased and</td>
<td>Pupils constricted</td>
</tr>
<tr>
<td>sphincters closed</td>
<td>Peristalsis, digestion &amp;</td>
</tr>
<tr>
<td></td>
<td>absorption increased</td>
</tr>
<tr>
<td>Catabolic in function</td>
<td>Bladder &amp; rectum evacuated</td>
</tr>
<tr>
<td>Works for today</td>
<td>Anabolic in function</td>
</tr>
<tr>
<td></td>
<td>Works for tomorrow</td>
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</tbody>
</table>