Peripheral Nervous System 1: The Somatic System

24 July 2017

Reading: Moore’s ECA5 27–33
ECA4 31–36

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Dichotomies

1. Tissues: neurons vs. glia
2. Position: CNS vs. PNS
3. Function 1: sensory vs. motor
4. Function 2: somatic vs. visceral
Neurons

- Dendrites: carry nerve impulses toward cell body
- Axon: carries impulses away from cell body
- Synapses: site of communication between neurons using chemical neurotransmitters
- Myelin & myelin sheath: lipoprotein covering produced by glial cells (e.g., Schwann cells in PNS) that increases axonal conduction velocity
- Demyelinating diseases: e.g., Multiple Sclerosis (MS) in CNS or Guillain-Barré Syndrome in PNS
Central Nervous System
- brain & spinal cord
- integration of info passing to & from the periphery

Peripheral Nervous System
- 12 cranial nerves
- 31 pairs of spinal nerves
- Naming convention changes at C7/T1

Collection of nerve cell bodies:
- CNS: nucleus
- PNS: ganglion

Moore’s COA6 2010
Sensory (Afferent) vs. Motor (Efferent)

sensory (afferent) nerve

(pseudo-) unipolar neurons conducting impulses from sensory organs to the CNS

e.g., skin

motor (efferent) nerve

multipolar neurons conducting impulses from the CNS to effector organs (muscles & glands)

e.g., muscle

Gray’s Anatomy 38 1999
<table>
<thead>
<tr>
<th>attribute</th>
<th>Somatic System</th>
<th>Visceral System</th>
</tr>
</thead>
<tbody>
<tr>
<td>embryological origin of tissue</td>
<td>“body wall:” somatic (parietal) mesoderm (dermatome, myotome)</td>
<td>“organs:” splanchnic (visceral) mesoderm, endoderm</td>
</tr>
<tr>
<td>examples of adult tissues</td>
<td>dermis of skin, skeletal muscles, connective tissues</td>
<td>glands, cardiac muscle, smooth muscle</td>
</tr>
<tr>
<td>perception</td>
<td>conscious, voluntary</td>
<td>unconscious, involuntary</td>
</tr>
</tbody>
</table>

![Diagram showing embryonic tissues](image-url)  

*Langman’s Embryo 9 2004*
<table>
<thead>
<tr>
<th></th>
<th>Somatic</th>
<th>Visceral</th>
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<tbody>
<tr>
<td>Sensory (Afferent)</td>
<td>somatic sensory</td>
<td>visceral sensory</td>
</tr>
<tr>
<td></td>
<td>[General Somatic Afferent (GSA)]</td>
<td>[General Visceral Afferent (GVA)]</td>
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<tr>
<td>Motor (Efferent)</td>
<td>somatic motor</td>
<td>visceral motor</td>
</tr>
<tr>
<td></td>
<td>[General Somatic Efferent (GSE)]</td>
<td>[General Visceral Efferent (GVE)]</td>
</tr>
</tbody>
</table>

**Somatic Nervous System** (today)

**Autonomic Nervous System** (August 7)
Structure of the Spinal Cord

- **Meninges**:
  - **Pia**
  - **Arachnoid**
  - **Dura**

- **White matter** (axons)
- **Gray matter** (cell bodies)
  - **Dorsal (posterior) horn**
  - **Ventral (anterior) horn**

- **Denticulate ligament**

- **Ventral rootlets**
- **Dorsal rootlets**

- **Dorsal root (spinal) ganglion**

- **Subarachnoid space** (CSF)

- **Spinal nerve**
  - **Dorsal primary ramus**
  - **Ventral primary ramus**

Moore's COA6 2010
**Rootlet Damage**

**Upper Brachial Plexus Injuries**
- Increase in angle between neck & shoulder
- Traction (stretching or avulsion) of upper rootlets (e.g., C5, C6)
- Produces Erb’s Palsy

**Lower Brachial Plexus Injuries**
- Excessive upward pull of limb
- Traction (stretching or avulsion) of lower rootlets (e.g., C8, T1)
- Produces Klumpke’s Palsy

“Obstetrical” or “Birth palsy”
- Becoming increasingly rare
- Categorized on basis of damage
  - Type I: Upper (C5,6), Erb’s
  - Type II: All (C5-T1), both palsies
  - Type III: Lower (C8, T1), Klumpke’s Palsy

Structure of Spinal Nerves: Somatic Pathways

- Dorsal root
- Ventral root
- Dorsal horn
- Ventral horn
- Dorsal root ganglion
- Spinal nerve
- Gray ramus communicans
- White ramus communicans
- Sympathetic ganglion
- Ventral ramus
- Somatic sensory nerve (GSA)
- Somatic motor nerve (GSE)

Mixed Spinal Nerve
Structure of Spinal Nerves: Somatic Pathways

- dorsal root
- dorsal root ganglion
- spinal nerve
- dorsal ramus
- somatic sensory nerve (GSA)
- somatic motor nerve (GSE)
- ventral ramus
- ventral horn
- CNS interneuron
- ventral root
- dorsal horn

Mixed Spinal Nerve

Somatic sensations:
- touch, pain, temperature, pressure
- proprioception: joints, muscles

Somatic motor activity:
- innervate skeletal muscles
Structure of Spinal Nerves: Dorsal & Ventral Rami

**Territory of Dorsal Rami**
(everything else, but head, innervated by ventral rami)

Stern Essentials of Gross Anatomy
Impact of Lesions

Disruption of sensory (afferent) neurons (paresthesia)
Impact of Lesions

Disruption of motor (efferent) neurons (paralysis)
Impact of Lesions

Disruption of sensory (afferent) neurons *(paresthesia)*

Disruption of motor (efferent) neurons *(paralysis)*
Impact of Lesions

Disruption of sensory (afferent) neurons (back paresthesia)

Disruption of motor (efferent) neurons (paralysis of deep back muscles)
**Segmental Innervation: Dermatomes & Myotomes**

**Dermatome:** cutaneous (skin) sensory territory of a single spinal nerve

**Myotome:** mass of muscle innervated by a single spinal nerve

*Moore’s COA6 2010*
Segmental Innervation: Dermatome Maps

- Based on clinical findings of deficits in cutaneous sensation
- Diagnostic aids: localization of lesions to cord levels
- Limits to specificity due to overlap of dermatomes

Moore’s COA6 2010
Dermatomes & Herpes Zoster ("Shingles")

- Chicken pox virus (varicella) infects dorsal root ganglia
- Once activated, travels along afferent axons to skin where it forms very painful rash
- Often has a typical dermatomal presentation
Segmental Innervation: Myotome Maps

- Particular functions are linked to muscles innervated by particular cord levels
  - Example: C5 lesion
    - Weakness in flexion of elbow & shoulder
    - Weakness in abduction & lateral rotation of shoulder

Grant’s Atlas 12 2009
PNS Plexus Formation

- Dermatomes: single spinal nerve
- Peripheral nerves: multiple spinal nerves from different cord levels
- Plexus formation: mixing of nerves from different cord levels by union and division of bundles

Moore’s COA6 2010
Example of named peripheral nerve

Radial nerve receives fibers from spinal nerves from five different cord levels — in fact, all cord levels of the brachial plexus

Radial Nerve C5–T1

Brachial Plexus (C5–T1)
PNS Plexus Formation

- Distribution of a single spinal throughout a plexus
- Myotome — return to the C5 lesion example

Abduction: supraspinatus & deltoid
Lateral Rotation: infraspinatus & teres minor
Flexion: Biceps brachii & Brachialis

Moore’s COA6 2010
References


