Spinal nerves

1. Formation and general organization of the spinal nerves
2. Dorsal roots and ventral roots
3. Spinal ganglia
4. Zonal and segmental innervation
5. Plexuses and peripheral nerve distributions
General organization

- 31 pairs of segmentally arranged nerves:
  - 8 cervical – C1-C8
  - 12 thoracic – Th1-Th12
  - 5 lumbar – L1-L5
  - 5 sacral – S1-S5
  - 1 coccygeal – Co1
- corresponds to a pair of embryonic somites
- emerges through the intervertebral foramen
- mixed spinal nerve (common nerve trunk)
- topographic relationships between spinal nerves, segments and vertebrae
Spinal nerve formation

- **ventral (motor) root:**
  - axons of neurons in anterior and lateral grey columns
  - motor and autonomic (sympathetic and parasympathetic)

- **dorsal (sensory) root:**
  - central processes of the dorsal ganglion cells
  - convey somatic and visceral sensory information
Spinal ganglion

- spindle-shaped aggregations on the dorsal roots – dorsal root ganglion
  - (pseudo)unipolar neurons – ovoid or spherical (primary afferent neurons)
  - satellite cells (capsular cells, amphicytes)
  - Schwann cells and blood vessels
- embryonic origin – neural crest cells
- location – in intervertebral foramina
- axons (afferents) – proximal and distal processes
- functional modalities:
  - mechanoreception
  - nociception
  - proprioception
Formation of a dermatome

- Dermatome – a localized area of skin supplied by a single nerve from a single nerve root of the spinal cord
  - herringbone pattern – the width of the cutaneous field of innervation
  - thorax&abdomen – like a stack of discs
  - arms&legs – longitudinally along the limbs

- Peripheral nerve field – a territory supplied by a peripheral nerve from more than one somite
Dermatome vs. skin innervation
Zonal innervation

- Sensory nerve innervation regions:
  - autonomic ⇒ anesthesia
  - mixed ⇒ hypoesthesia
  - maximal ⇒ no loss in sensibility

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Segmental innervation:
- organs or muscles innervated by one spinal segment
- corresponds to the general metamerism of the body

Embryonic somites (metamere):
- myotome ⇒ muscle
- sclerotome ⇒ skeleton
- dermatome ⇒ skin

Neuromere ⇒ somite
Spinal nerve trunks

- Spinal nerve functional components:
  - somatic components – efferent and afferent fibers
  - visceral components – sympathetic or parasympathetic

- Spinal nerve branches:
  - meningeal branch – at all vertebral levels (recurrent meningeal nerve)
  - white ramus communicans – myelinated preganglionic fibers
    - all thoracic and L1-L2 to corresponding sympathetic ganglion
    - S2-S4 nerves to the parasympathetic pelvic plexus
  - grey ramus communicans – unmyelinated postganglionic fibers
    - from paravertebral sympathetic ganglia
  - ventral (anterior) ramus – thicker
    - ventrolateral muscles
    - skin of the trunk and extremities
  - dorsal (posterior) ramus – thinner
    - intrinsic dorsal muscles of the back and neck
    - overlying skin from vertex to coccyx
Dorsal rami of the spinal nerves

- divide into medial and lateral branches (exception C1)
- have a typical segmental distribution
- cervical dorsal rami:
  - suboccipital nerve (C1) – purely motor
  - greater occipital nerve (C2) – mixed
  - C3 medial cutaneous branch, third occipital nerve
- thoracic dorsal rami:
  - Th1-Th6 – medial (mixed) and lateral (motor) branch
  - Th7-Th12 – medial (motor) and lateral (mixed)
- lumbar dorsal rami:
  - L1-L3 lateral cutaneous branches – superior clunial nerves
- sacral dorsal rami:
  - S1-S3 lateral cutaneous branches – medial clunial nerves
Ventral rami of the spinal nerves

- Thoracic ventral rami – 12 pairs:
  - segmental distribution – **intercostal nerves**
  - Th12 – subcostal nerve
  - anterior cutaneous branches
  - lateral cutaneous branches
Cervical plexus, *plexus cervicalis*

- **Formation and segmental origin:**
  - ventral rami of C1-C4 nerves
- **Branches:**
  - superficial (sensory) branches:
    - lesser occipital nerve, *n. occipitalis minor*
    - great auricular nerve, *n. auricularis magnus*
    - transverse colli nerve, *n. transversus colli*
    - supraclavicular nerves, *nn. supraclaviculares*
  - deep (motor) branches:
    - muscular branches, *rr. musculares*
    - inferior root of the ansa cervicalis, *radix inferior ansae cervicalis*
    - trapezius root, *ramus trapezius*
    - sternocleidomastoid root, *r. sternocleidomastoideus*
    - phrenic nerve, *n. phrenicus*
Brachial plexus, *plexus brachialis*

- **Formation and segmental origin:**
  - ventral rami of C5-C8, Th1 nerves

- **Three primary trunks:**
  - superior (upper) trunk – C5-C6
  - middle trunk – C7
  - inferior (lower) trunk – C8-Th1

- **Divisions:**
  - posterior division
    - posterior cord
  - anterior
    - lateral cord
    - medial cord
Brachial plexus, *plexus brachialis*

- **Main branches:**
  - supraclavicular part:
    - dorsal scapular nerve, *n. dorsalis scapulae*
    - long thoracic nerve, *n. thoracicus longus*
    - nerve to the subclavius, *n. subclavius*
    - suprascapular nerve, *n. suprascapularis*
  - infraclavicular part:
    - lateral cord, *fasciculus lateralis*:
      - musculocutaneous nerve, *n. musculocutaneus*
      - lateral root of median, *radix lateralis n. mediani*
    - medial cord, *fasciculus medialis*:
      - medial root of median, *radix medialis n. mediani*
      - ulnar nerve, *n. ulnaris*
      - medial cutaneous of arm, *n. cutaneus brachii medialis*
      - medial cutaneous of forearm, *n. cutaneus antebrachii medialis*
    - posterior cord, *fasciculus posterior*:
      - axillary nerve, *n. axillaris*
      - radial nerve, *n. radialis*
Brachial plexus, *plexus brachialis*

- **Brachial distribution of:**
  - musculocutaneous nerve
  - median nerve
  - ulnar nerve
  - radial nerve

- **Forearm innervation:**
  - median nerve
  - ulnar nerve
  - radial nerve

- **Hand innervation:**
  - median nerve
  - ulnar nerve
Muscle innervation of the upper limb

- Muscular branches of:
  - median nerve
  - ulnar nerve
  - radial nerve
Peripheral neuropathies

- Radial nerve palsy, wrist drop (Saturday night palsy)
- Ulnar nerve palsy, ‘claw hand’ handlebar palsy – cyclist’s hands
- Median nerve palsy, ‘accoucheur's hand’ median neuropathy (Carpal tunnel syndrome)
Lumbosacral plexus, *plexus lumbosacralis*

- Lumbar plexus, *plexus lumbalis*:
  - ✓ formation and segmental origin:
    - ventral rami of Th12, L1-L4 nerves

- Sacral plexus, *plexus sacralis*:
  - ✓ formation and segmental origin:
    - ventral rami of L5, S1-S5, Co1 nerves

- Coccygeal plexus, *plexus coccygeus*:
  - ✓ ventral rami of S5, Co1

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Lumbar plexus, *plexus lumbalis*

- **Branches:**
  - muscular branches, *rr. musculares*
  - purely sensory branch:
    - lateral femoral cutaneous nerve, *n. cutaneus femoris lateralis*
  - sensorimotor branches:
    - iliohypogastric nerve, *n. iliohypogastricus*
    - ilioinguinal nerve, *n. ilioinguinalis*
    - genitofemoral nerve, *n. genitofemoralis*
    - obturator nerve, *n. obturatorius*
    - femoral nerve, *n. femoralis*
Obturator nerve, *n. obturatorius*

- passes through obturator canal
- branches – L2-L4:
  - anterior division
  - posterior division
  - motor branches:
    - adductor muscles
    - gracilis muscle
  - sensory branches:
    - inner surface of the thigh
  - accessory obturator nerve, *n. obturatorius accessorius*
Obturator nerve, *n. obturatorius*

- passes through obturator canal
- branches – L2-L4:
  - ✓ anterior division
  - ✓ posterior division
  - ✓ motor branches:
    - ➢ adductor muscles
    - ➢ gracilis muscle
  - ✓ sensory branches:
    - ➢ inner surface of the thigh
  - ✓ accessory obturator nerve, *n. obturatorius accessorius*
Femoral nerve, *n. femoralis*

- passes through *lacuna musculorum*
- branches – L2-L4:
  - muscular branches, *rr. musculares*:
    - iliopsoas
    - pectineus
    - sartorius
    - extensor muscles of the knee – quadriceps femoris
  - sensory branches:
    - anterior femoral cutaneous nerve
    - saphenous nerve
Sacral plexus, *plexus sacralis*

- **Branches:**
  - motor branches:
    - muscular branches, *rr. musculares*
    - superior gluteal nerve, *n. gluteus superior*
    - inferior gluteal nerve, *n. gluteus inferior*
  - purely sensory branch:
    - posterior femoral cutaneous nerve, *n. cutaneus femoris posterior*
  - sensorimotor branches:
    - pudendal nerve, *n. pudendus*
    - coccygeal nerve, *n. coccygeus*
    - sciatic nerve, *n. ischiadicus*
  - visceral branch:
    - pelvic splanchnic nerve, *nervus erigens*
Sciatic nerve, *n. ischiadicus*

- passes through *foramen infrapiriforme*
- Main branches:
  - tibial nerve, *n. tibialis*:
    - articular branches
    - muscular branches
    - sural nerve
    - medial and lateral calcaneal
    - medial and lateral plantar nerves
  - common peroneal nerve, *n. peroneus communis*:
    - superficial peroneal nerve (musculocutaneous)
    - deep peroneal nerve (anterior tibial nerve)
Saturday night palsy

Thank you...