Spinal nerves and cervical plexus
Prof. Abdulameer Al-Nuaimi
E-mail: a.al-nuaimi@sheffield.ac.uk
E. mail: abdulameerh@yahoo.com
Scalp

- The scalp is the part of the head that extends from the *superciliary* arches anteriorly to the external occipital *protuberance and superior nuchal lines* posteriorly.
- Laterally it continues inferiorly to the *zygomatic arch*. 
Scalp

- The scalp is a multilayered structure with layers that can be defined by the word itself:
  - S-skin
  - C-connective tissue (dense)
  - A-aponeurotic layer (galea aponeurotica)
  - L-loose connective tissue
  - P-pericranium
Scalp

- The first three layers are tightly held together, forming a single unit.
- This unit is sometimes referred to as the scalp proper and is the tissue torn away during serious 'scalping' injuries.
Scalp

- **Skin** is thick, hair bearing and contains numerous sebaceous glands.
- **Connective tissue** is fibrofatty, the fibrous septa uniting the skin to the underlying aponeurosis of the occipitofrontalis muscle. Numerous arteries and veins are found in this layer. *The arteries are branches of the external and internal carotid arteries, and a free anastomosis takes place between them.*
- **Aponeurosis (epicranial)** is a thin, tendinous sheet that unites the occipital and frontal bellies of the occipitofrontalis muscle. The lateral margins of the aponeurosis are attached to the temporal fascia.
Sensory innervations of the scalp

Anterior to the ears and the vertex
- Supratrochlear nerve
- Supraorbital nerve
- Zygomaticotemporal nerve
- Auriculotemporal nerve

By branches of all four divisions of the trigeminal nerve

Posterior to the ears and the vertex
- Great auricular nerve
- Lesser occipital nerve
- Greater occipital nerve
- Third occipital nerve

By branches of all four divisions of the spinal cutaneous nerves (C2 and C3)
Sensory innervations of the scalp

- Supratrochlear nerve (CN V₁)
- Supraorbital nerve
- Zygomaticotemporal nerve (CN V₂)
- Auriculotemporal nerve (CN V₃)
- Lesser occipital nerve (C₂, C₃)
- Greater occipital nerve (C₂)
- C₃ nerve

Superficial temporal artery
Posterior auricular artery
Occipital artery
Supratrochlear artery
Supraorbital artery
Arterial Supply of the Scalp

External carotid arteries
- Occipital arteries
- Posterior auricular arteries
- Superficial temporal arteries

Internal carotid arteries
- Supratrochlear arteries
- Supraorbital arteries
- Branches of ophthalmic artery
Face

**Boundaries**

- Extends superiorly to the hair line, inferiorly to the chin and base of mandible, and on each side to auricle
- Forehead is common to both scalp and face.
Face

Muscles of face

• Called muscle of facial expression and lie in superficial fascia.
• Embryologically they develop from mesoderm of 2\textsuperscript{nd} branchial arch, therefore supplied by \textbf{facial nerve}.
• No deep fascia is present in the face.
Sensory Nerves of the Face

- The skin of the face is supplied by the trigeminal nerve (V), except for the small area over the angle of the mandible and the parotid gland which is supplied by the great auricular nerve (C2 and 3).
- The trigeminal nerve (V) divides into three major divisions—the ophthalmic (V₁), maxillary (V₂), and mandibular (V₃) nerves.
SENSORY BRANCHES OF TRIGEMINAL N ON FACE

- Vertex
- Auriculotemporal
- Zygomatico-temporal
- Zygomatico-facial
- Buccal
- Supratrochlear
- Supra-orbital
- Infratrochlear
- External nasal
- Infra-orbital
- Mental

- Ophthalmic (5 branches)
- Maxillary (3 branches)
- Mandibular (3 branches)

FACE: MOTOR SUPPLY (VII)

Facial nerve branches:
- Temporal: frontalis & procerus
- Zygomatic 1: eye & around orbit
- Zygomatic 2: mid face & smile
- Buccal: buccinator & upper lip
- Mandibular: lower lip & orbicularis oris
- Cervical: platysma

(note: proprioception is supplied by trigeminal)

Mnemonic:
- Two
- Zebras
- Befriended
- My
- Cat

Stroke:
- Upper motor neurone
- Lower face worse due to bilateral innervation of upper face

Bell’s Palsy
- lower motor neurone
- All branches equally affected
- Variable recovery
- Unilateral
A spinal nerve
Spinal nerve is a mixed nerve, which carries motor, sensory, and autonomic signals between the spinal cord and the body. In the human body there are 31 pairs of spinal nerves, one on each side of the vertebral column. These are grouped into cervical, thoracic, lumbar, sacral and coccygeal regions of the spine. There are eight pairs of cervical nerves, twelve pairs of thoracic nerves, five pairs of lumbar nerves, five pairs of sacral nerves, and one pair of coccygeal nerves. The spinal nerves are part of the peripheral nervous system.
Each spinal nerve is formed from the combination of nerve fibers from its dorsal and ventral roots. The dorsal root is the afferent sensory root and carries sensory information to the brain. The ventral root is the efferent motor root and carries motor information from the brain. The spinal nerve emerges from the spinal column through an opening (intervertebral foramen) between adjacent vertebrae. This is true for all spinal nerves except for the first spinal nerve pair (C1), which emerges between the occipital bone and the atlas (the first vertebra). Thus the cervical nerves are numbered by the vertebra below, except spinal nerve C8, which exists below vertebra C7 and above vertebra T1. The thoracic, lumbar, and sacral nerves are then numbered by the vertebra above
Outside the vertebral column, the spinal nerve divides into branches. The dorsal ramus contains nerves that serve the posterior portions of the trunk carrying visceral motor, somatic motor, and somatic sensory information to and from the skin and muscles of the back (epaxial muscles). The ventral ramus contains nerves that serve the remaining anterior parts of the trunk and the upper and lower limbs (hypaxial muscles) carrying visceral motor, somatic motor, and sensory information to and from the ventrolateral body surface, structures in the body wall, and the limbs.

The somatosensory system is a part of the sensory nervous system. The somatosensory system is a complex system of sensory neurons and pathways that responds to changes at the surface or inside the body.
Thermoreceptor carries information about temperature changes. Other types include mechanoreceptors, chemoreceptors, and nociceptors (responds to damaging or potentially damaging stimuli) and they send signals along a sensory nerve to the spinal cord.
The meningeal branches (recurrent meningeal or sinuvertebral nerves) branch from the spinal nerve and re-enter the intervertebral foramen to serve the ligaments, dura, blood vessels, intervertebral discs, facet joints, and periosteum of the vertebrae.

The rami communicantes contain autonomic nerves that serve visceral functions carrying visceral motor and sensory information to and from the visceral organs.

Some anterior rami unite with adjacent anterior rami to form a nerve plexus, a network of interconnecting nerves. Nerves emerging from a plexus contain fibers from various spinal nerves, which are now carried together to some target location. Major plexuses include the cervical, brachial, lumbar, and sacral plexuses.
1. **Somatic efferent.**
2. **Somatic afferent.**
3,4,5. **Sympathetic efferent.**
6,7. **Sympathetic afferent**
Cervical plexus

The cervical plexus is a network of nerve fibres that supplies innervation to some of the structures in the neck and trunk. It is located in the posterior triangle of the neck, halfway up the sternocleidomastoid muscle, and within the prevertebral layer of cervical fascia. The plexus is formed by the anterior rami (divisions) of cervical spinal nerves C1-C4.
The cervical plexus begins as a combination of the anterior divisions of the spinal nerves C1, C2, C3 and C4. Cervical plexus gives rise to numerous branches which supply structures in the head and neck. through **muscular branches and cutaneous sensory branches**. After arising from the cervical plexus, the **muscular branches tend** to travel initially in an anteromedial direction. Cutaneous branches travel posteriorly.
Muscular branches supply the muscles of the neck, back and the diaphragm.

1- Phrenic Nerve
The phrenic nerve arises from the anterior rami of C3-C5. It provides motor innervation to the diaphragm. After arising from the cervical plexus, the nerve travels down the surface of the anterior scalene muscle, and enters the thorax. In the thoracic cavity, the nerve descends anteriorly to the root of the lung to reach the diaphragm.
2- Nerves to Geniohyoid and Thyrohyoid
The C1 spinal nerve gives rise to nerves to the **geniohyoid** (moves the hyoid bone anteriorly and upwards, expanding the airway) and the **thyrohyoid** (which depresses the hyoid bone and elevates the larynx).
These nerves travel with the **hypoglossal nerve** to reach their respective muscles.
3- Ansa Cervicalis
The ansa cervicalis (goose’s neck) is a loop of nerves, formed by nerve roots C1-C3. It gives off four muscular branches:

- Superior belly of the omohyoid muscle
- Inferior belly of omohyoid muscle
- Sternohyoid
- Sternothyroid

These muscles (the infrahyoids) act to depress the hyoid bone; an important function for swallowing and speech.
4- Other Muscular Branches

Several other minor branches arise from the nerve roots to supply muscles of the neck and back:

**C1-C2**: Rectus capitis anterior and lateralis

**C1-C3**: Longus capitis

**C2-C3**: Prevertebral muscles and sternocleidomastoid

**C3-C4**: Levator scapulae, trapezius and scalenus medius, middle and anterior scalenus muscles
Sensory Branches
The cutaneous branches of the cervical plexus supply the skin of the neck, upper thorax, scalp and ear. These nerves all enter the skin at the middle of the posterior border of the sternocleidomastoid. This area is known as the nerve point of the neck (Erb’s point), and is utilised when performing a cervical plexus nerve block.

1- Greater Auricular Nerve
The greater auricular nerve is formed by fibres from C2 and C3 roots. It provides sensation to the external ear and the skin over the parotid gland. It is the largest ascending branch of the plexus
2- Transverse Cervical Nerve
The transverse cervical nerve is also formed by fibres from C2 and C3. It curves around the posterior aspect of the sternocleidomastoid, and supplies sensation to the anterior neck. The nerve then pierces the deep cervical fascia and then gives branches that pass superiorly and inferiorly to supply the anterolateral skin of the neck and upper sternum.
3- Lesser Occipital Nerve
The lesser occipital nerve is derived from the C2 root, with a contribution from C3 in some individuals. It supplies cutaneous sensation to the **posterolateral scalp**, and commonly communicates with the posterior branch of the greater auricular nerve.
4- Supraclavicular Nerves
The supraclavicular nerves are a group of nerves formed from the C3 and C4 roots. They arise from the behind the posterior border of sternocleidomastoid, and provide sensation to the skin overlying the **suprascapular fossa** and upper thoracic region and sternoclavicular joint.
Thank You