OLFACTORY NERVE

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RESOURCES

1. Essential of Human Anatomy & Physiology
   By Elaine Marieb and Suzanne Keller

2. Clinical Neuroanatomy
   By Richard Snell

3. Atlas of Human Anatomy
   By Frank Netter
“Cranial nerves are the nerves that emerge directly from the brain, in contrast to spinal nerves which emerge from segments of the spinal cord”
- There are 12 pairs of cranial nerves in our body (I-XII).
- They are called cranial nerve because they originated directly from the brain.
- They communicate and relay information between the brain and parts of the body, primarily to and from regions of the head and neck.
- They are generally named from anterior to posterior based on structure or function.
- For example, the olfactory nerve (I) provides smell, and the facial nerve (VII) provides motor innervation to the face.
- The first and shortest cranial nerve.
- It is the nerve to transmit special sensory information to have a sense of smell.
- It is one of two nerves that DO NOT emerge from brainstem,
- Elderly people usually have less sensation of smell probably because of progressive reduction in number of olfactory cells.
Function

- It is only sensory.
- Function is to carry afferent impulses for the sense of smell.
Nerve Course

- It passes through the cribriform plate of the ethmoid bone and attached to olfactory bulb.
- The fibers enter the olfactory bulb, which lies in the olfactory groove, within the anterior cranial fossa.
- The olfactory tract runs inferiorly to the frontal lobe.
- Function is to carry afferent impulses for the sense of smell.
- Once the axon penetrates through the basement membrane, it joins other non-myelinated processes to form the fila olfactoria.
  - bundles of olfactory axons.
- They enter the cranial cavity through the cribriform plate of the ethmoid bone.
  - the roof of the nasal cavity.
**Olfactory Pathway**

- **First neurons:**
  - Olfactory receptors are specialized, ciliated nerve cells that lie in the olfactory epithelium.
  - The axons of these bipolar cells 12-20 fibers form the true olfactory nerve fibers, which passes through the cribiform plate of ethmoid.
  - They join the olfactory bulb.
  - Preliminary processing of olfactory information is within the olfactory bulb, which contains interneurons and large Mitral cells; axons from the latter leave the bulb to form the olfactory tract.

- **Second neurons:**
  - It is formed by the Mitral cells of olfactory bulb.
  - The axons of these cells form the olfactory tract.
  - Each tract divides into two roots at the anterior perforated substance:
    - Lateral root carries olfactory fibers to end in cortex of the Uncus & adjacent part of Hippocampal gyrus (center of smell).
    - Medial root crosses midline through anterior commissure and joins the uncrossed lateral root of opposite side.
  - It connects olfactory centers of two cerebral hemispheres. Thus, each olfactory center receives smell sensation from both halves of nasal cavity.
In the cranial cavity, the fibers enter the olfactory bulb, which lies in the olfactory groove, within the anterior cranial fossa.

The olfactory bulb is an ovoid structure which contains specialized neurons, called mitral cells.

The olfactory nerve fibers synapse with the mitral cells, forming collections known as synaptic glomeruli.

From the glomeruli, second order nerves then pass posteriorly into the olfactory tract.
Olfactory Tract

- The olfactory tract runs inferiorly to the frontal lobe to reaches the anterior perforated substance to divides into medial and lateral stria:
  - The lateral stria carry the axons to the olfactory area of the cerebral cortex (also known as the primary olfactory cortex).
  - The medial stria carry the axons across the medial plane of the anterior commissure where they meet the olfactory bulb of the opposite side.
  - The primary olfactory cortex sends nerve fibers to many other areas of the brain, like piriform cortex, amygdala, olfactory tubercle and the secondary olfactory cortex.
  - These areas are involved in the memory and appreciation of olfactory sensations.

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Posterior and anterior to the optic chiasm, the olfactory tract on both sides divides into medial and lateral olfactory striae.

The medial stria projects to the anterior commissure, and then to contralateral olfactory structures.

The lateral stria continues to structures associated with the olfactory cortex.
It is important to note that the olfactory nerve is made up of multiple nerve fibers/rootlets coming from the receptor's cells.

The pathway can be summarized as follows:

- olfactory receptor cells
- olfactory nerves
- olfactory bulb
- olfactory tract
- olfactory striae
- olfactory cortex
The olfactory mucosa is a very important structure as it not only senses smell, but also the more advanced aspects of taste.

It is located in the roof of the nasal cavity and is composed of pseudostratified columnar epithelium which contains a number of cells.
- **Basal cells**: form the new stem cells from which the new olfactory cells can develop.
- **Sustentacular cells**: tall cells for structural support. These are analogous to the glial cells located in the CNS.
- **Olfactory receptor cells**: bipolar neurons which have two processes, a dendritic process and a central process. The dendritic process projects to the surface of the epithelium, where they project a number of short cilia, the olfactory hairs, into the mucous membrane. These cilia react to odors in the air and stimulate the olfactory cells. The central process (also known as the axon) projects in the opposite direction through the basement membrane.
- There are also **Bowman’s glands** present in the mucosa, which secrete mucus.

**Mucosa Cells**
CLINICALS

1. Anosmia
2. Dysosmia
3. Hyposmia
4. Hyperosmia
Anosmia

- The complete absence of the sense of smell.
- It can be temporary or permanent.
- Temporary anosmia can be caused by infection or by local disorders of the nose.
- Permanent anosmia can be caused by head injury, or tumours which occur in the olfactory groove (e.g. meningioma).
- Anosmia can also occur as a result of neurodegenerative conditions, such as Parkinson’s or Alzheimer’s disease.
Dysosmia

- A distortion in the quality of the perception of an odor.
- Sometimes, the perception of an odor when no odor is present.
- Damage to olfactory nerve fibers can occur as a complication of upper respiratory tract infections.
- A decrease in the number of nerve fibers from these infections mean that there are not enough different fibers to accurately differentiate odors resulting in parosmia.
Hyposmia

- It is the reduction of the ability to smell and to detect odors.
- The causes include allergies, nasal polyps, viral infections and head trauma.
- Older people are subjected to have hyposmia.
- Hyposmia might be a very early sign of Parkinson's disease.
- Lifelong hyposmia could be caused by Kallmann syndrome or Autistic Spectrum Disorder.
Hyperosmia

- Hyperosmia is an increased olfactory sharpness with increased sense of smell.
- This perceptual disorder arises when there is an abnormally increased signal at any point between the olfactory receptors and the olfactory cortex.
- The causes may include genetic, hormonal or environmental.
- When odorants enter the nasal cavity, they bind to odorant receptors at the base of the olfactory epithelium.
- These receptors are bipolar neurons that connect to the glomerular layer of the olfactory bulb, traveling through the cribriform plate.
- The hyperosmic person may need to be removed from strong odorants for a period of time if the sensation becomes unbearable.
Questions

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