# OLFACTORY NERVE

# Introduction

- First cranial nerve
- One of the two cranial nerves which doesn't course through the posterior fossa
- Only neurons which can regenerate (basal cells)
- Only sensation which is not processed in the thalamus directly

# Overview of olfactory system

- Sensory system used for smell
- Represents one of the oldest sensory modalities in the phylogenetic history of mammals
- Less developed in humans than in other mammals such as rodents. As a chemical sensor, the olfactory system detects food and influences social and sexual behavior.
- 2 distinct parts-
  - Main- for volatile air-borne stimuli
  - Accessory- for fluid-phase stimuli
- Often spoken along with the gustatory system as the chemosensory senses
- Mechanism-Peripheral and central

# Peripheral component

- External stimulus( odour)
- Olfactory receptors in olfactory epithelium
- Transduction of receptor activation into electric signals
- Signals travel along the olfactory nerves (part of peripheral)
- End in olfactory bulb ( part of central)

# Central component

- Olfactory bulb
- Medial and lateral olfactory striae
- Terminal areas

- First order- Bipolar sensory cells in the olfactory epithelium
- Second order- Mitral and tufted cells in the olfactory glomeruli
- Third order- Neurons in the olfactory cortex

# Olfactory epithelium

- Specialised epithelial tissue inside the nasal cavity that is involved in smell
- It is about 1 cm2 on each side and lies in the roof of nasal cavity around 7 cm above and behind the nostrils
- Part of the olfactory system directly responsible for detecting odors
- 3 types of cells- olfactory, supporting, basal cells

# Cells

- Olfactory cells- Bipolar cells which congregrate to form the olfactory nerve
- Supporting/ sustentacular cells- metabolic and physical support to olfactory cells
- Basal cells- STEM CELLS capable of differentiating into either of the two.
  - Their constant division leads to olfactory epithelial regeneration every 2-4 weeks
- Can be injured by- Toxic fumes/physical injury/? nasal sprays

# Olfactory nerves

- Not a single nerve
- Instead, a collection of many sensory nerve fibers that extend from the olfactory epithelium to the olfactory bulb, passing through the many openings of the Cribriform plate of the Ethmoid bone; a sieve-like structure.
- The olfactory nerve is the shortest of the twelve cranial nerves and only one of two cranial nerves (the other being the optic nerve) that do not join with the brainstem.

# Olfactory bulb

- The olfactory bulb lies inferior to the basal frontal lobe.
- The olfactory bulb is a highly organized structure composed of several distinct layers and synaptic specializations- most important being Mitral and tufted cells

# Olfactory tract

- Projections of the mitral cells to the olfactory cortex
- Divide into medial and lateral olfactory striae
- Some fibres decussate in the anterior commisure
- Medial strial fibres contact the anterior olfactory nucleus and septal area
- Lateral striae end in the third order neurons of the olfactory cortex
- Third order neurons in turn send projections to-
  - Dorso-medial nucleus of thalamus
  - Basal forebrain
  - Limbic system

# Olfactory cortex

- Pyriform lobe includes olfactory tract, uncus and ant part of parahippocampal gyrus
- Primary olfactory cortex- pre-pyriform and periamygdaloid areas
- Secondary cortex- entorrhinal area

# Olfactory abnormalities

- Terminologies used
  - **Anosmia - Absence of smell sensation**
  - **Hyposmia - Decreased sensation**
  - **Hyperosmia- Overly acute sense of smell**
  - **Dysosmia – Impairment or defect in sense of smell**
  - **Cacosmia - Sensation of a bad or foul smell**
  - **Coprosmia- cacosmia with fecal odour**
  - **Parosmia – Perversion or distortion of smell**
  - **Phantosmia- Perception of an odour that is not real**
  - Olfactory agnosia- Inability to identify detected odours

# Testing of the function

- Use common odours- coffee, lemon, peppermint, soap etc
- NEVER USE IRRITANT ODOURS- such as ammonia, as it stimulates the V th nerve instead of I cr n
- Make sure that nasal passages are open and pt doesn't have local nasal pathology
- Patient must close his eyes and asked to smell through one nostril after another
- Points to note-
  - Whether he can detect any odour/not
  - Whether he can identify the correct odour
  - Is the intensity symmetrical on both sides

- Perception more important than identification
  - Perception indicates continuity of olfactory pathways
  - Identification indicates intact cortical function as well
- Lesion central to the decussation never causes anosmia such as lesion of olfactory cortex
- Appreciation of presence of smell is enough for exclusion of anosmia.

# Applied aspect

- History- Enquire about
  - Past head injury
  - Smoking
  - Recent URTI
  - Systemic illness
  - Toxins/medications/illicit drugs
- Most common causes-
  - URI
  - Trauma
  - Idiopathic

# Neurologic causes of anosmia

- Lesions of the orbital surface of brain-
  - Sphenoid ridge/ olfactory groove meningiomas
  - Frontal lobe gliomas
- Cranio-cerebral trauma with damage to the cribriform plate
- Damage due to excessive retraction of frontal lobes
- Temporal lobectomies ( pt cant identify)
- Foster-Kennedy syndrome-
  - Anosmia+ I/L optic atrophy (due to direct compression)+ C/L papilloedema ( as ICP rises)
  - In orbito-frontal tumours- olfactory groove meningiomas
- Pseudo-FK syndrome-
  - Optic atrophy+ C/L papilloedema
    - In ant optic n ischemia
    - Mass causing asymmetrical compression of optic nerves

# Other causes

- Drugs- Antihistamines/ prpylthiouracil/antibiotics
- Toxins-cadmium/toulene
- Vit def- A,B6,B12
- Alzheimer's/ Parkinson's disease/ Multiple sclerosis
- Conversion disorder
- Kallman Syndrome-
  - Hereditary disorder (X-linked)
  - Hypogonadism + anosmia.

# Olfactory hallucinations

- Psychosis
- Lesion of central olfactory system-neoplastic/ vascular
- Uncinate fits-
  - Complex partial/ temporal lobe seizures
  - Usually preceded by an olfactory/gustatory area that is often disagreeable
  - Often accompanied by chewing movements
  - Seizure focus- MEDIAL TEMPORAL LOBE
  - No objective loss of smell interictally

# Thank you