The Sense of Smell

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- Olfactory receptor cells
- Area of 5cm² in roof of nasal cavity near the septum
- 10 to 20 million receptor cells
- Each olfactory receptor is a neuron
- Olfactory mucous membrane is the place in body where NS is closest to external world

Composition of Olfactory epithelium

- Each neuron has a thick dendrite with an expanded end called olfactory rod
- From rods and cilia project to the mucous surface
- Each receptor neuron has 10-20 cilia
- Axons of olfactory receptor neurons pierce cribriform plate of ethmoid bone and enter olfactory bulbs

Mucus producing Glands

- Olfactory mucous membrane is constantly covered by mucus
- Mucus is produced by Bowman's glands, placed just under the basal lamina of the membrane

Olfactory Bulbs

- Axons of receptors contact the primary dendrites of mitral cells and tufted cells.
- Forming complex globular synapses called olfactory glomeruli.
- Periglomerular cells are inhibitory neurons connecting one glomerulus to another

- Granule cells have no axons and make reciprocal synapses with lateral dendrites of tufted and mitral cells
- Mitral and Tufted – excite granule releasing glutamate and granule cell in turn inhibits both by releasing GABA
Stimulation of Olfactory cells

- $G$-protein is stimulated - triggers activation of Adenyl cyclase (enzyme speeds up the conversion of ATP to cAMP – cAMP then binds to action channels in membrane of cilia - influx of Ca ions opens channels - influx of Ca ions activates Cl channels - this causes channels to open – influx of Ca ions and Cl leaves. Membrane becomes depolarized and AP is created. The action potential travels down the axon of olfactory receptor cell eventually meets with the other axons and forms the olfactory nerve (CN I).

Stimulation of olfactory cells

Transmission of smell signals to CNS

- Olfactory thresholds and discrimination:
  - Olfactory receptors respond only to substances in contact with olfactory epithelium and need to be dissolved in mucus.
  - Methyl mercaptan one of the substances in garlic can be smelled at very low concentration showing the remarkable sensitivity of olfactory receptors.
  - Humans can recognize more than 10,000 different odors.
  - However, determination of intensity of odor is poor.

Substance | mg/L of Air |
--- | --- |
Ethyl ether | 5.83 |
Chloroform | 3.30 |
Perylene | 0.03 |
Oil of peppermint | 0.02 |
Pyrethrum | 0.009 |
Propyl mercaptan | 0.006 |
Artificial musk | 0.00004 |
Methyl mercaptan | 0.000004 |

Vomeronasal Organ

- Organ is not well developed in humans very well developed in rodents.
- This organ is concerned with perception of odors that act as pheromones.
- There is evidence of pheromones in humans and a close relationship between smell and sexual function.
Role of Pain Fibers in the Nose

Many trigeminal pain fibers are found in olfactory membrane. They are stimulated by irritating substances and are responsible for initiating sneezing, lacrimation, and other reflex responses.

Abnormalities

- Anosmia – absence of sense of smell
- Hyposmia – diminished olfactory sensitivity
- Dysosmia – distorted sense of smell
- More than 75% of humans over the age of 80 have an impaired ability to identify smells

Summary

Glossary

- Olfactory Receptor Neurons: Sensory cells that detect odors.
- Olfactory Bulb: First relay station in the olfactory system.
- Frontal Cortex: Involved in conscious perception of smell.
- Amygdala: Involved in emotional aspects of smell.
- Hypothalamus: Involved in motivational aspects of smell.
- Hippocampus: Involved in odor memory.

Bibliography

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