UNIVERSITAS CAROLINA PRAGENSIS

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Smell and taste

Sensory organs & their pathways

Institute of Anatomy

Author: David Sedmera Subject: Anatomy 2 Date: 1.6.2015 Olfaction in literature:

The Perfume



Importance of olfaction in animals

- There are identified 1300 odorant receptors in the mouse vs. 500 in humans.
- If mice possess 20,000 genes, then as much as 5% of the genome, i.e., one in 20 genes, encodes the odorant receptors (ORs).

Olfactory nerve (I)





Olfactory area (shown in blue)





Ment - mesocortex, CC - corpus callosum, F - frontalní kura, Ment - mesocortex (entorhinální kůra), Mpp - mesocortex (prepiriformní kůra), P - paleocortex, T - temporální kůra. Srovnej s obr. 111 a 56.



Olfactory cell (1, in TEM)

2 – goblet cell

Olfactory bulb and connections



Obr. 67.: Zapojení buněk bulbus olfactorius do čichové dráhy.

BO - bulbus olfactorius, com - komisurálni vlákna (z druhostranného BO), dbB - vlákna z diagonálního svazku Brokova (ze septa a hypothalamu), ETHM - os etheoidale, G - granulární buňky, gl.olf. - glomerulus olfactorius, M - mitrální buňka, p.b. - podpůrná buňka ve sliznici regio olfactoria, pG - periglomerulární buňka, s.b. smyslová čichová buňka. Šipky vyznačují směr dendro-dendritického přenosu impulsů. Směr přenosu v normální axo-dendritické synapsi (polokoule na konci vláken) není vyznačen.



Obr. 111.: Schema terminací čichové dráhy, srovnej s obr. 110. Jemné tečky - paleocortex a prepiriformní mesocortex (P, M_{PP}), čárky - entorhinální mesocortex (M_{ent}), hrubé tečky - orbitofrontální čichová kůra gpH - gyrus parahippocampalis, s.col. - sulcus collateralis, tr.o - trigonum olfactorium, u - uncus.

Olfactory cortex



Diagram of the base of the brain showing the location of the primary olfactory cortex. (Olfactory tract fibers only end in a small, rostral portion of the entorhinal cortex. Most of the entorhinal area serves as part of the olfactory association cortex.) Fibers of the olfactory tract also terminate directly in a portion of the amygdala.



FIG. 1. Semischematic drawing illustrating the localization of the olfactory epithelium and vomeronasal organ in the snake head (A). B indicates level of sections. C–H correspond to frontal hemisections of the snake brain showing the neural circuitry of chemosensory pathways. Hatched areas correspond to olfactory (vertical), vomeronasal (horizontal) and mixed chemosensory (crossed) information. Abbreviations: ac, anterior commissure; AOB, accessory olfactory bulb; DC, dorsal cortex; DLA, dorsolateral amygdala; ExA, external amygdala; LC, lateral cortex; LHN, lateral posterior hypothalamic nucleus; MA, medial amygdala; MC, medial cortex; MOB, main olfactory bulb; NS, nucleus sphericus; OE, olfactory epithelium; PDVR, posterior dorsal ventricular ridge; PH, periventricular hypothalamic nucleus; S, septal complex; VAA, ventral anterior amygdala; VMH, ventromedial hypothalamic nucleus; VNO, vomeronasal organ; XIIN, hypoglossal nucleus.



Important connections of the olfactory pathway

- Entorhinal area and hippocampus
- Thalamus (nuclei anteriores) => cingulum, hippocampus, frontal neocortex, insula
- Amygdala => fronto-orbital cortex
- Hypothalamus (vegetative functions)

Current research on olfaction

- Olfaction is a vitally important sense for all animals.
- There are striking similarities between species in the organization of the olfactory pathway, from the nature of the odorant receptor proteins, to perireceptor processes, to the organization of the olfactory CNS, through odor-guided behavior and memory.
- These common features span a phylogenetically broad array of animals, implying that there is an optimal solution to the problem of detecting and discriminating odors.
- Each olfactory neuron expresses only a single olfactory receptor.

Morphology of olfactory cells is conserved across species



Dynamic evolution of the olfactory receptors genes



Ache & Young, Neuron 2005



Molecular mechanisms of olfactory signaling:

a) cAMP

b) PIP3

Ache & Young, Neuron 2005

Convergence of olfactory neurons to olfactory bulb (mouse)



ORs are expressed on both dendrites and axons



Olfactory maps in glomeruli are conserved (fly)



CO2 activates a single olfactory glomerulus and leads to avoidance reaction in fly



Smell can save your life!

Reading the olfactory code: projection neurons







řez chuťovým pohárkem

schematický stereogram: oblast vymezená nahoře





Taste buds & papillae

Obr. 2: Řez hrazenou papilou (vlevo) a chuťovým pohárkem (vpravo).
V černě vyznačené sliznici jazyka jsou bíle zakresleny chuťové pohárky, uložené v příkopu hrazené papily. Pod příkopem leží slinné žlázky. Vpravo, v chuťovém pohárku, jsou tečkovaně vyznačeny chuťové smyslové buňky a černě je zakresleno terminální větvení sensorického nervového vlákna.





Innervation of the tongue





Innervation of the tongue - the nuclei at the floor of fourth ventricle







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