

PHYSIOLOGY

Lecture : 9

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Chemical senses-smell

هو عبارة عن chemical senses لانو يتم عن طريق دخول chemical stimulus زي food, odour وبصير لها chemical stimulus transduction

Smell

-least understood of all senses

-poorly developed in humans

ال smell بالانسان وال animal وال pathway لحتى ال cortical region لحد الان مش مفهومة
وال smell بالانسان هي less develop بس بالحيوانات بنكون اكثر تطورا وهو مهم الها لحتى تلاقي طعامها وتعرف
اعدائها و.....

حاسة الشم مش مهمة لل survival هي مهمة لل quality of life

Important of smell

-enjoyment& selection of food

-flavours are combination of taste and smell (smell contribution about 80%)

هسا لحتى تحكي عن الاكل انو لذيذ هاض بعتمد على الشم والتذوق بس اكثر اشيا على الشم بنسبة 80%

-giving warning of harmful substance and place

هسا الشم مهم لحتى نعرق انو في خطر مثلا نسينا جرة الغاز مفتوحة بحاسة الشم بتقدر تميز الريحة وتتدارك الخطر او
مثلا مبيد حشري او نار وغيره

Olfactory membrane

Located on the superior part of nostril

The olfactory epithelium consist tree kind of cell

1-olfactory receptor

2-supporting cells/ sustentacular cells

3-basal cell

عملية ال smell بتبلىش بال olfactory cell وهي موجودة بال superior part of nostril ولحتى تشم لازم تكوم volatile
وكمان بلعب دور ال structure وكيفية تركيب ال nose الي هو انو turbid فبعمل flow turbid to of odour to
transduction facilitated odour to attach to olfactory membrane

Olfactory receptors

-The receptor cells for smell sensation are the olfactory cell

-they are actually bipolar nerve cell **derived from the CNS**

هنا receptor cell هي عبارة عن bipolar cell بتغطي olfactory rod بتروح بتجاه ال mucous وبتغطي axon الي بتجمع وبعطي olfactory nerve

-there are about **100M of these cell** in the olfactory epithelium

-the mucosal end of the olfactory cell from knob

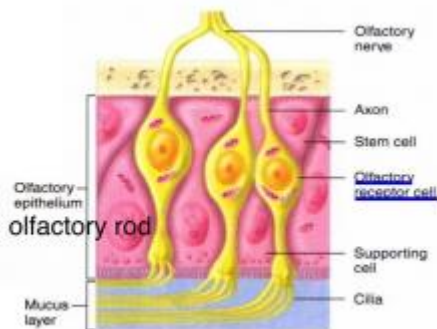
-from knob 4 to 25 olfactory hairs (olfactory cilia), project into the mucosa that coats the inner surface of the nasal cavity

-these projecting olfactory cilia form a dense mat in the mucus

ال olfactory rod الي بتجاه ال mucosa layer بعملونا knob وهاض ال knob ومنو بطلع منو ال cilia تقريبا 4 to 25 olfactory cilia from each knob

-these cilia react to odours in the air and stimulate the olfactory cells

هنا ال cilia هي الي بتتفاعل مع ال odours مع ال olfactory cell حتى يصير stimulation to olfactory receptor



Supporting cells/ sustentacular cells

-The receptor cells in the olfactory epithelium are interspersed among sustentacular cell or supporting cell

موجودين حولين ال olfactory receptor وهم عبارة عن epithelium

Function:

1-They provide physical support, nourishment and electrical insulation for olfactory receptor
بعطو ال physical support لل olfactory receptor ويزودو بال nourishment وكان بعملو electrical insulation

2-they help detoxify chemical that come in contact with the olfactory epithelium

بعملو detoxify to toxic substance زي مثلا المبيدات الحشرية

Basal cell

-basal cells are stem cell located between the bases of the supporting cells

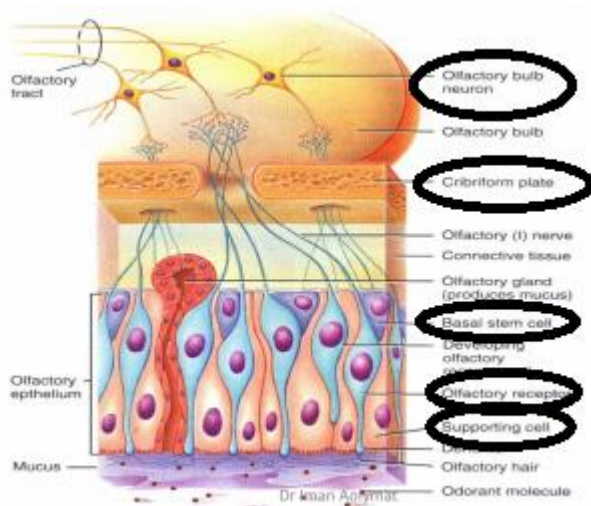
-they continually undergo cell division to produce new olfactory receptor, which live for only a month or so before being replaced

-the olfactory renewal process is carefully regulated- a bone morphogenic protein (BMP) exerts an inhibitory effect

هو موجود بال base of supporting cell and olfactory cell و stem cell و precursor للolfactory receptor وبالتالي ال olfactory receptor بصير لهم degeneration بالوضع الطبيعي تقريبا هلال شهر فبصير renewal of olfactory receptor by basal cell

هسا اغلب ال neuron الي بصير لهم degeneration ما بصير لهم regeneration and production of new neuron بس نتيجة ال function of olfactory receptor بصير لهم sloughing and replacement with new neuron حتى تكمل عملية ال smell sense

Regeneration of olfactory receptor control by growth factor called bone morphogenic protein (BMP) which make inhibit effect on renewal process



Bowman's gland

Spaced among the olfactory cells in the olfactory membrane are many small Bowman's gland that secret mucous onto the surface of the olfactory membrane

Mucous is carried to the surface of the epithelium by ducts

The section can moistens the surface of the olfactory epithelium and dissolve odourants so that transduction can occur

ال Bowman's gland هاض مهم لحتى يصير production of mucous الي بطلع عن طريق ال duct لل epithelium

هسا ال mucosa مهمة لانو بعطينا ترطيب لل nasal cavity وبشتغل as solvent media لحتى اقدر اعمل inhalation لل odourant لازم يذوبو بال mucosa لحتى يرتبطو بال olfactory receptor وتصير عملية ال transduction

Mechanism of excitation of olfactory receptor

The portion of olfactory cell that response to the olfactory chemical stimulant is the olfactory cilia

The odorant substance, on coming in contact with the olfactory membrane surface

First, it is diffuse into the mucous that covers the cilia then it bind with receptor protein in the membrane of cilia

Each receptor protein is along molecular, transmembrane protein about seven time folding inward and outward

The inside of the folding protein is coupled to G-protein also called Golf

G-protein is tree substance: alpha, beta, gamma

On excitation receptor protein, an alpha subunit breaks away from G-protein and immediately activate adenylyl cyclase

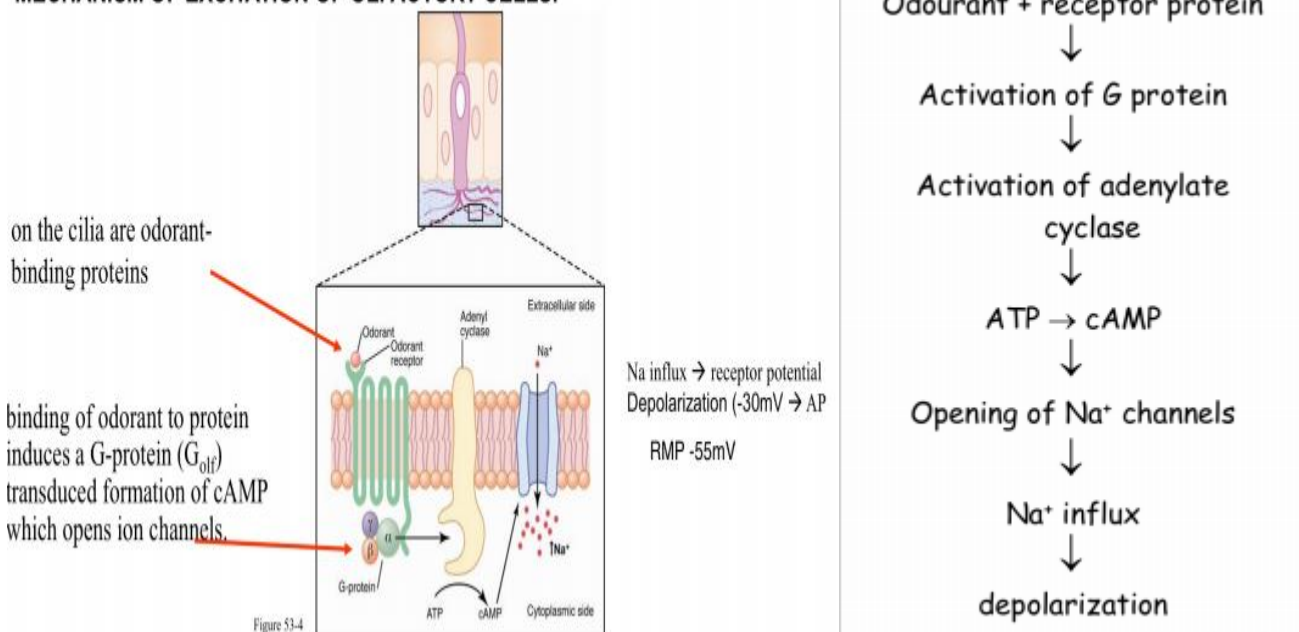
Adenylyl cyclase is attachment to inside of the ciliary membrane near to receptor cell body and when excitation is converts the intracellular ATP to cAMP

And finally, cAMP activate membrane protein, gated Na ion channel, that open this gate and allow Na to inter the cytoplasm of receptor cell

The Na increase electrical potential in the positive direction(depolarization) thus exciting the olfactory neuron and transmitted action potential into the CNS by away of the olfactory nerve

The membrane potential at resting membrane potential is -55mV when become depolarize decrease negativity from -55 to -30mV

MECHANISM OF EXCITATION OF OLFACTORY CELLS.



To be smell

There are several factor affect to degree of the stimulation:

- 1-substance must **be violate** so that it can be sniffed into the nostrils
 - 2-substance musket be at least slightly **water soluble** to penetrate mucosa to reach the olfactory cell
 - 3-subctance must at least slightly **lipid soluble** to interact with the membrane
- olfactory substance adapt very slowly
 - olfactory sensation itself adapt rather rapidly
 - must involve central mechanism

هسا ال olfactory receptor بصيرلهم adaptation و هاض بتصير اول ما تطلع الريحه بتشمها بعد شوي بتبطل تشعر فيها

هسا ال adapt بصير بال sensation and receptor بس ال adapt بال sensation يكون اسرع وكل هاض يكون control on central nervous system

هو سلاح ذو حدين مثلا صار تسريب غاز اول اشي بتلاحظ ولكن مع مرقر الوقت ما بتشم ريحة وممكن تكون مقيدة مثلا دخلت على غرفة في ريحة كريهة فشوي شوي بتبطل تشعر فيها

Olfactory pathway

Axons of olfactory neuron pass through perforations in the cribriform plate tp enter olfactory bulb in the cranial cavity

Short axon from the olfactory cells terminate in multiple globular structure within the olfactory bulb called glomeruli

Each bulb has several thousand such glomeruli, each of which is the terminus for about 25.000axons from olfactory cells

Each glomerulus also is the terminus for dendrites from about 25 large mitral cells and about 60 smaller tufted cells, the cell bodies of which **lie in the olfactory bulb superior to the glomeruli**

These dendrites receive synapse from the olfactory cell neuron

The mitral and tufted cells send axons through the olfactory tract to transmit olfactory signals to higher level in the central nervous system

Some research has suggested that different glomeruli respond to different odours

Olfactory nerve fiber leadinf from olfactory bulb are called cranial nerve 1 or olfactory tract

هسا بعد ما حولنا ال chemical sense ل action potential بروح هاض ال axon لل cribriform plate الموجود بال base of skull فيتجمع ال axon ل 20 filament بطلع من cribriform plate وهنا بقوت على ال olfactory bulb وبعمل synapse مع different type of cell بنسميهم glomeruli

كل bulb فيو thousand of glomeruli كل glomeruli بوصول 25,000 axon from olfactory cell
ال glomeruli response to different odorance بس لس العملية مش مفهومة
هسا ال glomeruli عبارة عن محطة بينة (mitral and tuft cell) axon and dendrite to other cell
كل glomeruli فيها 25 large mitral cell and 60 smaller tuft cell ل terminal dendrite
فبصير synapse between dendrite of mitral and tufted cell with axon of olfactory cell neuron
هسا ال mitral and tuft cell بتطلع axon بنسميه ال 1 olfactory tract or cranial nerve لل CNS

The olfactory tract enter the brain at anterior junction between mesencephalon and cerebrum

There, the tract divides into two pathways, one passing medially olfactory area (primitive olfactory system) of the brain stem, and the other passing laterally onto the lateral olfactory area

The medial olfactory area represent a very old olfactory system, whereas the lateral olfactory area is the input to 1-a less old olfactory system and 2-a newer system

ال axon طالع من mitral and tuft cell ويتدخل لل brain عن طريق anterior junction between mesencephalon and cerebrum

هون ال tract بتفرع ل medial and lateral olfactory area

ال medial olfactory area بنسُميها primitive olfactory system وبتودي ل very old olfactory system
ال lateral olfactory area بتودي ل a less old olfactory system and a newer system

The medial olfactory area send to septal nuclei which input to hypothalamus and primitive portion of limbic system (very old olfactory area)

The important of these area is :more primitive response to olfaction such as salivation, liking lip and other feeding response caused by smell food and primitive emotion drive to smell these basic olfactory reflex

It is called primitive because present in all animal not just human

The lateral olfactory system in put to

1-less old olfactory system: in put to prepyriform cortex, pyriform cortex and amygdala and from these area signal pathway into all portion of limbic system especially hippocampus which is less primitive portion

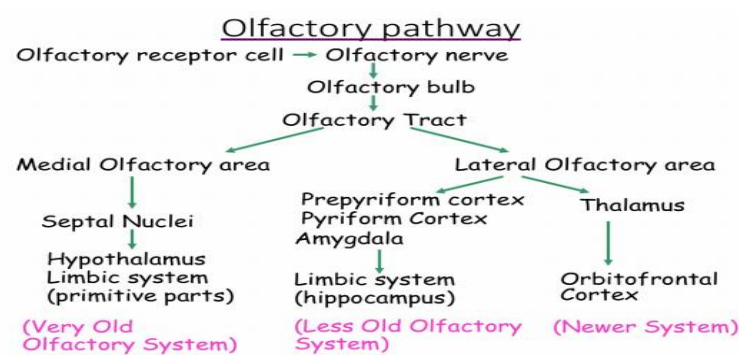
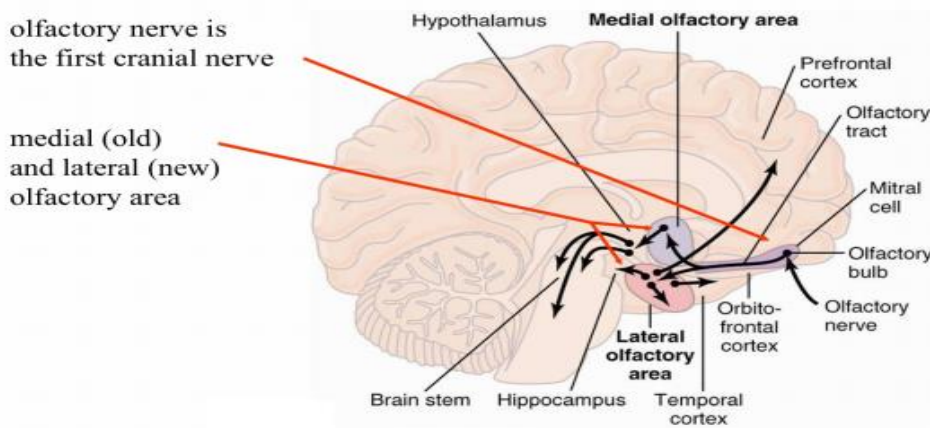
And it is important to learning to like or dislike certain food depend once experience with them like aversion food to food that have caused nausea and vomiting

2-the newer system: pass through the thalamus then to the orbitofrontal

The important is conscious perception and analysis of ordour (ordour discrimination)

يعني تميز الروائح :ريحة مبيد ريحة غاز,.....

Note: Less old olfactory system and vary old olfactory system both send to limbic system but in very old olfactory system send to primitive part of olfactory system and less old olfactory system to hippocampus



Abnormality of olfactory sensation

1-Anosmia: Total loss of smell sensation

Two type:

a. Temporary anosmia caused by Obstruction of nose –common cold, nasal sinus and allergic condition

انها تكون مؤقتة مثلا زي رشح او واحد مصاب بكورونا

b. Permanent anosmia caused by olfactory tract lesion ,meningitis and neurodegenerative disorder

meningitis or damage of olfactory neuron او بال CNS ممكن نتيجة Parkinson neurodegenerative disorder مثل

2-Hyposmia : Reduce ability to recognize and to detect any order

The most common disorder of smell

3-Hyperosmia= olfactory hyperesthesia: Increase and exaggerated olfactory sensation

Caused by Brain injury, epilepsy and neurotic condition

نهاية التلخيص سامحونا على اي اخطاء