LEC 23

SLIDE 2

tract: a bundle of axons inside the central nervous system.

SLIDE 4

posterior column = dorsal column

SLIDE 5

the posterior column is responsible for certain actions such as:
1- fine-touch
2- vibration
3- pressure
4- proprioception
proprioceptive = the movement of joint or tendon or any skeletal muscles in space (knowing if it goes up, down, right, left).
how are these signals transmitted to the posterior column? a type of receptors need to be stimulated (check slide 6)
the stimulation would go UP through the DORSAL GANLGION ROOT which is found outside of the spinal cord where a synapse happens with the DORSAL ganglion (check slide 7), this is called a first-order neuron.
now, the pathway of the signal would go into the spinal cord.
we have two divisions for the posterior column:
1- fasciculus cuneatus
2- fasciculus gracilis
(check slide 8)
these two divisions would transmit the signals UP to the medulla oblongata where they synapse with the NUCLEUS GRACIILIS AND CUNATEOUS. this is called the second-order neuron.
the second-order neuron would CROSS OVER to the opposite side (in the picture it goes from the right side TO the left side).
* because of this, the right side of our body is controlled by the left side of our brain and vice versa.
the signal would then go up to the medial lemniscus in the mid-brain and go up to the fore-brain in the ventral nuclei of the thalamus.
ALL SENSORY SIGNALS HAVE TO TRANSMIT TO THE THALAMUS EXCEPT THE SMELLING SENSATION.
from the thalamus, all the sensory signals would transmit to cerebral cortex of the brain which has the following three regions.
the three regions are:
1- the projection fibers (responsible of ascending or descending information)
2-corpus callosum (connects the right side of the brain with the left side and transmits information between them)
3- parietal lobe/association area (transmits information between the anterior and posterior part of the brain)
there are three types of nerve fibers in our body:
1- type A (fastest)
2- type B
3- type C (slowest)
the posterior column is the fastest column in our body; because it uses type A nerve fibers which is the most thickly myelinated nerve fiber type. type A nerve fibers has three sub-categories:
1- alpha α (fastest)
2- beta β
3- delta δ (slowest)

SLIDE 6

in the picture on the right you'll find different types of receptors that are found in the epidermis.
each receptor is stimulated by a certain sensation.

1- merkel's disk: a type of receptor that is responsible of fine-touch/superficial touch sensation.
fine-touch can be described as an example when you sense a type of clothes texture.
مثال لهالنوعية من الإحساس: أول ما تروح تشتري بلوزة جديدة بتروح تمسك عشان تحس كيف نوعية القماش.

2- Meissner's corpuscle: a type of receptor that is responsible of distinctive touch sensation.
distinctive = التمييز
distinctive touch can be described as an example when someone puts their hand on your arm and know how many fingers are touching you,
Meissner's corpuscle is MORE sensitive than merkel's disk; as it can identify more localizations.
خلوا حدا يلمس ذراعكم بعدد معين من أصابعه بدون ما تشوفوا، عقلكم حيعرف كم إصبع لامس ذراعك بسبب هذا المستقبل.

3- ruffini ending:
a type of receptor that is found in the DERMIS layer of the skin and is responsible of sensing the skin's stretching.
زي لما حدا يشد خدودك.

4-pacinan's corpuscle:
a type of receptor that is found in the DERMIS layer of the skin and is responsible of sensing deep pressure and vibration.
vibration: the frequent stimulation (pressure) of the skin.
الضغط: زي لما حدا يمسك إيدك بقوة
الاهتزاز: زي لما تكون حاطط جوالك ع وضع الهزاز وتجيك مسج فتحس بالهزة تاعته.
as we can see, each receptor is involved in a certain type of stimulation/sensation to the posterior column tract.

how does a stimulation happen? for this example let's take the Pacinian corpuscle (which is responsible for the deep pressure stimulation).
when a pressure is applied, Na+ channels open in the NEURON ENDING in the corpuscle that would cause a DRAMATIC increase of Na+ inside in the neuron and an action potential would happen.
for this example,
↑ pressure ↑ Na+ voltage-gated channels open ↑ action potential

a general rule for ALL receptor:
↑ stimulation ↑ Na+voltage-gated channels open ↑ action potential

when more action potentials are created this causes something called "frequency"
frequency: the increasing of a stimulation per a unit of time.
frequency = تردد
عشان توضح بشكل أكبر، كل ما بيصير عندنا تحفيز للمستقبلات كل ما تكون عندنا سيلان عصبي، فكل ما زاد عنا كمية التحفيز صار عندنا زيادة لكمية السيلانات العصبية المتكونة.
التردد هو عبارة عن كمية التحفيز الي بتصير بفترة زمنية معينة، فكل ما زادت عدد مرات التحفيز كل ما صار عندنا تردد أكبر للسيلانات العصبية.
there is a certain level of frequency that is allowed. when it reaches the MAXMIUM FREQUENCY it gets stopped by the refractory period (absolute refractory period).

SLIDE 7

this picture shows a cross-section of the spinal cord.
the brown color in the picture is the white matter of the spinal cord.
the beige color in the picture is the grey matter of the spinal cord.
we have two roots coming out of the spinal cord:
1- the dorsal root
2- the ventral root
dorsal rootlets come out of the white matter to make the dorsal root and synapse with the dorsal root ganglion.
this pathway is ONLY for the sensory tract.
REMEMBER, that the sensory tract is ASCENDING so it would go from the place of the stimulation TO the spinal cord.
the ventral root does not synapse with a ganglion BUT both the VENTRAL AND DORSAL ROOTS join together to make the SPINAL NERVE.
the spinal nerve divides into four ways:
1- the dorsal ramus (thin, only responsible for the back muscles)
2- ventral ramus (thick, responsible for ALL the muscles besides the back muscles)
3- white ramus communicans (all sympathetic nerves pass through this division and synapse with the sympathetic chain ganglion)
4- grey ramus communicans (all signals would get carried out to a specific organ).

SLIDE 8

the two divisions of the posterior column can be seen in the picture. how to identify them?
in the middle of the spinal cord there is a place called the "fissure" which makes us easier to identify both divisions AND to know who is medial and who is lateral.
the part that is localized MEDIALLY (close to the fissure) is the fasciculus gracilis.
the part that is localized LATERALLY (farther from the fissure) is the fasciculus cuneatus.
the fasciculus gracilis is localized medially; because its sensory neurons come from a low level of the spinal cord (below C6).
the fasciculus cuneatus is localized laterally; because its sensory neurons come from a higher level of the spinal cord (above C6).

SLIDE 9

do not forget this order!
sensation in a certain part of the body --> stimulation by the posterior column up to the brain --> the association area of that part of the body would get stimulated in the SENSORY cortex --> the stimulation goes to the association area of that part of the body would get stimulated in the MOTOR cortex to send an appropriate response.

SLIDE 11

both anterior spinothalamic tract and lateral spinothalamic tract transmit in the same tract this is why it is called "anterior spinothalamic tract". but, to make it easier we will study each one alone.
lateral spinothalamic tract:
it is responsible of transmitting two types of sensations:
1- pain
2- temperature sensation
the anterior spinothalamic tract:
it is responsible of transmitting two types of sensations:
1- crude touch
2- pressure sensation

both crude touch and pain use a type of receptor called "nociceptors". sensation receptors use type C nerve fibers (which is the slowest) and type A delta nerve fibers. these nerve are what make the "pain pathway" which transmits the pain sensation to the brain.

there are two types of pain that can cause the stimulation of the receptors:
1- mechanical pain (that is caused by a crude touch "hard touch")
2- chemical pain (response to a mechanical pain by secreting a certain chemical such as potassium, protons, histamine, etc. which cause an inflammation)

type A delta fibers are responsible of transmitting a very fast pain sensation which is mainly caused by a mechanical pain.
مثال بيوضح هالنوع من الألم، أول ما تحس بوغز الإبرة هاد يعتبر ألم سريع ويتم نقله من خلال الديلتا فايبر.
type C fibers (which is unmyelinated) are responsible of transmitting very slow pain sensations which is mainly caused by a chemical pain.

SLIDE 12

85% of the C fibers reach the reticular formation region which is mainly responsible of sleeping/waking up.
because of this, you can't sleep when you are in a lot of pain.
only 15% of the C fibers reach the thalamus in a specific region called "intralaminar nuclei".
the C fibers would also go to other regions in the brain such as the hypothalamus (which is responsible of controlling the ANS system), by this we are controlling the autonomic response to pain.
for example, how does our body control pain? by increasing the heart rate, by increasing the blood pressure, etc.
another example, when giving birth the pain would be transmitted to the hypothalamus which would release oxytocin to increase uterine muscles contraction.