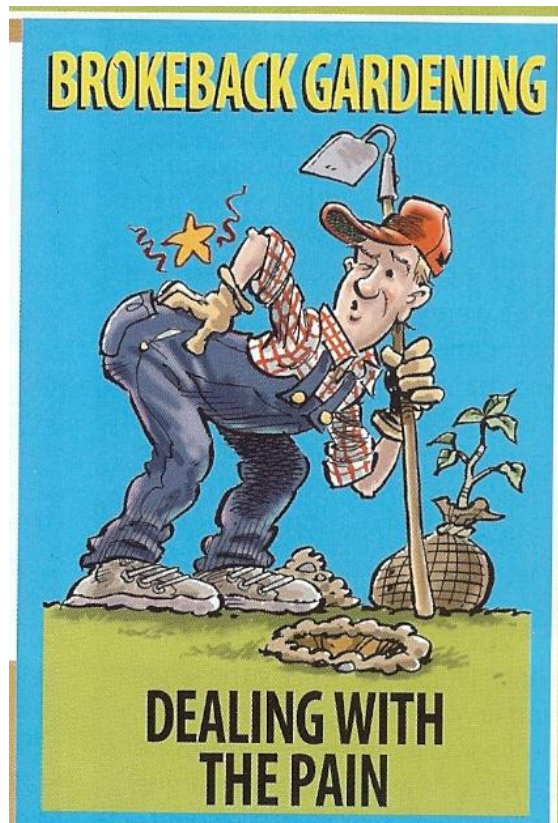




## Pain physiology



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Created by :

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### Outline of study:

- Receptors
- Peripheral nerve pathway
- Inside the spinal Cord
- central pathway
- cortex
- Prof. Ashraf Hussain

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First of all :

❖ What is pain ?

- \* It is an unpleasant sensory and emotional experience associated with actual or potential tissue damage

It's subjective , it means that it differs from an individual to another

❖ How do we classify pain ?

- \* Pain has a lot of shapes , kinds .. it could be visceral or somatic (somatic= deep or superficial)

❖ What's referred pain ?

- \* Organ is affected , the pain shows up in another place ( example : visceral pain )

❖ Phantom pain ?

- \* Feeling pain of organ that doesn't exist

❖ Periosteal pain ?

- \* Severe pain

	P A I N		
Sensation	Somatic		Visceral
Quality			
Character	Superficial	Deep	
Time-course	Initial or delayed	Initial or delayed	
Origin	Skin	Bone, joints, muscles	
Conditions	Pinching Pricking Cutting Burning	Cramps Arthritis Rheumatism	Ulcers Appendicitis Angina Migraine Renal colic

### Pain receptors ( Nociceptors )

- free nerve ending act as a pain receptors = generation of pain
- There are no pain receptors in the GIT
- On Viscera , pain is founded because the receptors in the peritoneum
- Pain receptors are stimulated by pressure , temperature , chemical substances
- Muscle spindle acts as a muscle receptor inside the muscle fiber

- What's tract ?
- What's receptors ? ( **go back to first lectures** )

We feel **2** types of pain : instant : By **A $\delta$**  fiber  
Late : By **C** fiber

**A $\delta$**  goes to **1 & 5** neurotransmitter : **glutamate** **fast**  
**C** goes to **1 & 2** neurotransmitter : **P-substance** **slow**

**C** receptors give deferent types of pain ( that's why it is called : polymodal )

### **A $\delta$ Fiber:**

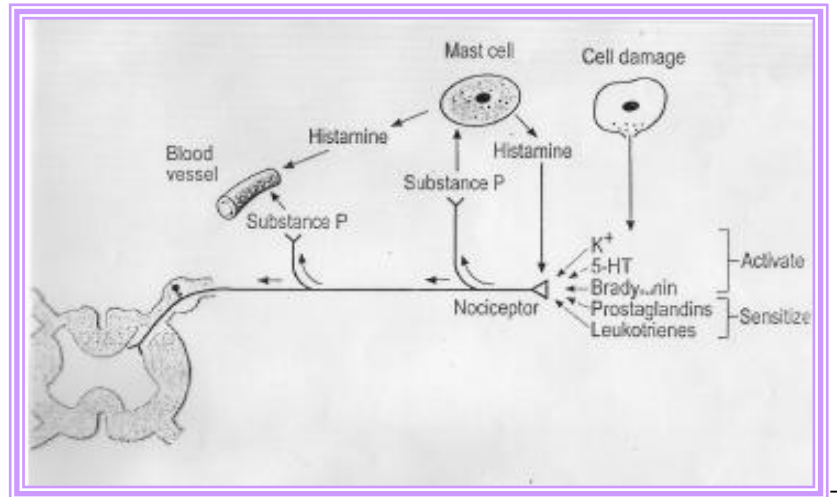
- Thin Myelinated
- Diameter fine 2 - 5  $\mu\text{m}$
- 12 - 30 m/sec. conduction velocity
- Terminated at I and V layer (1 & 5)
- Fast pain, rapid, pricking and well localized
- Neurotransmitter - Glutamate
- 20% pain conduction , why ? Because it's fast

### **C – Fiber:**

- Thin Non-Myelinated
- Diameter less than 2 f.lm .-0.5 to 2 m/s conduction velocity
- Slow, diffuse, dull, aching
- Neurotransmitter - P-Substance
- 80% of pain conduction

**3** things Activate Action potential :

- temperature
- pressure
- chemical



- **Potassium (K)** & **bradykinin** are very painful activators
- **A $\delta$**  only respond to pressure without any chemical substance released, all chemical substance released (K, bradykinin) within **C**
- Pain fiber goes in front & behind the central cranial
- **A $\delta$**  is responsible for cold, **C** for hot

### From within the spinal cord up to the cortex :

- The nerve fibers enter the spinal cord through the dorsal horn

The dorsal horn is divided into several layers called Redox layers

for the second order neuron they are received by dorsal horn then they cross in front & behind the central canal to pass up in the anterolateral tract of the opposite side.

- then to the thalamus

➔ : thalamus is the higher center for pain, cortex is important to localize the site of pain, but it is not essential for reception of pain ..

**extra :**

## how is emotional sensation carried then ?

carried by spinoreticular tract ( medially).

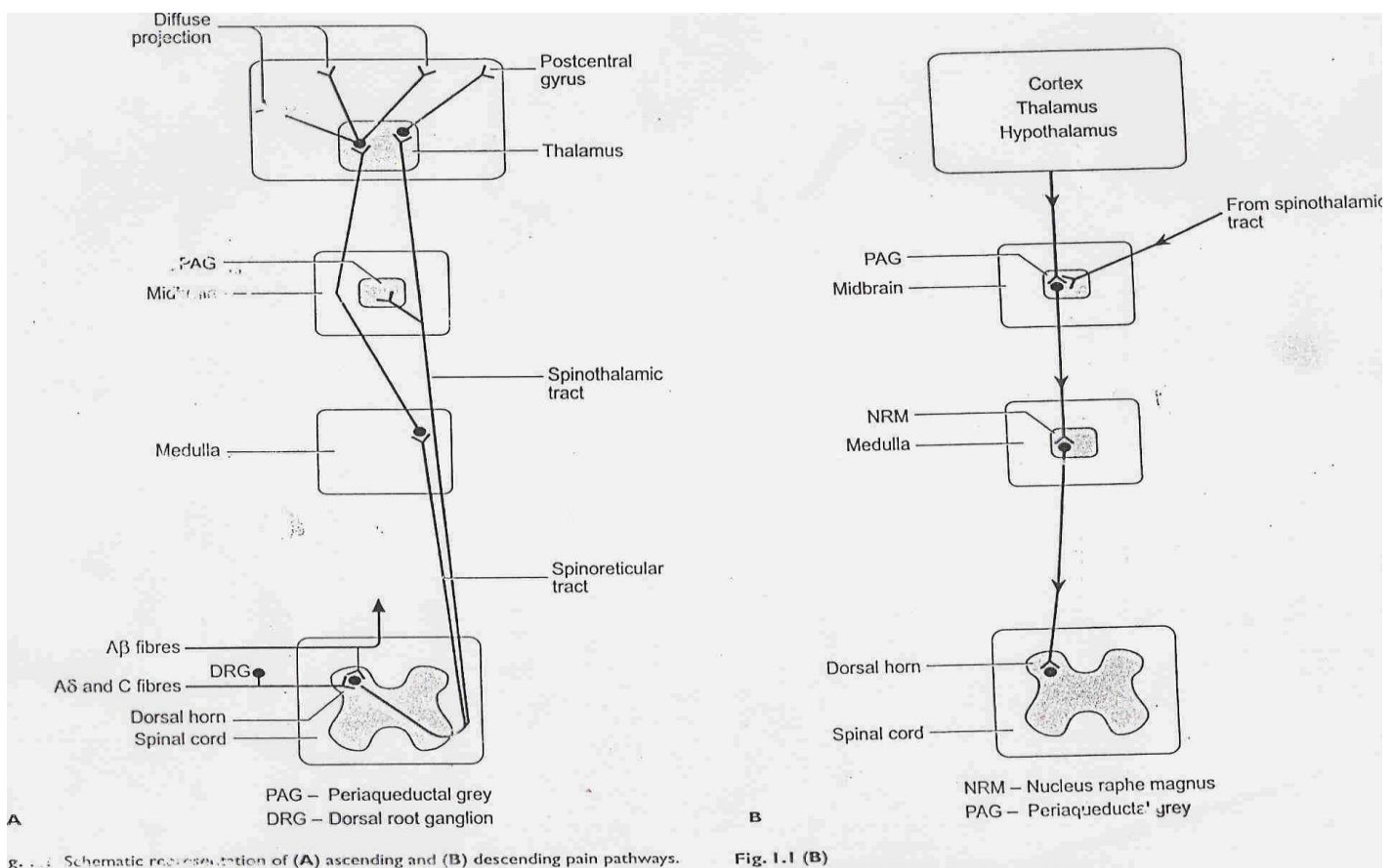
Spinoreticular tract ends at all level of reticular formation in Medulla and pons which also keeps you awake. Then they go to Thalamus Then to cortex.

- Highest center for emotion is gyrus cinguli in Cortex.
- The Lateral spinothalamic and the Spinoreticular tract are the ascending tracts

## Pain Pathway:

❶ causing :by lateral spinothalamic and spinoreticular which ascending

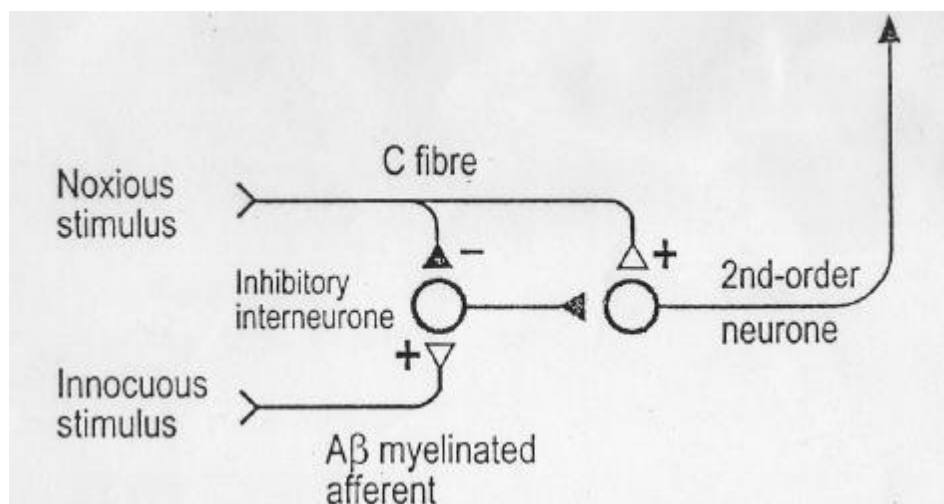
❷ Decreasing: analgesic pathway which descending.



## Descending analgesic Pathway:

- In the midbrain there is peri-aqueductal gray matter (PAG) which is present around aqueduct of Sylvius
- This area receives neural input from Cortex, Hypothalamus and thalamus.
- PAG projects neurons that stimulate raphe magnus in the medulla, Then from the medulla to the dorsal horn
- Then the three interneurons connect which work as ANALGESIC TRACT
- The upper part of this pathway is serotonergic.
- The areas of the upper part have morphine receptors.
- The lower part of this pathway has Enkephalin

## Gate Mechanism of Pain:



This theory assumes that the Dorsal horn of the spinal cord forms the gate through which pain impulses must pass to reach the brain.

- ✳ Impulses coming along type C pain fibers cause the release of substance P from these fibers and open the gate
- ✳ While impulses coming along A<sub>β</sub> fibers close the gate by process of presynaptic inhibition of C fibers and post synaptic inhibition of 2<sup>nd</sup> order neurons in dorsal horn
- ✳ This is seen when you have a pain let's say in your hand and normally we will rub our skin to relieve the pain.

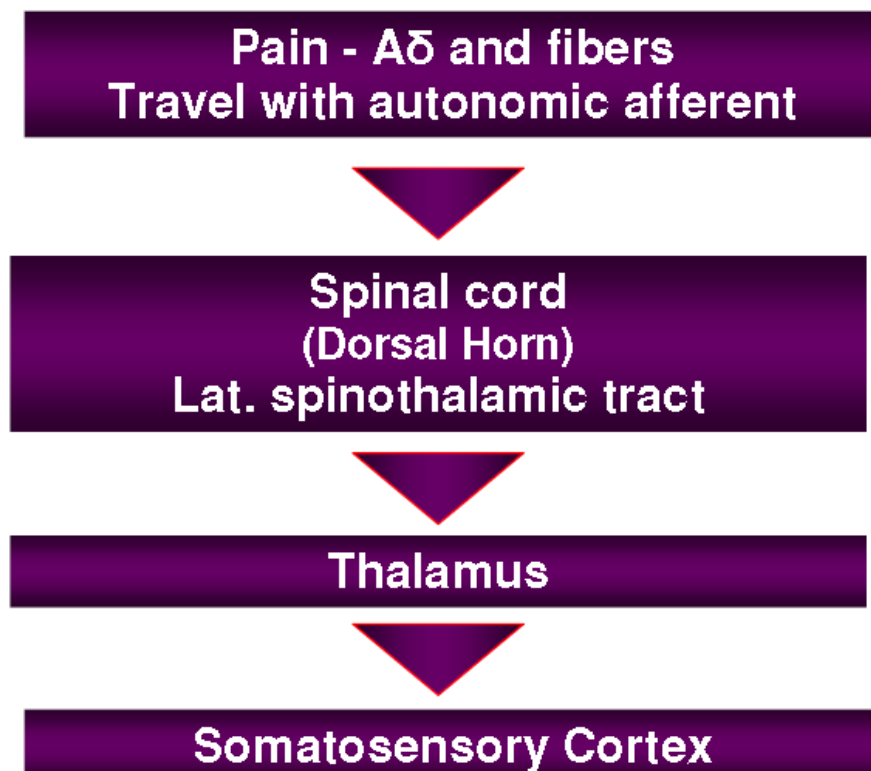
## Classification of pain

- By two ways First :

### ① Visceral pain :

\_ Visceral afferent fibers travel with the autonomic nervous system fibers by joining the dorsal horn at the spinal cord.

\_ There is no pain sensations in the viscera, but the pain occur due to visceral wall distention





## ② Referred pain

- Pain referred to a place other than the initial place of pain.
- Physiologists proposed two theories regarding the cause of it:
  - The dermatomal theory: dermatomes receive pain stimuli from a specific location and the pain is sensed in another location supplied by the same dermatome due to the brain thinking that the latter one is the original pain location.
  - The convergence theory: afferent fibers from different locations converge in the same place in the spinal cord. Note that this is a weak theory.

Referral of pain from the internal organs

**Organ :**

**Site of referred pain :**

Meninges	Back of head and neck
Heart	Central chest arms (usually left), neck, occasionally abdomen.
Trachea	Behind sternum
Diaphragm	Shoulder tip
Oesophagus	Behind sternum
Stomach, duodenum	Upper abdomen, epigastrium
Small bowel	pancreas Around umbilicus
Large bowel, bladder	Lower abdomen above pubic bone

## What if ?

If we cut the pain pathway, what will happen ?

Pain will be gone , but it will come back after while , why ?

No one actually knows , but some people say they're plasticity

When we cut thalamus ?

Sever pain (hyperalg..) )

Pain the same , sever pain appears ( thalamic syndrome ) any thing around him cause pain even his own clothes !

That's all : )