pain

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Stage 4th

2025-2025

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Defenition

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Definition

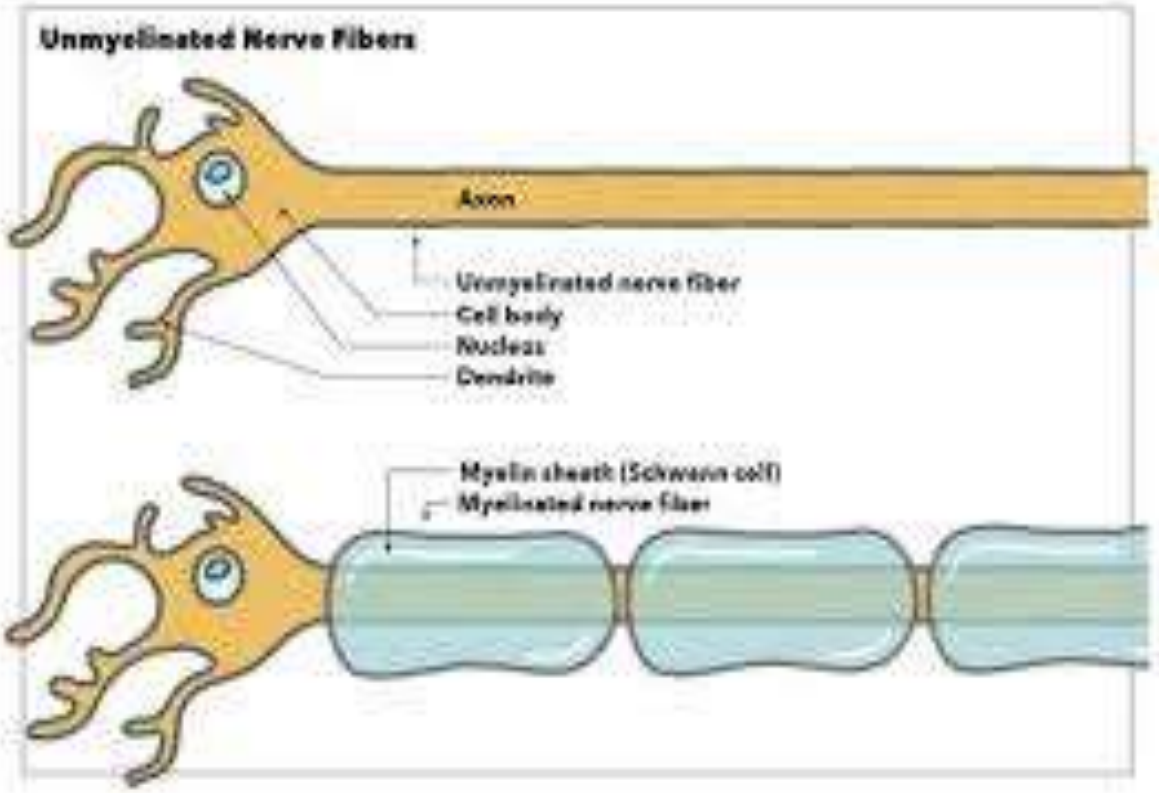
- Pain is an unpleasant sensory & emotional experience associated with, or resembiling that associated with, actual or potential tissue damage (IASP).

Types of pain

1. Cutaneous pain
2. Pain elicited by stimulation of cutaneous receptors. It has 2 componant

A. Fast component: instantaneous, momentary, sharp, conducted by A- delta receptors.

B. Slow component: elicited by deep penetrating of deep tissues. It is dull aching, poorly localized, conducted by C fibers.


Unmyelinated Nerve Fibers
Axon
Unmyelinated nerve fiber
Cell body
Nucleus
Dendrite
Myelin sheath (Schwann cell)
Myelinated nerve fiber

2. Deep somatic tissues pain :

Dull, poorly localized, vary in intensity.

3. Visceral pain: stimulation of pain receptors, by stretching, distention, spasm, 0r ischemia. It is referred pain, like myocardial infarction, peptic ulcer..

Anatomy of pain system

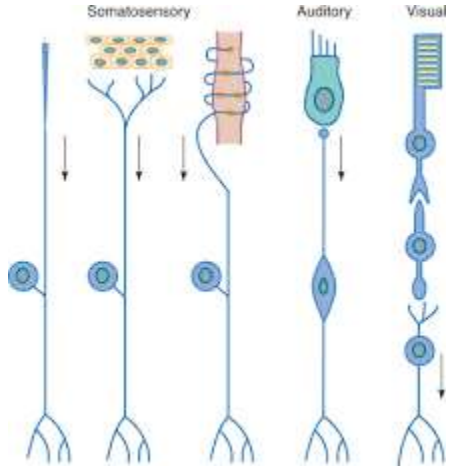
1. Peripheral component: nociceptors (pain receptors), located in skin, joints, mucous membrane, viscera.

Types of receptors:

*mechanical receptors: respond to pressure or deformity.

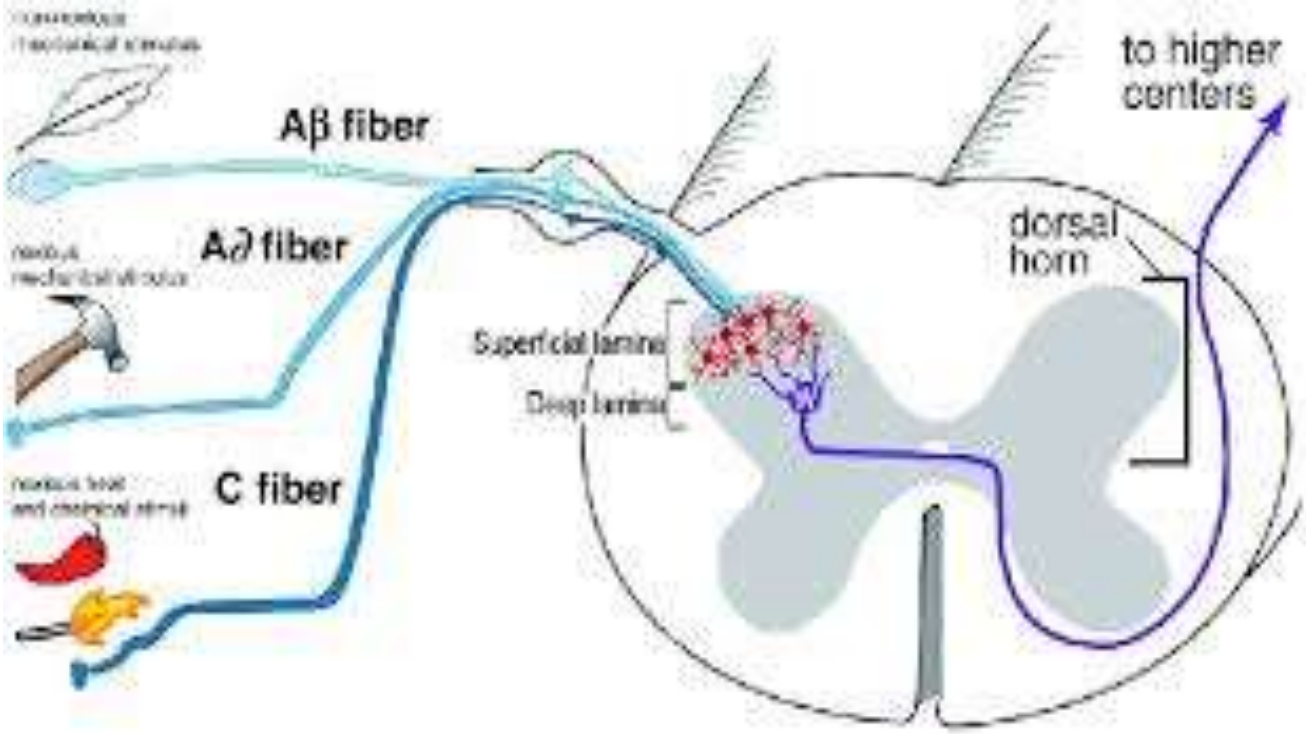
*Thermal receptors: respond to extreme temperature.

* Chemical receptors: respond to chemical irritation


Somatosensory
Auditory
Visual

2. Spinal cord level

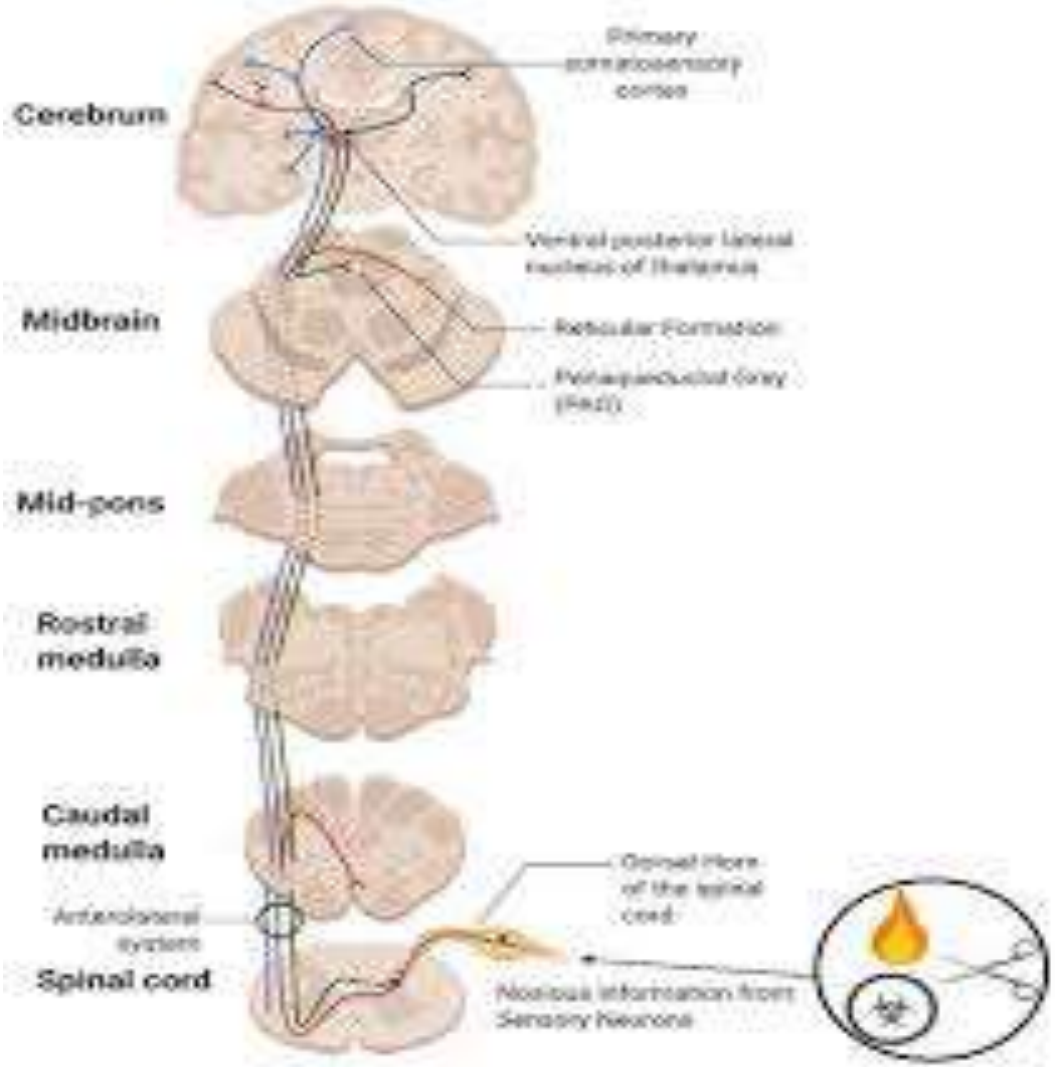
- Nociceptors fibers enter the dorsal horn of spinal cord & ascend to brainstem, then to the brain.



3. Ascending pain pathway

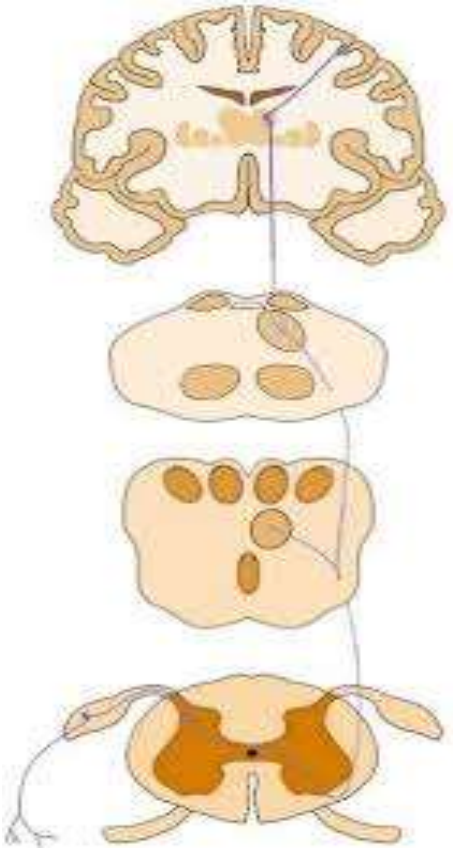
- A: Spinothalamic tract
- Start from dorsal horn of spinal cord & cross the midline to opposite site& end in the thalamus.
- It conveys pain& temperature sensation

Spinothalamic tract



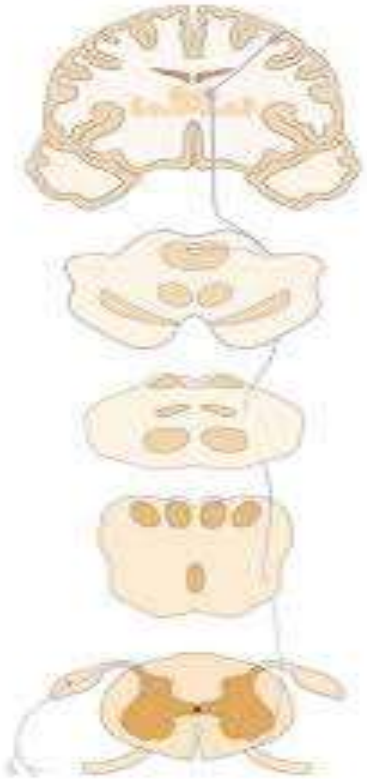
B. Spinoreticular tract

- Project to reticular formation in brainstem.
- Involved in emotional, arousal aspect of pain



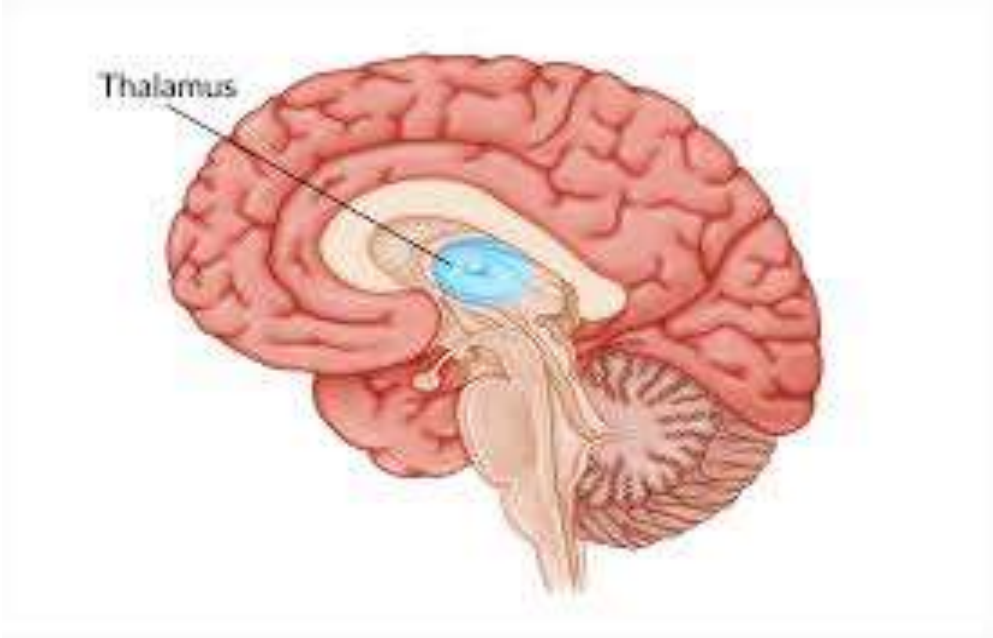
c. Spinomesencephalic tract

- Project to periaquiductal gray in midbrain.
- Play a role in pain modulation& descending inhibition.



4. Thalamus

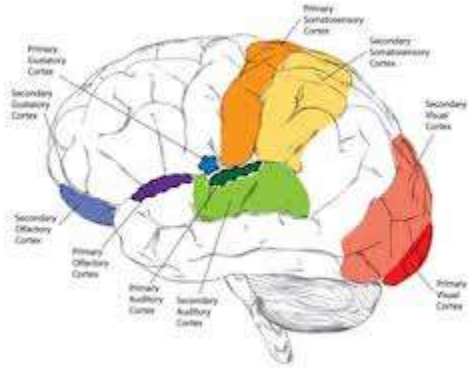
- Act a relay state for all ascending sensation& send signals to the cerebral cortex(somatosensory area), alsoconneted with limbic system for emotional processing



5. Cerebral cotex

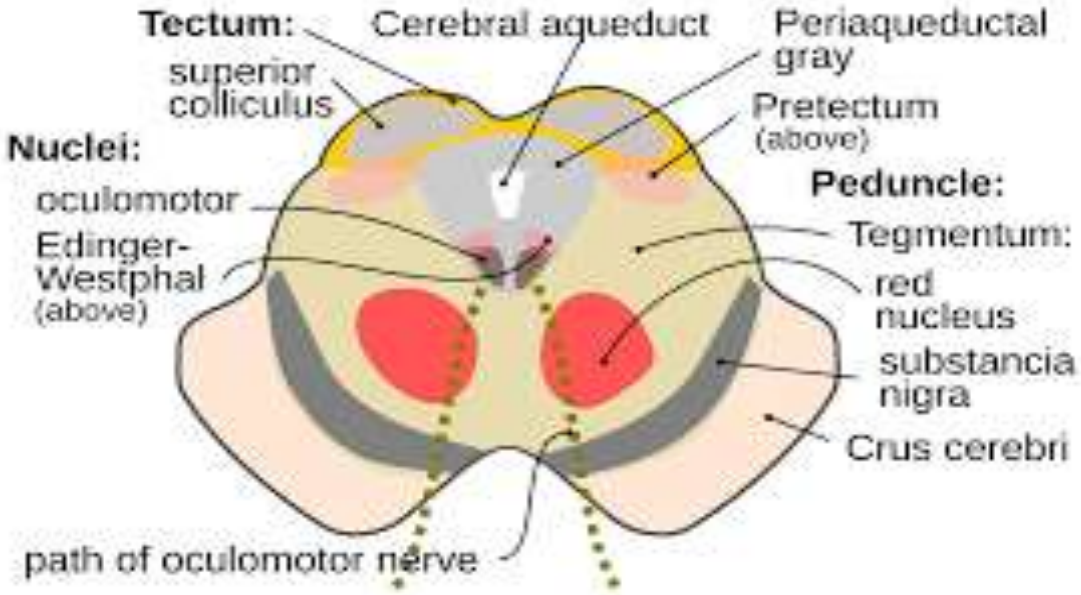
- * primary cerebral cortex: for pain localization
- * secondary cerebral cortex: for interpret intensity& quality of pain.
- * anterior cingulate area: for affective component of pain
- * prefrontal area: pain- related decision-making& attention

cerebral cortex



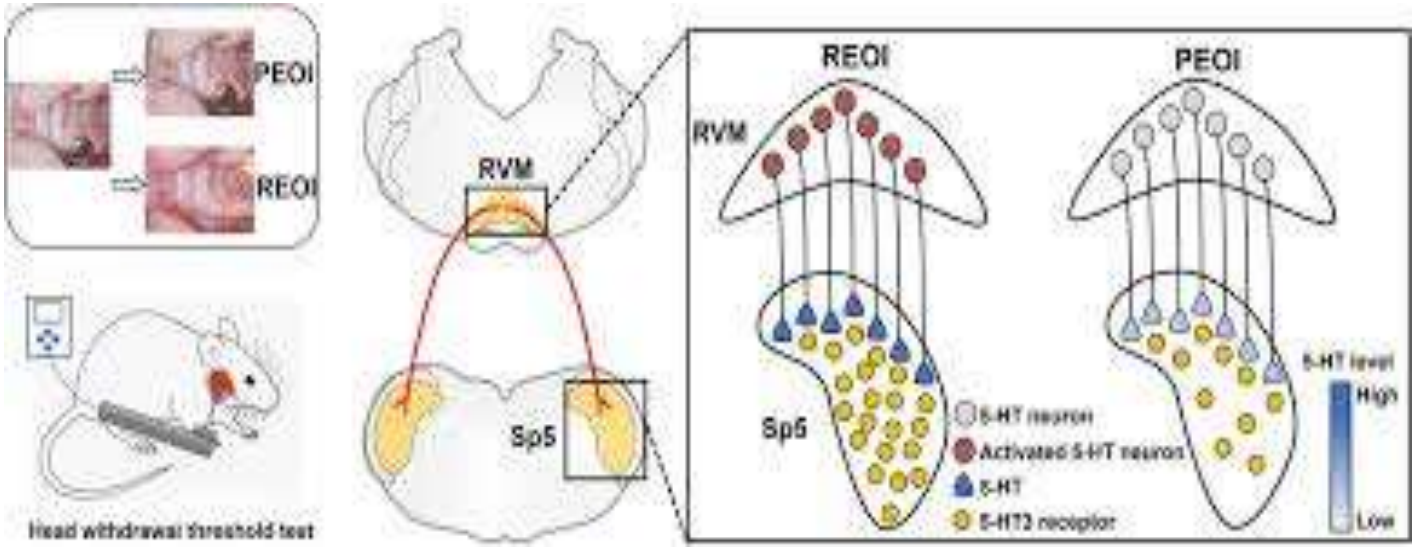
6. Descending pain modulation

- * periaquiduct gray: receive input from higher brain region. It activate descending pathway that activate inhibition of pain.



Descending pain modulation

- * Rostral ventromedial medulla oblingata:
- Contain ON& OFF cells that facilitate or inhibit pain transmission, it project to dorsal horn to regulate spinal nociceptor.



Pathophysiology of pain

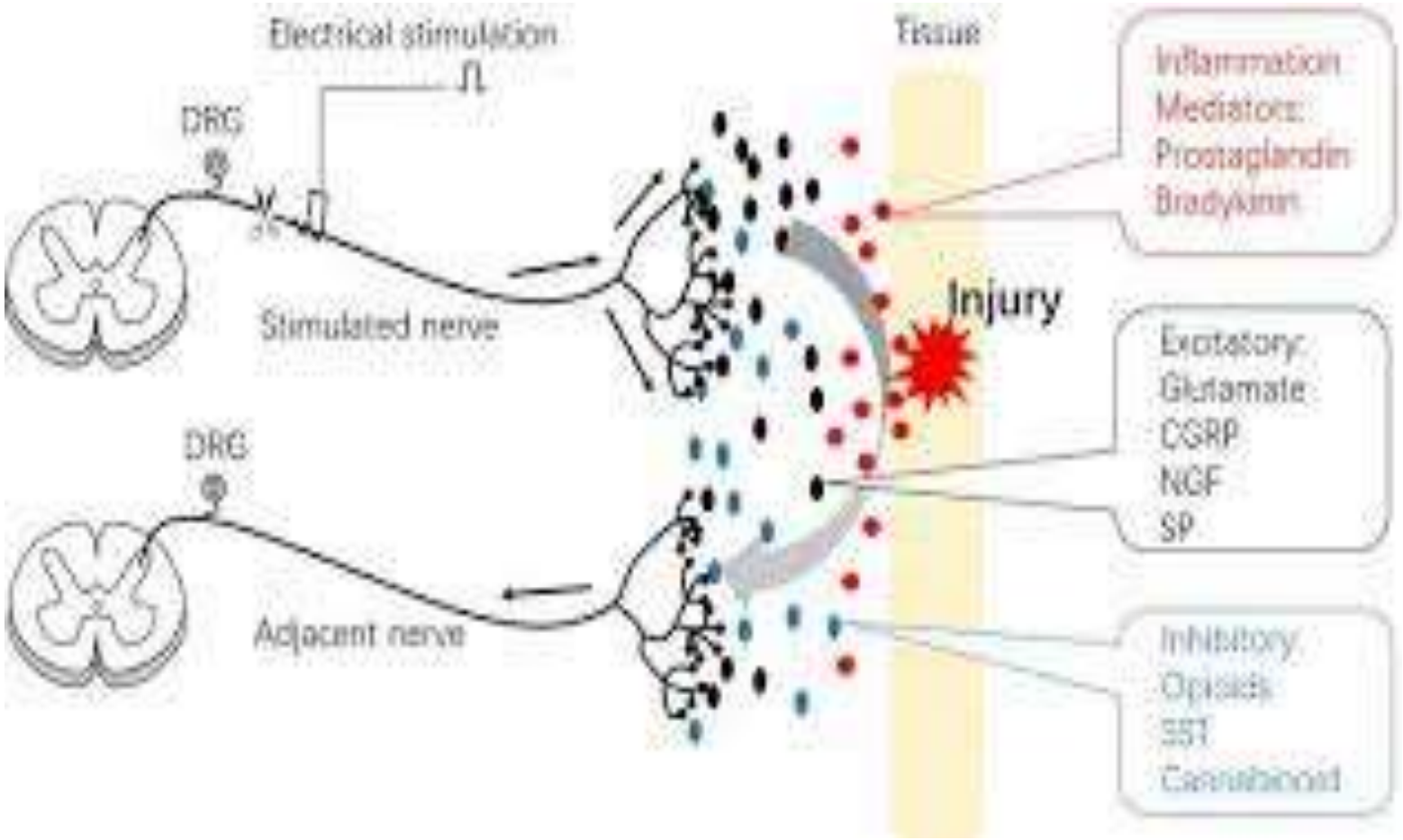
1. Transduction: conversion of noxious(harmful) stimuli(mechanical, thermal, chemical) into electrical impulse by nociceptors.
2. Transmission: propagation of nerve signal from the periphery to the dorsal horn of spinal cord, then to the higher centers via ascending tracts.
3. Modulation: amplification or inhibition of pain signals at spinal cord or cerebral hemispher.

4. Perception: conscious experience of pain generated by cerebral cortex & limbic system.

Mechanisms of pain

1: Peripheral mechanism:

- Nociceptors: A-delta, &C fib
- Chemical mediators release during tissues injury: bradykinen, prostaglandin, substance P, histamin, serotonin.
- These mediators lower the threshold of nociceptors (sensitization).

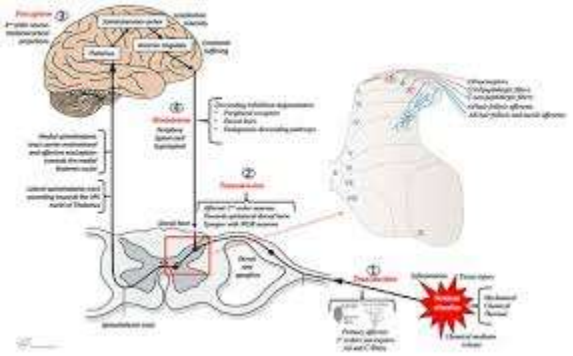

Electrical stimulation
DRG
Stimulated nerve
DRG
Adjacent nerve
Tissue
Injury
Inflammation
Mediators:
Prostaglandin
Bradykinin
Excitatory:
Glutamate
CGRP
NGF
SP
Inhibitory:
Opioids
SST
Cannabinoid

2. Spinal cord mechanism

- Pain signals enter the dorsal horn of spinal cord.
- Neurotransmitters involved:

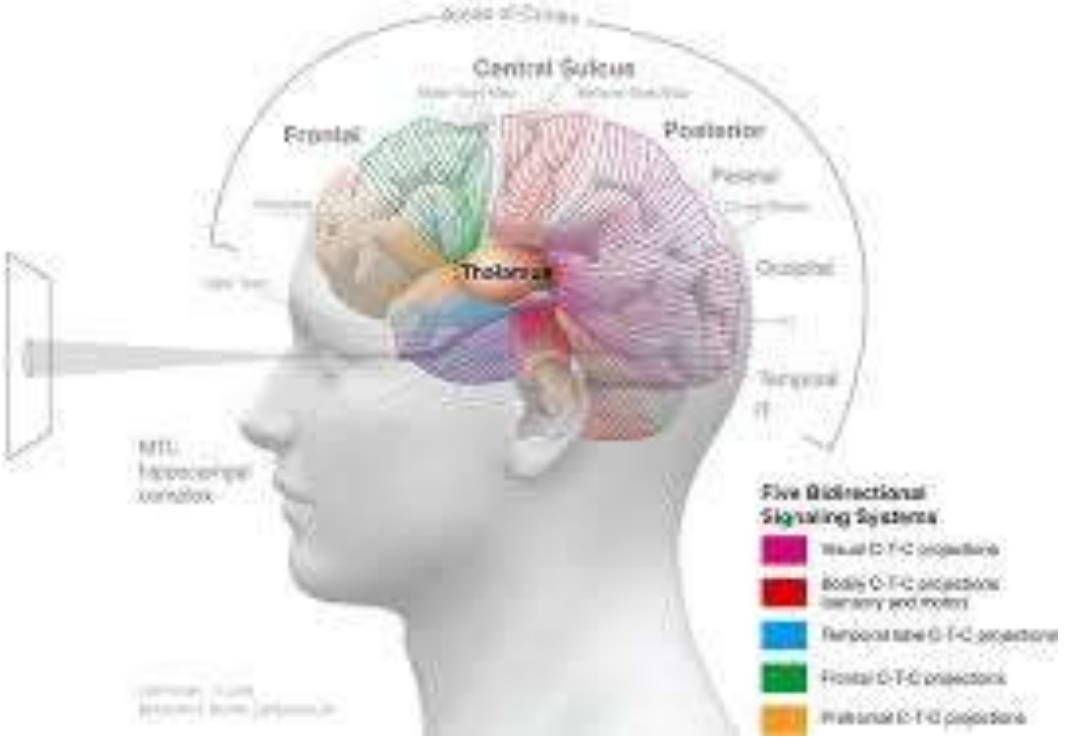
A: glutamate& substance P(excitatory)

B: GABA& glycin(inhibitory)



3: central mechanism

- The thalamus relays signals to the somatosensory cortex(localization& intensity)& limic system(emotional aspect of pain)



- Descending inhibitory pathways from the brainstem(periaquductal gray, locus coeruleus, raphe nuclei) release .
- Endorphen, Enkephalin, serotonin, norepinephrin.
- These suppress pain transmission in the dorsal horn

Thank you