SOMATIC PAIN
&
THERMAL SENSATION

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SENSATIONS

- *They are divided according to the site of origin into*

1. Somatic sensations (comes from soma or body)
2. Visceral sensations (from viscera). As visceral pain and fullness of the bladder.
3. Special sensations (vision, hearing, smell, taste)
4. Hypothalamic or organic sensations (thirst-hunger-fear).

SOMATIC SENSATIONS

- further subdivided according to **site of receptors** into *:*

1. Cutaneous sensations (pain-touch-temperature).
2. Deep sensations : as sense of *position, movements, muscle tension, deep pressure, relation of the body parts to each other and relation of the body to the space.*
3. Mixed sensations (receptors in skin and deep structures):

A) STEREOGNOSIS

B) VIBRATION SENSE

PAIN SENSATION

characters:

- ***unpleasant sensation*** resulting from tissue damage and resulting in protective mechanisms as withdrawal reflex.
- ***Pain is a specific type*** of sensation and is not due to over stimulation of other sensations.
- ***The threshold of excitation*** of pain receptors is much higher than other sensations.
- ***Pain is a "pre-potent stimulus"*** during pain; any other sensations are inhibited as hunger sensation .

TYPES OF PAIN :

- *According to the **site, pain** is classified to:*

- Cutaneous pain
- Deep pain
- Visceral pain

pain receptors :

They are specific naked ***free nerve endings*** ***(slowly or even not adapt at all)*** called **nociceptors** **&** subdivided into **3 types** according to the **mode of stimulation**.

1. **Mechanosensitive** *pain receptors* stimulated by excessive mechanical stress as crushing or server trauma.
2. **Thermosensitive** *pain receptors* stimulated by extremes of either cold or hot i.e., above °45 or below 10 c°.
3. **Chemosensitive** *pain receptors* which respond to chemical injurious stimuli.

The first two types are connected to (**A delta**) myelinated fibers. (**5-15 meters/sec**) while the third type is attached to **C-fibers-non myelinated** a slowly conducting fibers (**0.2 - 2 meters/sec**.).

Mechanism of stimulation of pain receptors

- *Painful stimuli* ⇨ tissue damage ⇨ liberation of pain mediators ⇨ stimulation of nociceptors.

- *Pain mediators* like substance **P** & **P**rostaglandins & **P**otassium & **B**radykinin.

1- Cutaneous pain:

- It arises from the skin.
- Usually described as pricking , stitching or burning pain.
- There are **2 types** of cutaneous pain: **fast & slow** pain
- **Cutaneous pain** is accompanied by ***sympathetic reactions*** as increase in heart rate and blood pressure, sweating and dilatation of the pupil. Also, ***protective withdrawal reflexes*** occur in this type of pain.

fast pain	slow pain
•bricking •immediate and persist for short time.	•burning •delayed and persists for long time
•well localized	•Poorly localized
•Conducted by fast myelinated group "**A delta**" fibers(neo- lat. spinothalamic tract) Moderate compression on nerve, blocks "**A**" fibers	Conducted by "**C**" un-myelinated fibers(paleo- lat. spinothalamic tract) local anesthesia block "**C**" fibers
• Relay in thalamus then to somatic sensory cortex	•Relay mainly in reticular- formation then to all areas of cerebral cortex.

2- Deep pain

- It arises from **deep structures** (muscle, ligaments, joints, capsules).
- It is described as dull aching pain and is not well localized.
- Transmitted by **"C" fibers**.
- Deep pain is accompanied by reflex muscle spasm, bradycardia ,drop of the blood pressure, miosis ,nausea and even vomiting.
- ***Important type*** of deep pain is (**intermittent claudication**)

occurs in skeletal muscles due to ischemia or atherosclerosis.

REACTIONS TO PAIN :

1. Somatic reflexes :

- protective withdrawal reflex
- reflex spasm of skeletal muscle over diseased viscera.
- The mechanism is that the nerve fibers which carry pain sensations on entering the spinal cord will give collaterals to the anterior horn cells which innervate the surrounding muscles.

2. Emotional reactions :

- As impulses carrying pain sensations to sensory cortex send collaterals to the hypothalamus which is one of the higher centers of emotions. This causes emotional reactions like **crying**, **anger** or **depression**. Very severe pain on the other hand may cause even complete loss of consciousness or fainting attacks.

3. Autonomic reactions :

- By impulses that reaches the reticular formation from ascending pain fibers.
- Autonomic reactions include changes in heart rate, respiratory rate, dilation of pupil, sweating and even inhibition of gastrointestinal activity. **Mild pain** as a rule causes **sympathetic stimulation** ; while **very severe or visceral pain** stimulates **parasympathetic activity**

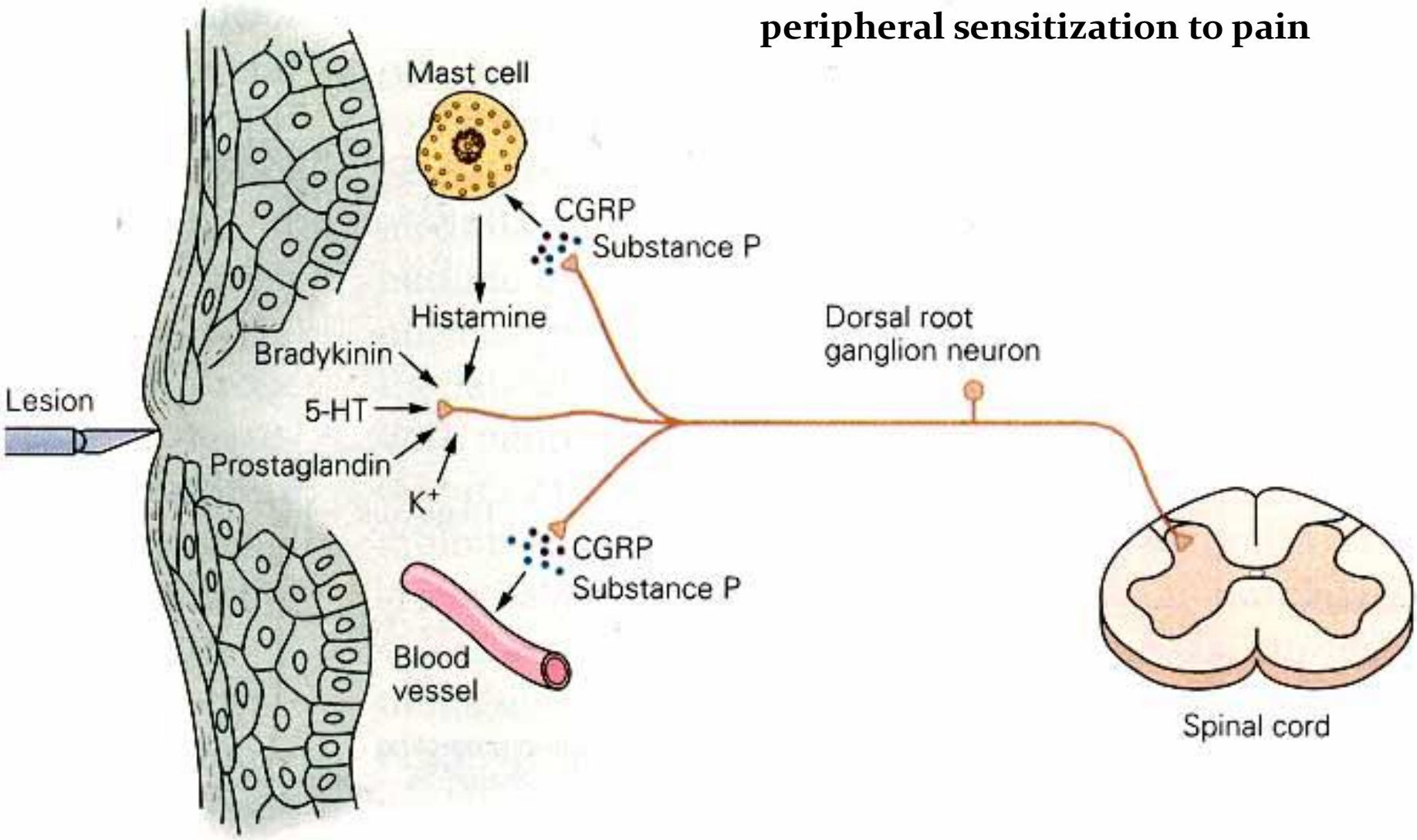
4. HYPERALGESIA:

it is state of pathological skin condition in which non painful stimuli become painful.

Primary hyperalgesia: (At site of the lesion itself)

- It becomes edematous, red, hot and very painful
- The mechanism is by **local axon reflex**.
- Destroyed tissues release **mediators** that **lower threshold of pain receptor** and cause local vasodilatation and **anti-dromic impulses** that cause arteriolar dilation, edema occurs which cause continuous pressure on the hypersensitive nerve endings causing maintained pain.

Mechanisms associated with peripheral sensitization to pain

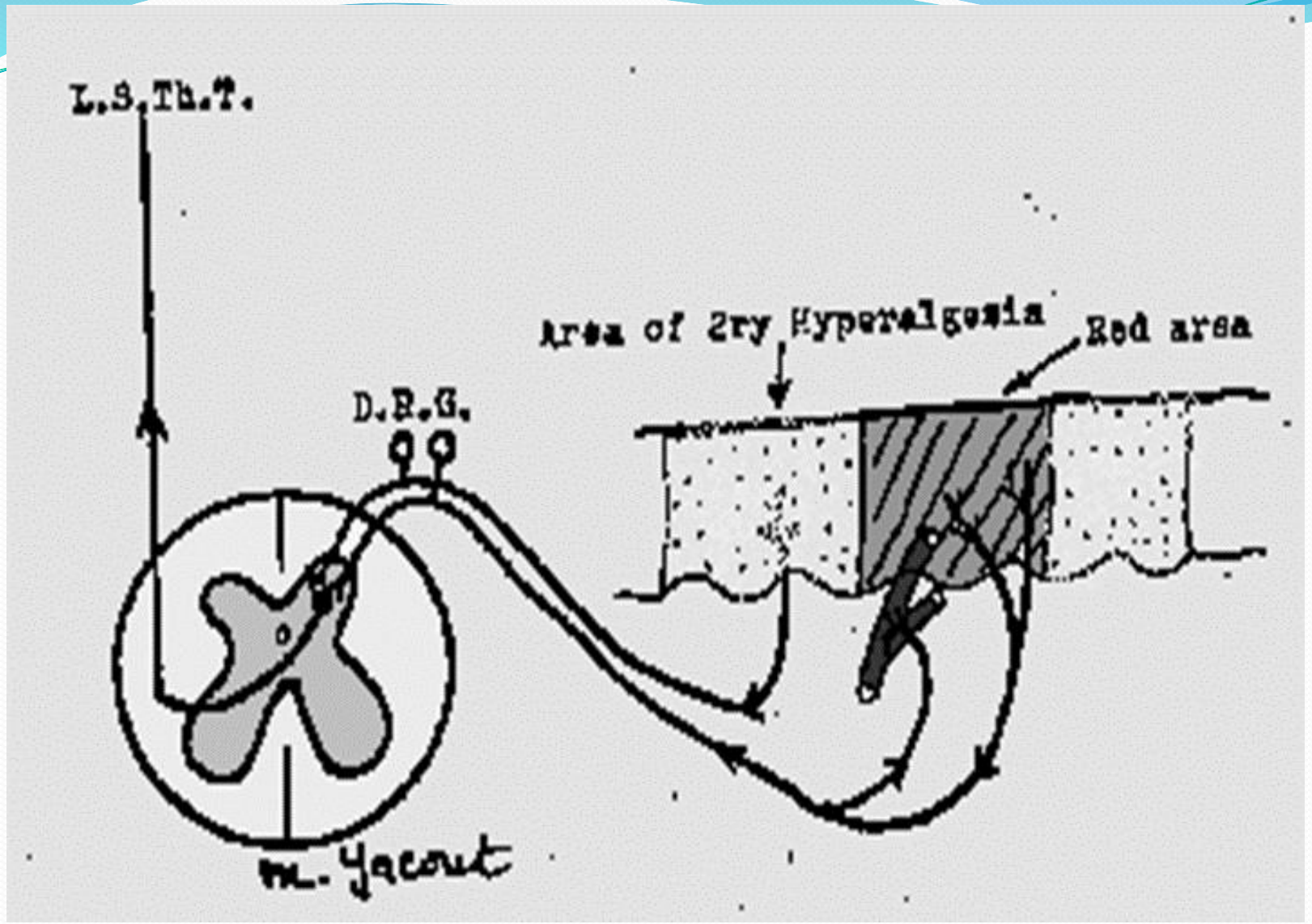


Secondary hyperalgesia:

- In the surrounding area of the lesion.
- It appears normal but painful stimulus to it induces severe pain.
- It is explained by **convergence- facilitation theory**

As pain from primary area is carried by sensory nerve that **converge** on a certain neuron in the spinal cord.

This neuron becomes **"facilitated"** have a lot of chemical transmitter, now if painful sensation reach this neuron from the surrounding **secondary area**, it will transmit it to **sensory cortex** as if it is **very painful sensation.**



Secondary hyperalgesia

TEMPERATURE SENSATION

- **"COLD" SENSATION** between 10° and 30c°.
- **"WARM" SENSATION** between 30° and 45c°.
- **BELOW 10° AND ABOVE 45°** tissue damage begins to occur, and this is described as **pain** sensation.
- **AT 0 °C** No action potential is recorded from nerves.
- **THERMO RECEPTORS ADAPT** between 20c° and 40c°

Types of thermoreceptors:

A. **Superficial** receptors in skin: they are **free nerve endings.**

- 1) **Warm spots**: transmitted by "**C** " fibers.*(Free nerve ending receptor)*
- 2) **Cold spots**: transmitted by **" A delta** " fibers. *(Krause's end bulb receptors !)*

B. **Deep** receptors in hypothalamus: detect body temperature from blood.

- **Mode of stimulation of thermoreceptors:**

Chemically by change in their metabolic activity.

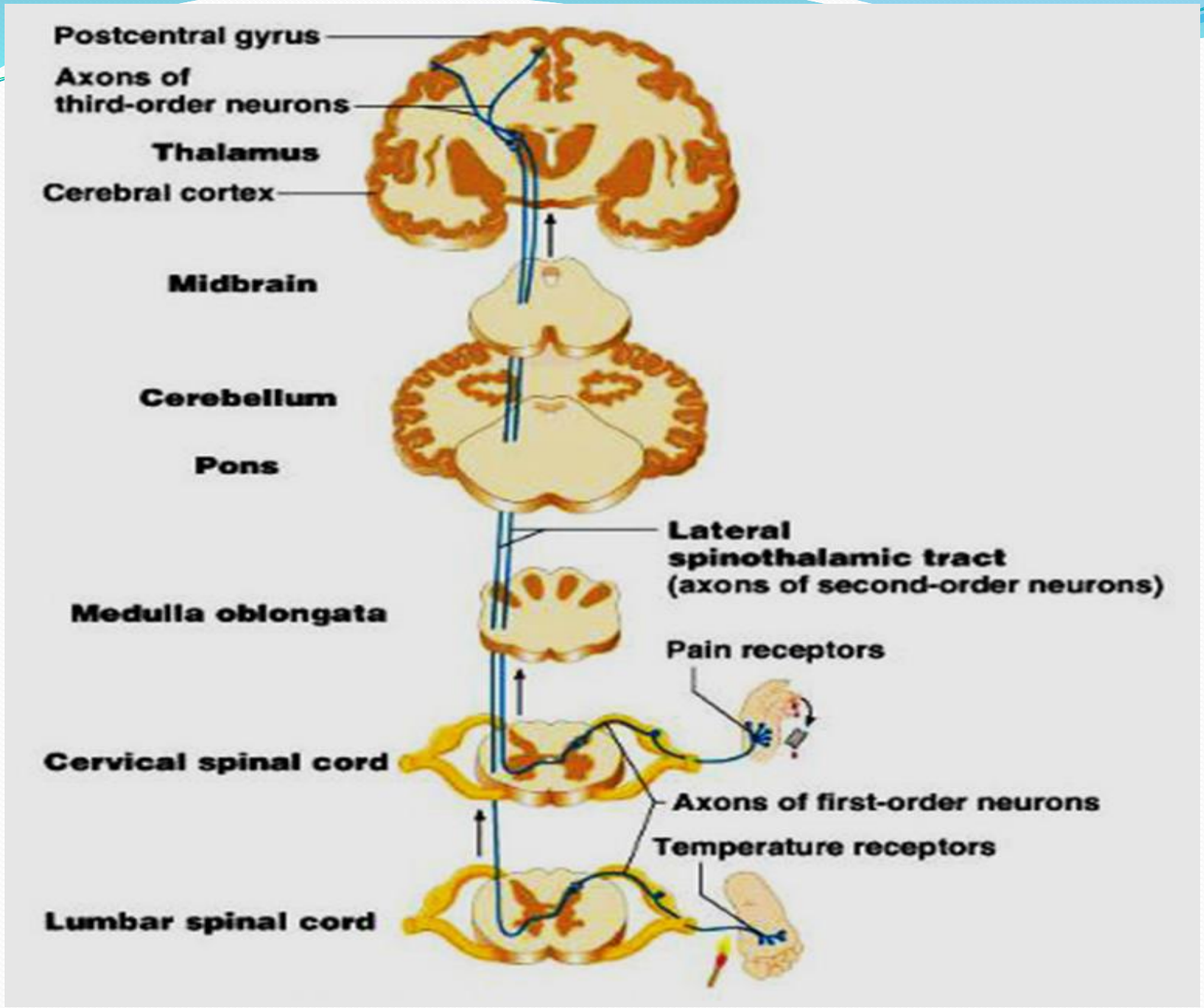
Paradoxical cold sensation:

On taking hot shower at 45 °C, we 1st feel cold (shivering) followed by warm sensation. Because **cold receptors** are:

a) 10 Times **M**ore numerous & **M**ore superficial than warm receptors.

b) **M**omentary Brisk discharge at 45°C.

- **Temperature pathway**: Through **Lateral spinothalamic tract**


Postcentral gyrus
Axons of third-order neurons
Thalamus
Cerebral cortex
Midbrain
Cerebellum
Pons
Lateral spinothalamic tract (axons of second-order neurons)
Medulla oblongata
Pain receptors
Cervical spinal cord
Axons of first-order neurons
Temperature receptors
Lumbar spinal cord

Thank You