


PHYSIOLOGY OF PAIN

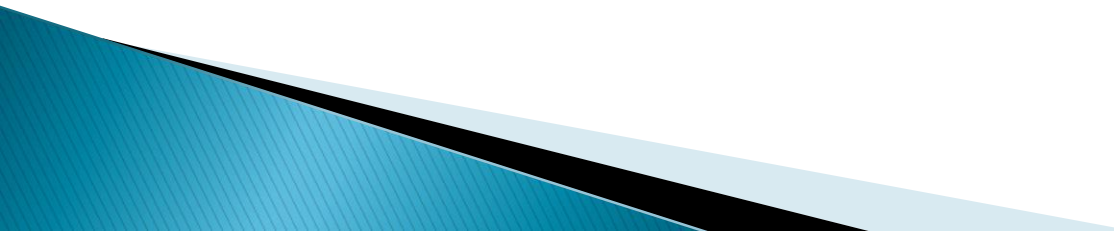
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PAIN

- ▶ DEFINATION
 - ▶ TYPES OF PAIN
 - ▶ PAIN RECEPTORS
 - ▶ PAIN PATHWAYS : SPINOTHALAMIC TRACTS
 - ▶ ANALGESIA SYSTEM
 - ▶ REFERRED PAIN
 - ▶ VISCERAL PAIN
 - ▶ GATE CONTROL THEORY
 - ▶ TREATMENT
 - ▶ APPLIED
- 

DEFINITION

- ▶ UNPLEASANT SENSORY AND EMOTIONAL EXPERIENCE ASSOCIATED WITH ACTUAL OR POTENTIAL TISSUE DAMAGE OR DESCRIBED IN TERMS OF SUCH DAMAGE.
 - ▶ INTERNATIONAL ASSOCIATION FOR THE STUDY OF PAIN (IASP).
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PAIN

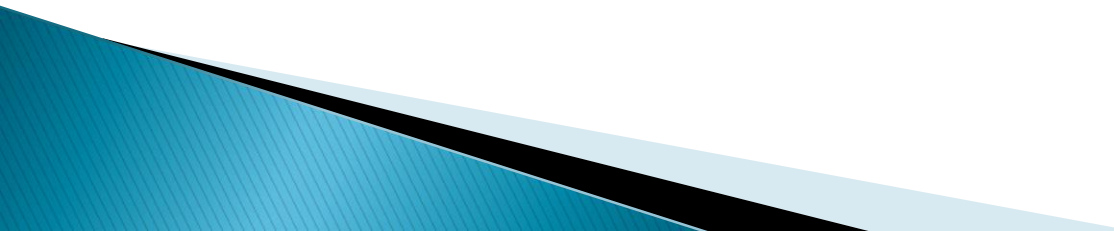
▶ SOMATIC PAIN

- 1) SUPERFICIAL:
from skin
- 2) DEEP :
from muscles, joints,
bones, fascia etc.

▶ VISCERAL PAIN

Pain arising from
viscera

Viscera insensitive to pain

- ▶ Parenchyma of liver
 - ▶ Alveoli of lungs
 - ▶ Brain tissue
- 

TYPES OF PAIN

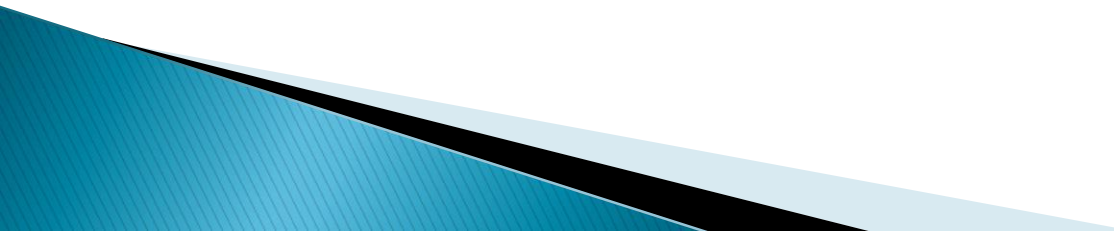
▶ FAST PAIN

1. WITHIN 0.1 SEC
2. EXAMPLES
3. MECHANICAL AND THERMAL STIMULI
4. TYPE A delta FIBRES
5. VELOCITY:
6–30 mt/sec
6. Neospinothalamic tract

▶ SLOW PAIN

1. BEGINS AFTER 1 SEC
2. EXAMPLES
3. MECH., CHEM., AND THERMAL
4. TYPE C FIBRES
5. VELOCITY: 0.5–2
mt/sec
7. Paleospinothalamic tract

Reactions to pain

- ▶ Emotional
 - ▶ Muscular
 - ▶ Reflex response
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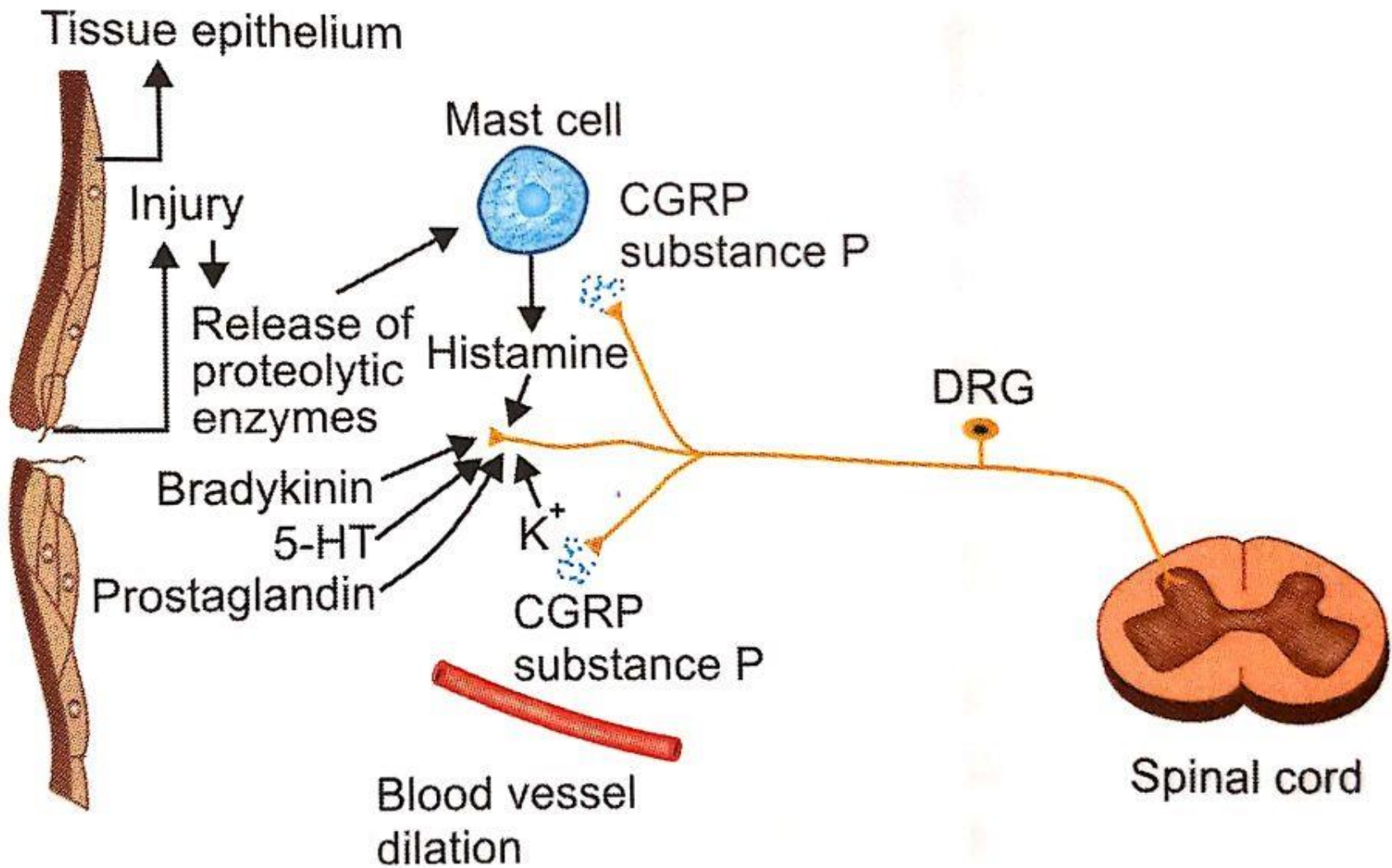


Fig. 120.6: Mechanism of pain recognition.

PATHWAY OF PAIN: SPINOTHALAMIC TRACT

- ▶ ANTERIOR STT– LIES IN ANT. WHITE FUNICULUS
- ▶ LATERAL STT– LIES IN LATERAL WHITE FUNICULUS
- ▶ ORIGIN:
 - FIRST ORDER NEURONS– POST. NERVE ROOT GANGLIA
 - 2ND ORDER NERONS–
 - ANT. STT –CHIEF SENSORY CELLS OF POSTERIOR GRAY HORN
 - LATERAL STT– SUBSTANTIA GELATINOSA OF ROLANDO.

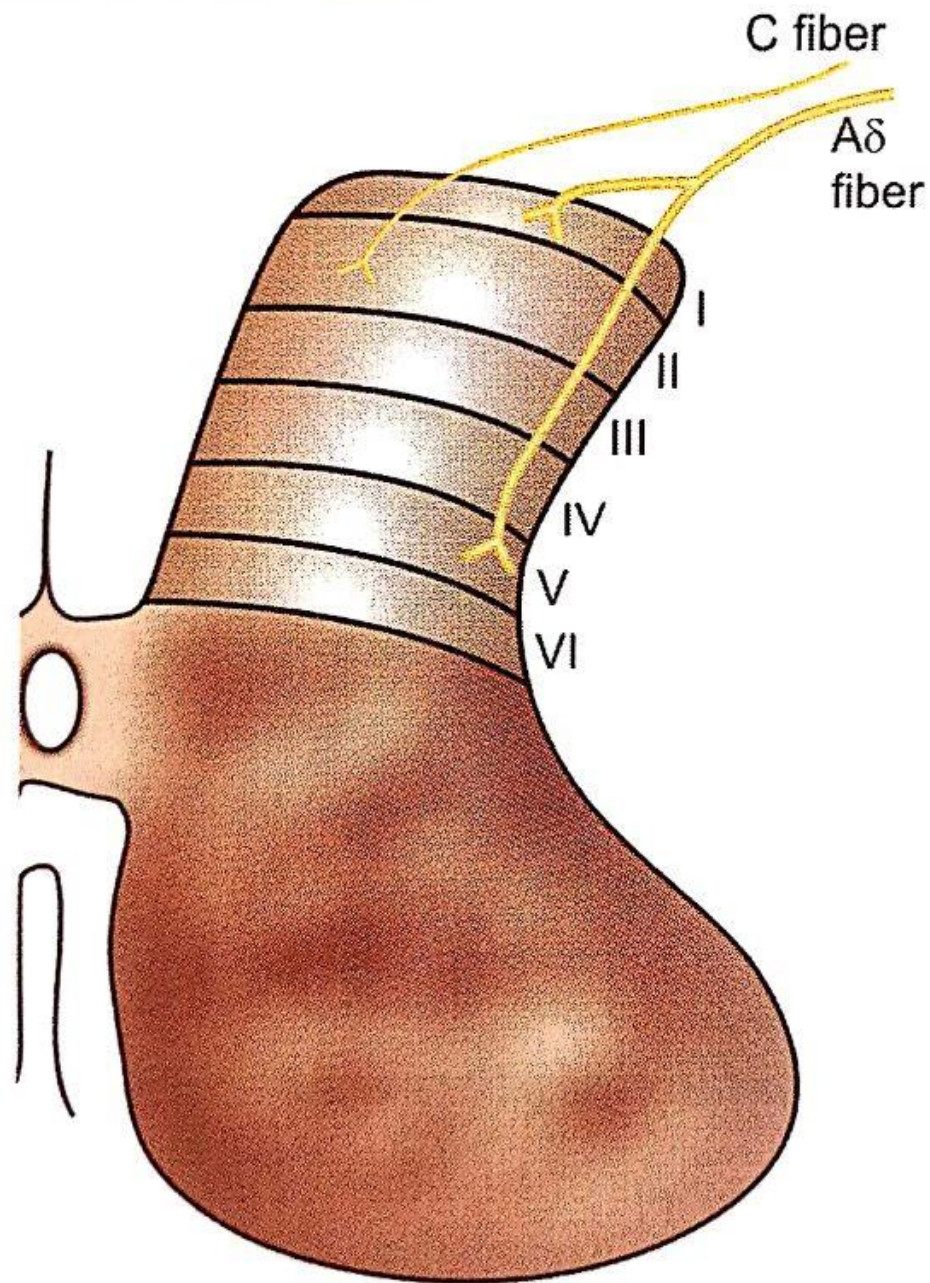


Fig. 120.1: Termination of pain fibers in dorsal horn of spinal cord.

COURSE

- ▶ SPINAL CORD– cross to opp. side and enter ant. or lat. white funiculus.
crossed fibers then ascend up through other segments of sc.
- ▶ BRAINSTEM– fibers ascend through bs (called spinal lemniscus) and reach thalamus .some fibers of lat. stt end in reticular formation of brainstem.
- ▶ THALAMUS: 2nd order neuron fibers end in thalamic nucleus and give rise to 3rd order neuron fibers.
- ▶ CEREBRAL CORTEX: 3rd order neuron fibers terminate in sensory area of cortex.

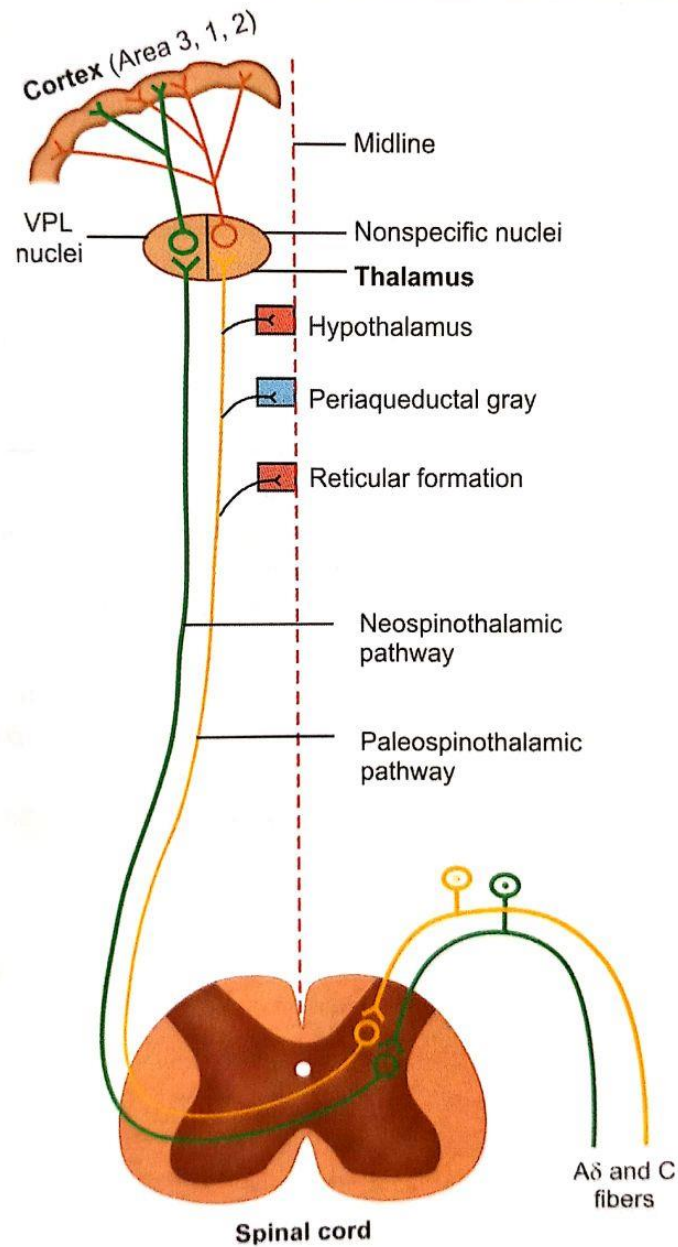


Fig. 120.2: Paleospinothalamic and neospinothalamic pain pathways. Note the collaterals in the brainstem from paleospinothalamic pathway terminating in different brainstem nuclei.

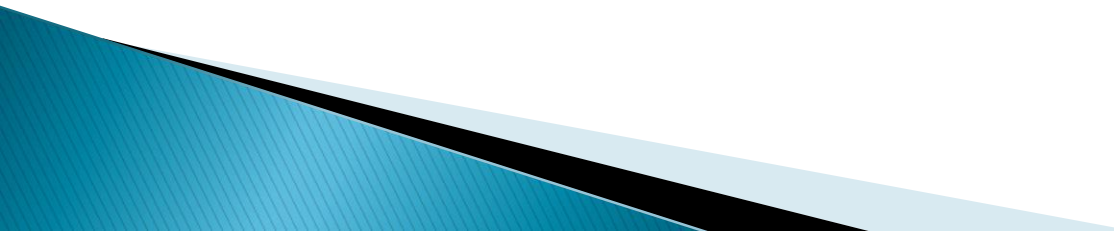
FUNCTION:

- ▶ ANTERIOR STT. CARRIES– CRUDE TOUCH.
- ▶ LATERAL STT CARRIES – FINE TOUCH, PAIN, TEMPERATURE SENSATIONS.

EFFECT OF LESION:

UNILATERAL LESION CAUSE LOSS OF PAIN, TEMP, AND TOUCH ON OPPOSITE SIDE OF LESION.

PROPERTIES OF PAIN

- ▶ Threshold and intensity
 - ▶ Adaptation
 - ▶ Localisation of pain
 - ▶ Emotional component
 - ▶ Types of pain
- 

REFERRED PAIN

- ▶ PAIN ORIGINATING IN VISCERAL ORGAN IS FELT (REFERRED) TO AREAS ON THE SKIN.

Scientist contributed

Henry Head (1861–1940), had pioneered in the study of visceral pain; especially he analyzed the **referred pain originating from viscera**. His studies on skin sensation and on loss and regeneration of sensations after cutting a nerve stimulated many pupils in physiology. He had demonstrated the function of vagus nerve in regulation of respiration.

Sources: On disturbances in sensation with special reference to the pain of visceral disease. *Brain* 1893;16:1-133.



Henry Head
(1861–1940)

DERMATOME

- ▶ Segmental field of skin innervated by a single spinal nerve.

THEORIES FOR REFERRED PAIN

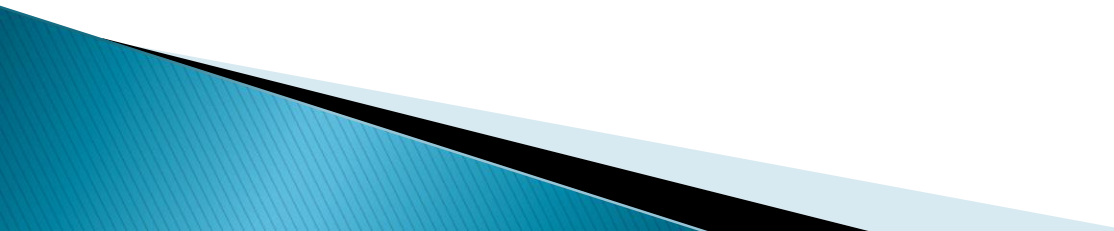
1) DERMATOMAL THEORY:

VISCERAL PAIN IS USUALLY REFERRED TO A STRUCTURE THAT DEVELOPS FROM THE SAME EMBRYONIC SEGMENT (DERMATOME).

EG. HEART AND INNER ASPECT OF ARM.



2) CONVERGENCE THEORY:
VISCERAL AND SOMATIC
AFFERENT FIBERS CONVERGE
ON THE SAME SECOND ORDER
NEURON IN THE
SPINOTHALAMIC TRACT



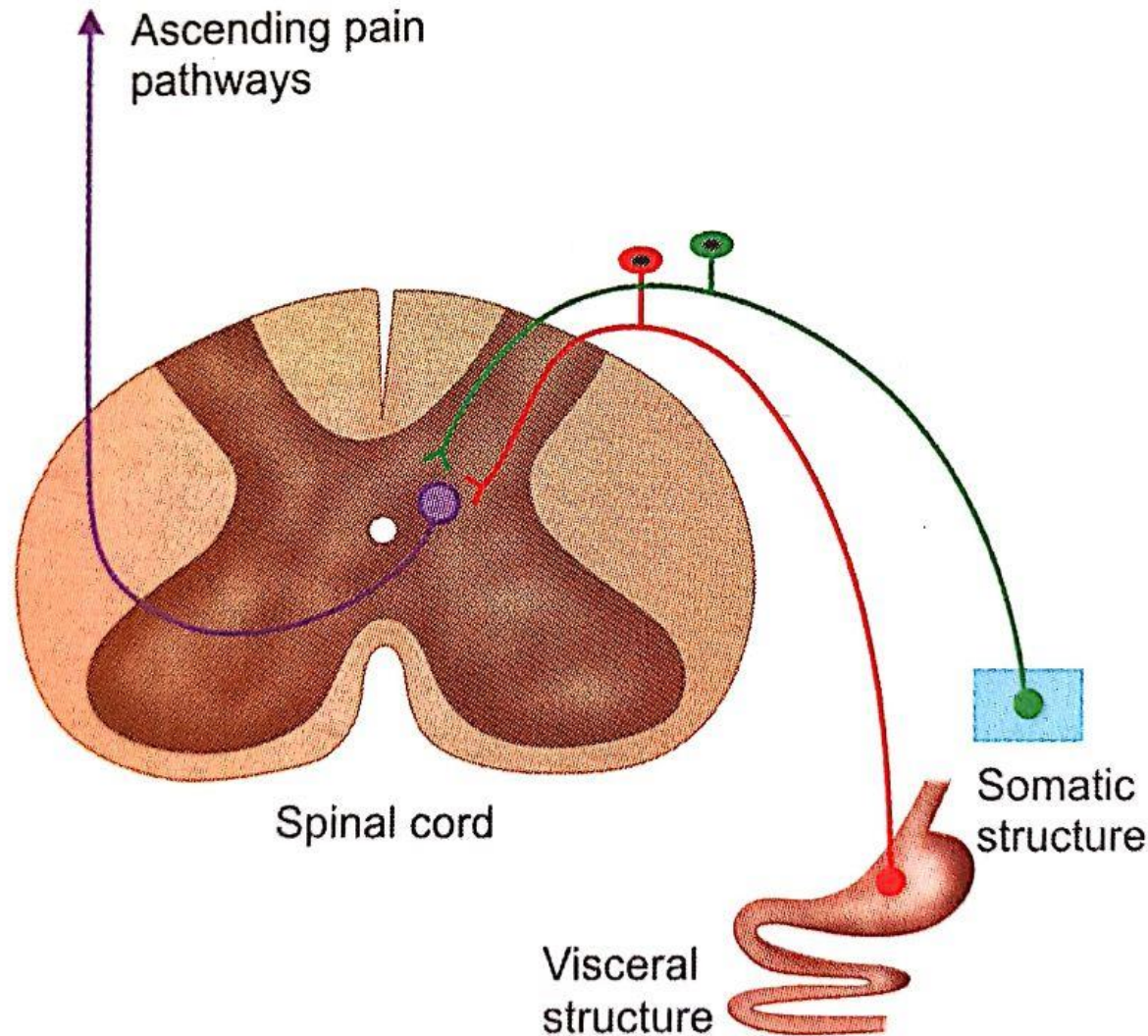


Fig. 120.4: Convergence theory of referred pain. Note, due to convergence of fibers from somatic and visceral structures on a single second order neuron, fibers transmitting pain sensation from the somatic structure also carry the pain sensation arising from the visceral structures.

3) FACILITATION THEORY

- ▶ COLLATERALS FROM VISCERAL AFFERENT FIBERS PROJECT TO SPINOTHALAMIC NEURONS THAT RECEIVES AFFERENTS FROM SOMATIC STRUCTURES.

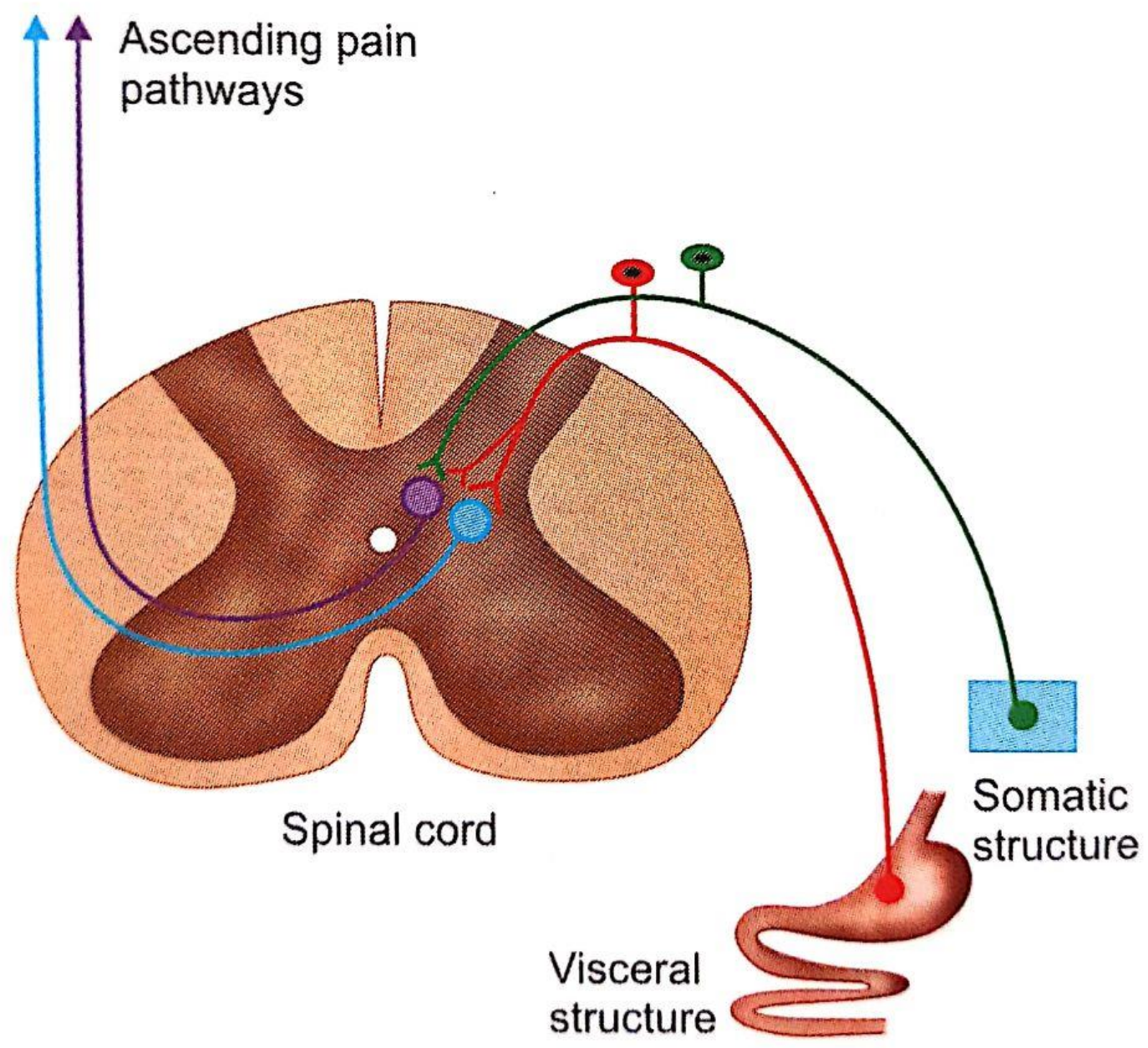
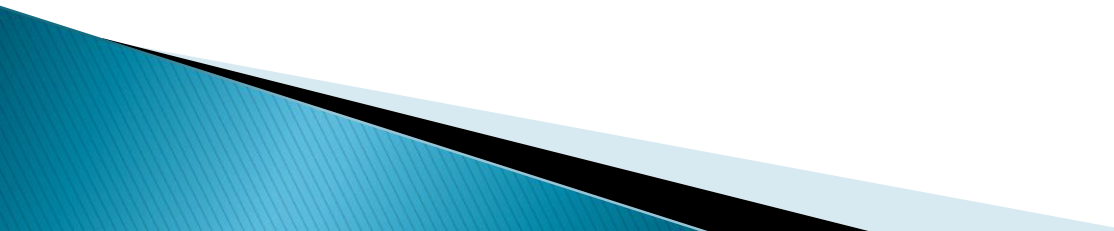
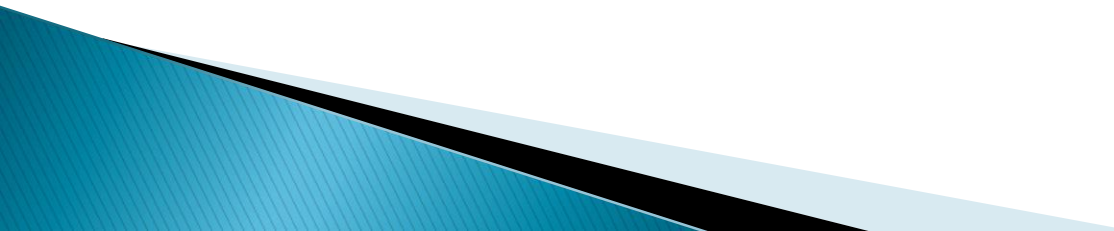


Fig. 120.5: Facilitation of pain by somatic and visceral structures.

VISCERAL PAIN

- ▶ POORLY LOCALISED, DIFFUSE IN NATURE
 - ▶ ASSOCIATED WITH AUTONOMIC SYMPTOMS
 - ▶ REFERRED TO OTHER STRUCTURES
 - ▶ NOCICEPTORS ARE MUCH LESS IN NUMBER COMPARED TO SOMATIC PAIN
- 

CAUSES OF VISCERAL PAIN

- ▶ INFLAMMATION
 - ▶ ISCHAEMIA
 - ▶ CHEMICAL STIMULI
 - ▶ SPASM OF HOLLOW VISCUS
 - ▶ OVERDISTENSION OF HOLLOW VISCUS
 - ▶ PARIETAL PAIN
- 

ENDOGENOUS PAIN CONTROL MECHANISM:

- ▶ DESCENDING PAIN INHIBITING SYSTEM:
PERIAQUEDUCTAL GRAY MATTER
NUCLEUS RAPHE MAGNUS
- ▶ OPIOID SYSTEM:
MORPHINE
ENDORPHINES– ENKEPHELIN

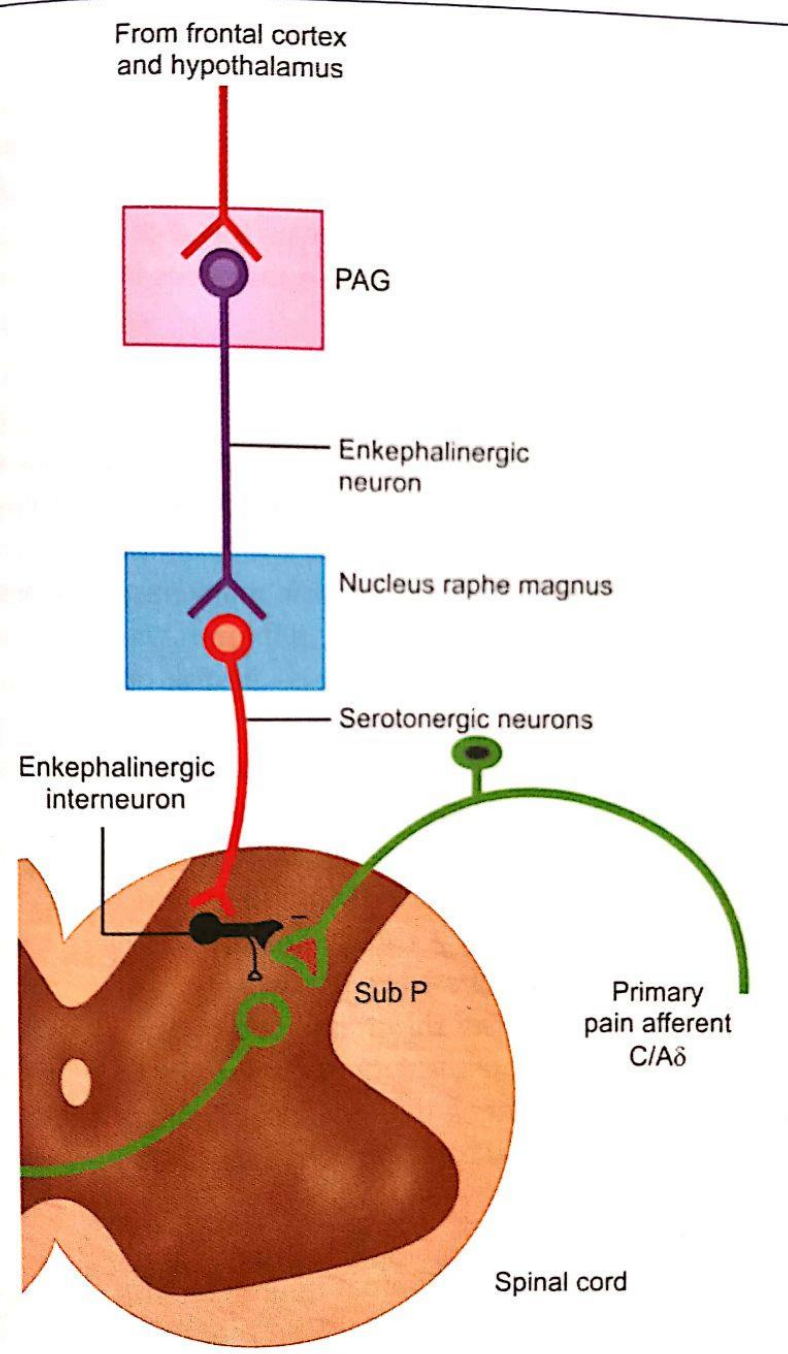


Fig. 120.7: Endogenous neural analgesia system.

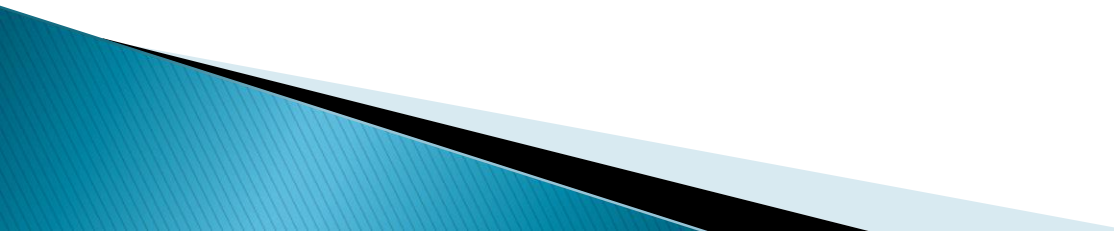
GATE CONTROL THEORY OF PAIN:

- ▶ PAIN CAN BE MODULATED BY PERIPHERAL MECHANISMS.
- ▶ COLLATERALS FROM TOUCH SENSATION PRODUCE PRESYNAPTIC INHIBITION OF 'A' DELTA AND 'C' FIBERS IN DORSAL HORN OF SPINAL CORD.

MANAGEMENT:

- ▶ Counter irritants: balms etc.
- ▶ Analgesic drugs: pcm, diclofenac etc.
- ▶ Acupuncture
- ▶ Sectioning of nerve innervating the area.
- ▶ Sympahtectomy
- ▶ Myelotomy: sec. of STT fibers in SC
- ▶ Posterior rhizotomy: sectioning of dorsal root of sc.
- ▶ Antereo lateral cordotomy: sec. of lateral STT.
- ▶ Thalamotomy
- ▶ Gyrectomy: removal of grey matter of areas 1,2,3
- ▶ Pre frontal lobectomy or topectomy: sense of well being or euphoria.

APPLIED:

- ▶ HYPERALGESIA
 - ▶ HYPOALGESIA
 - ▶ ANALGESIA
 - ▶ HYPERPATHIA: DEFECT IN PAIN PERCEPTION ASSOCIATED WITH INCREASED REACTION TO PAIN SENSATION.
 - ▶ ALLODYNIA: EXCESSIVE RESPONSE TO MILD STIMULUS EG. LIGHT TOUCH PRODUCES PAIN.
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THALAMIC SYNDROME

- ▶ When a branch of post. Cerebral artery supplying posteroventral nucleus of thalamus is blocked, nuclei of this area of thalamus disintegrate whereas other nuclei are intact.
- ▶ Patient suffers from: loss of all sensations on opposite side of the body, sensory ataxia (due to loss of position and kinaesthetic sensations to thalamus).

**THANK
YOU**

