

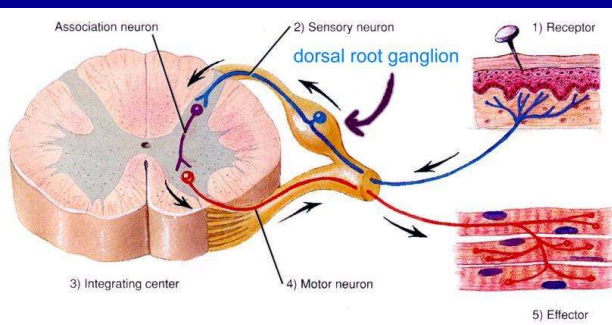
Clinical Physiology of the Nervous System II.

Sensory Disorders, Pain

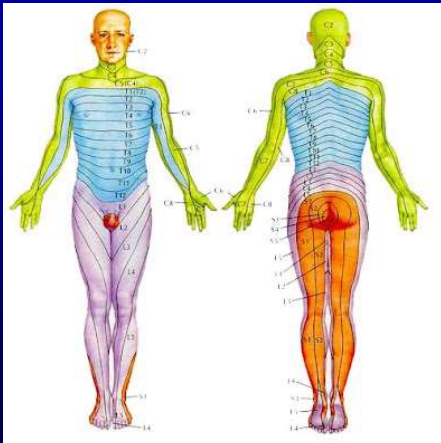
Judit Boczán, MD, PhD
UD CC Department of Neurology

ANATOMY OF THE SENSORY SYSTEM

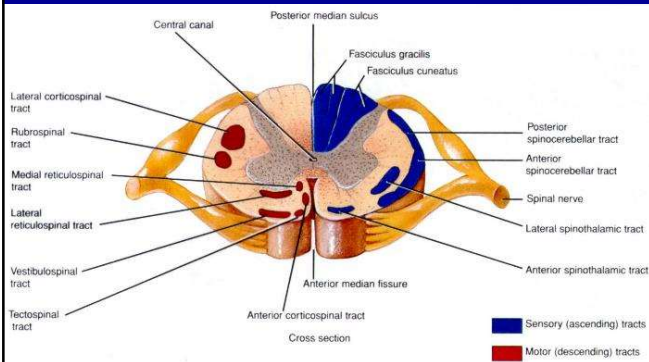
PRIMARY SENSORY EVENTS AND FUNCTIONS



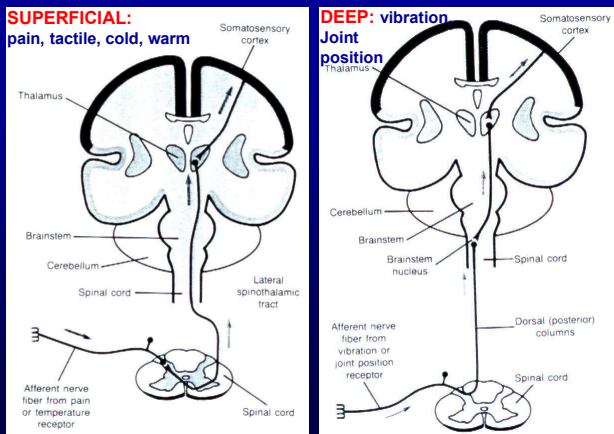
RADICES AND DERMATOMES



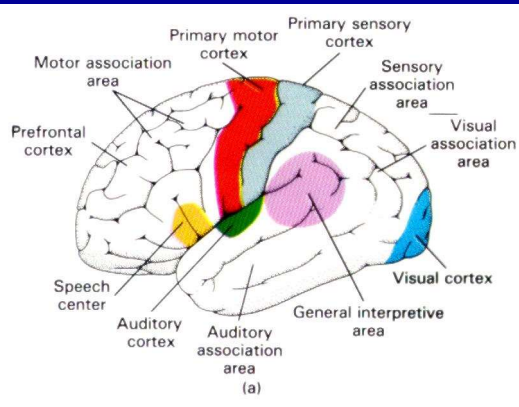
SPINAL CORD TRACTS



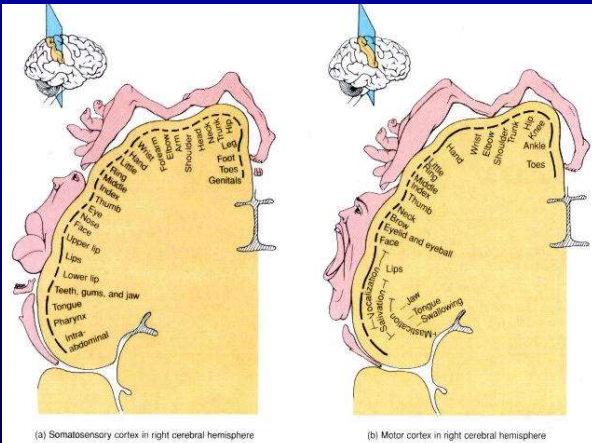
PATHWAY OF THE SUPERFICIAL AND DEEP SENSORY SYSTEM



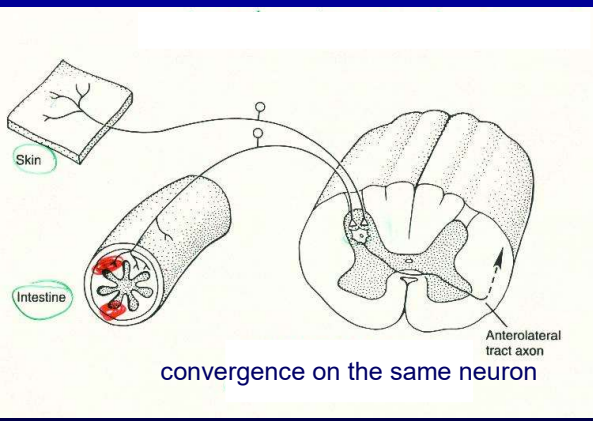
SENSORY CORTEX



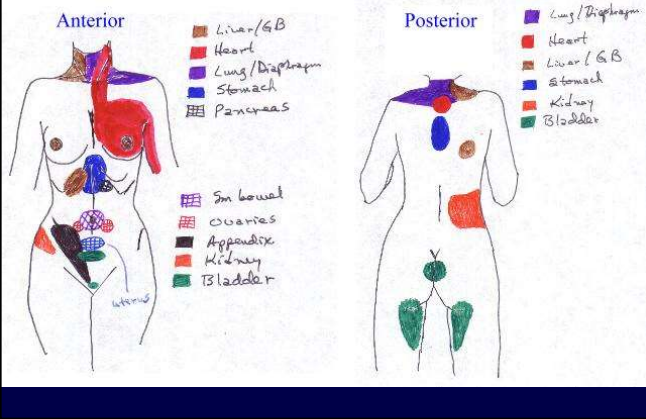
HOMUNCULUS



REFERRED PAIN



REFERRED PAIN OF INTERNAL ORGANS



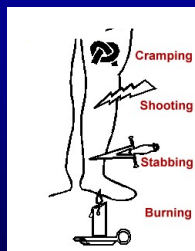
EXAMINATION OF THE SENSORY SYSTEM

TERMES TO CONSIDER

Complaints typical for damage of the sensory system

- Superficial

- Pain
- Numbness
- Sensory loss
- Hypersensitivity



- Deep

- Imbalance (worsenes with eyes closed!)

Examination of the sensory system

- Superficial

Pain: needle

Tactile: cotton wool, light touch

Warm: test tube filled with warm water

Cold: test tube filled with cold water

- Deep

Vibration: tuning fork (skin – bone connection)

Joint position

TERMS TO CONSIDER

Hyperaesthesia (opposite = **Hypaesthesia**): a non-painful stimulus is perceived to be stronger than normal (weaker than normal) but is not painful e.g. a light touch becomes a stronger (weaker) touch.

Hyperalgesia (opposite = **hypalgesia**) where a painful stimulus is perceived to be more painful than normal (less painful than normal) e.g. a pin prick is felt as a stronger (weaker) pinprick than normal.

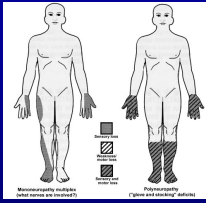
Paraesthesia is an abnormal sensation which is not perceived as painful e.g. gently knocking your funny-bone at the elbow causes non-painful tingling in your little finger.

Dysaesthesia is an abnormal sensation which is perceived as unpleasant or painful e.g. strongly knocking your funny bone at the elbow causing painful unpleasant tingling and pain in the little finger.

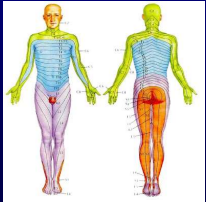
Allodynia (Greek - other pain) is pain produced by a stimulus which would not normally cause pain e.g. lightly stroking the skin causing vibrational allodynia, putting your hands in luke warm water causing thermal allodynia.

Causalgia: spontaneous burning pain without a trigger

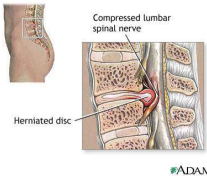
TYPES OF SENSORY DISTURBANCES



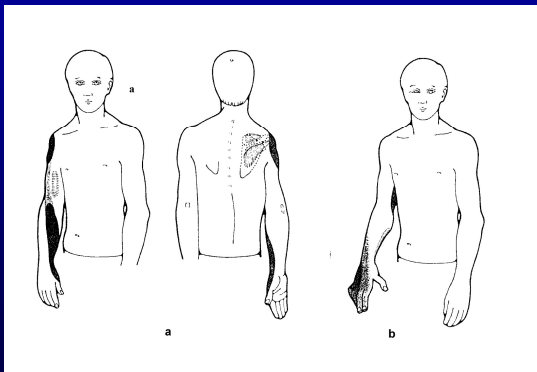
-Mononeuropathy
(sensory disturbance on the territory of a peripheral nerve)
-Polyneuropathy
(distal type of sensory disturbance – glove, stocking)

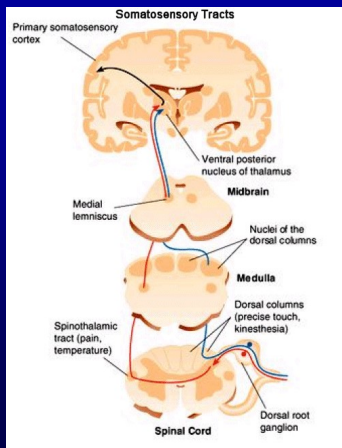


-Dermatomal / radicular
(eg. disc herniation)



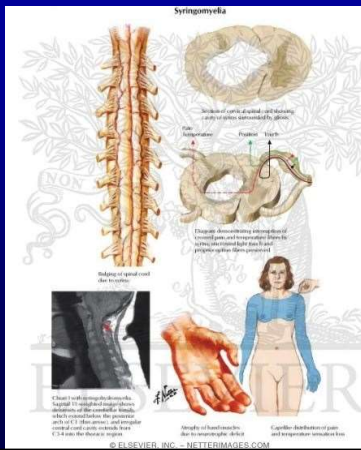
UPPER AND LOWER BRACHIAL PLEXUS LESION





DISSOCIATED SENSORY DISTURBANCES OF THE SPINAL CORD: SYRINGOMYELIA

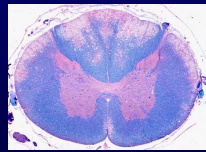
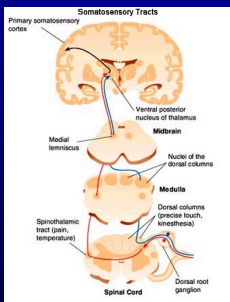
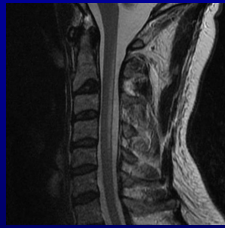
Cervical MRI



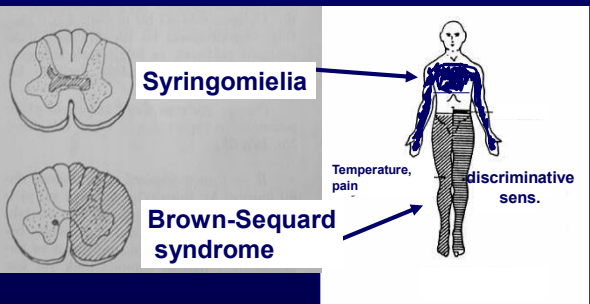
DISSOCIATED SENSORY DISTURBANCES OF THE SPINAL CORD: DORSAL COLUMN

- paraesthesia of the extremities and trunk
 - deep sensory dysfunction
 - sensory ataxia
- Cause: B12 deficiency, tabes dorsalis

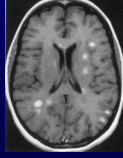
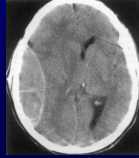
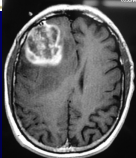
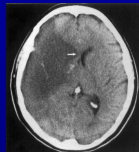
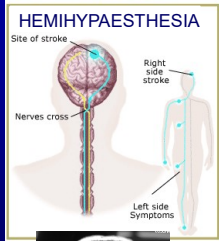
Cervical MRI



DISSOCIATED SENSORY DISTURBANCES OF THE SPINAL CORD



HEMISPHERAL SYMPTOMS

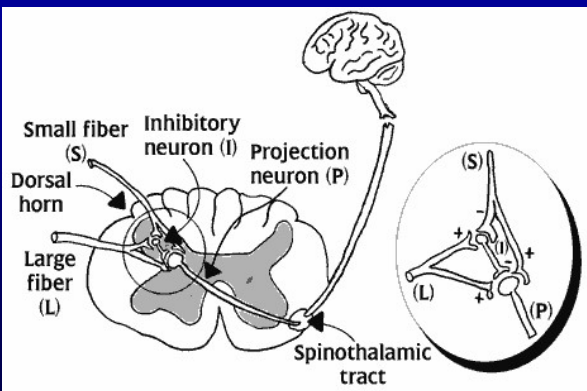


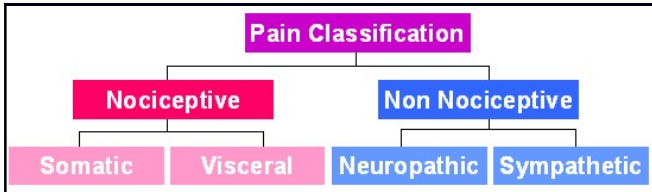
PAIN

"An 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.

Pain is always subjective with each individual learning about the application of the word through experiences related to injury in early life.

Gait control theory of spinal cord pain transmission





Nociceptive Pain: arises from the stimulation of specific pain receptors. These receptors can respond to heat, cold, vibration, stretch and chemical stimuli released from damaged cells.

Non Nociceptive Pain: arises from within the peripheral and central nervous system. Specific receptors do not exist here, with pain being generated by nerve cell dysfunction.

Somatic Pain

Source - tissues such as skin, muscle, joints, bones, and ligaments - often known as musculo-skeletal pain.

Receptors activated - specific receptors (nociceptors) for heat, cold, vibration, stretch (muscles), inflammation (e.g. cuts and sprains which cause tissue disruption), and oxygen starvation (ischaemic muscle cramps)

Characteristics - often sharp and well localized, and can often be reproduced by touching or moving the area or tissue involved.

Visceral Pain

Source - internal organs of the main body cavities. There are three main cavities - thorax (heart and lungs), abdomen (liver, kidneys, spleen and bowels), pelvis (bladder, womb, and ovaries).

Receptors activated - specific receptors (nociceptors) for stretch, inflammation, and oxygen starvation (ischaemia).

Characteristics - often poorly localized, and may feel like a vague deep ache, sometimes being cramping or colicky in nature. It frequently produces referred pain to the back, with pelvic pain referring pain to the lower back, abdominal pain referring pain to the mid-back, and thoracic pain referring pain to the upper back.

Neuropathic Pain (frequent)

Source - from within the nervous system itself. The pain may originate from the peripheral nervous system, or from the CNS

Causes - Nerve Degeneration - multiple sclerosis, stroke, oxygen starvation
 Nerve Pressure – entrapment neuropathies (tunnel syndroms)
 Nerve Inflammation - torn or slipped disc
 Nerve Infection – varicella zoster (shingles) and other viruses

Receptors activated - the nervous system does not have specific receptors for pain (non nociceptive). Instead, when a nerve becomes injured by one of the processes named above, it becomes electrically unstable, firing off signals in a completely inappropriate, random, and disordered fashion.

Characteristics - These signals are then interpreted by the brain as pain, and can be associated with signs of nerve malfunction such as hypersensitivity (touch, vibration, hot and cold), tingling, numbness, and weakness. There is often referred pain to an area where that nerve would normally supply e.g. sciatica from a slipped disc irritating the L5 spinal nerve produces pain down the leg to the outside shin and big toe i.e. the normal territory in the leg supplied by the L5 spinal nerve. Nerve pain is often described as lancinating, shooting, burning, and hypersensitive.

Sympathetic Pain (rare)

Source - due to possible over-activity sympathetic nervous system, and central/peripheral nervous system mechanisms. The sympathetic nervous system controls blood flow to tissues such as skin and muscle, sweating by the skin, and the speed and responsiveness of the peripheral NS.

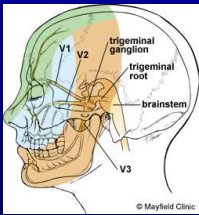
Causes - occurs more commonly after fractures and soft tissue injuries of the arms and legs, and these injuries may lead to Complex Regional Pain Syndrome. CRPS was previously known as Reflex Sympathetic Dystrophy.

Receptors activated - like nerve pain there are no specific pain receptors (non nociceptive). The same nerve processes as mentioned above may operate in CRPS.

Characteristics - presents as extreme hypersensitivity in the skin around the injury and also peripherally in the limb, and is associated with abnormalities of sweating and temperature control in the area.

The limb is usually so painful, that the sufferer refuses to use it, causing secondary problems after a period of time with muscle wasting, joint contractures, and osteoporosis of the bones. It is possible that the syndrome is initiated by trauma to small peripheral nerves close to the injury.

Neuralgic pain (eg. trigeminal neuralgia)



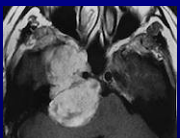
- sudden onset
- suddenly ends
- short duration (max. 5 sec.)
- intense
- many times a day
- sensitivity of the exit points



Causes of trigeminal neuralgia



Postherpetic neuralgia



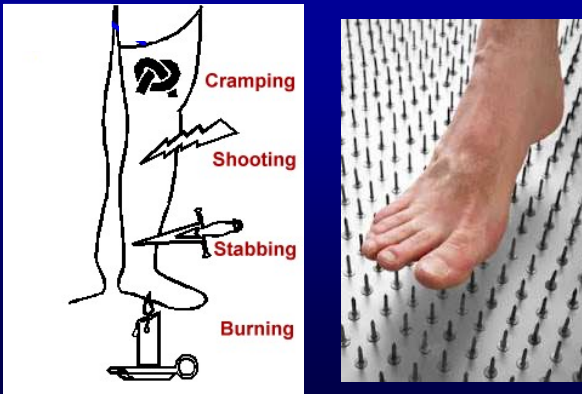
Tumor of the posterior fossa (MRI)



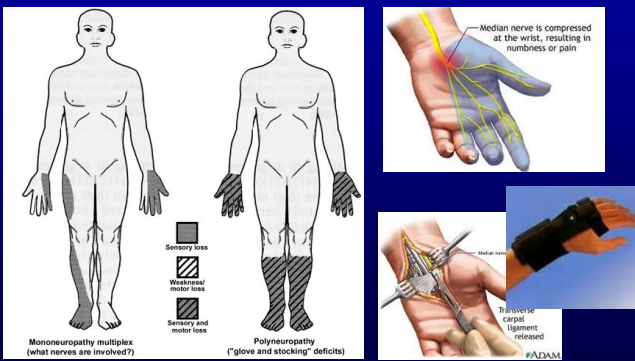
Neurovascular compression (MRI)

+ Idiopathic

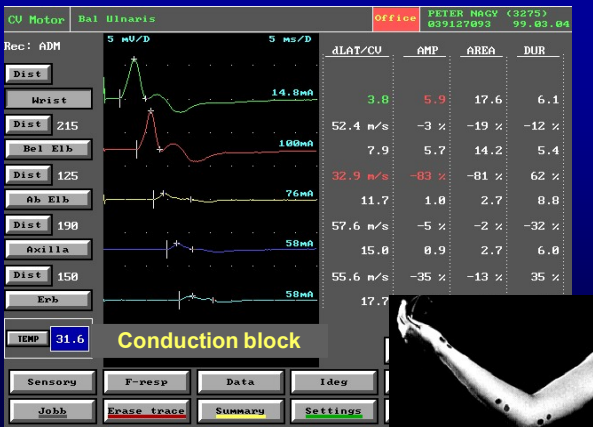
NEUROPATHIC PAIN



NEUROPATHIC PAIN (eg. Tunnel syndroms, polyneuropathies)



Electroneurography (ENG): cubital tunnel sy



SUMMARY

- Sensory system is often affected in neurologic diseases
- Pattern of sensory deficit helps to localize the pathology
- Imaging, electroneurography and lab tests help to find the cause
- Treat the cause
- Neuropathic pain can be treated by antiepileptic or tricyclic antidepressant drugs

THANK YOU FOR YOUR ATTENTION!

Radnai mountains, 2013