EEG

=Electroenencephalogram

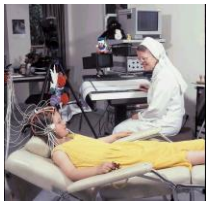
…bioelectric activity of the brain

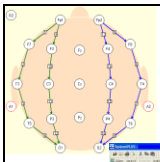
… The recording of the electric currents developed in the brain, by means of electrodes applied to the scalp, to the surface of the brain (intracranial e.) or placed within the substance of the brain (depth e.).

EEG- indications

- Epilepsy: the origin within the brain of the individual's seizures
- Dementia syndromes- dif. Dg. Creutzfeld Jacob disease, infection
- Intoxications-alcohol, drugs
- ?Brain death

Scalp





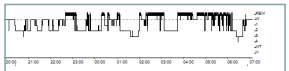
Scalp EEG

Polsomnography

Polysomnography

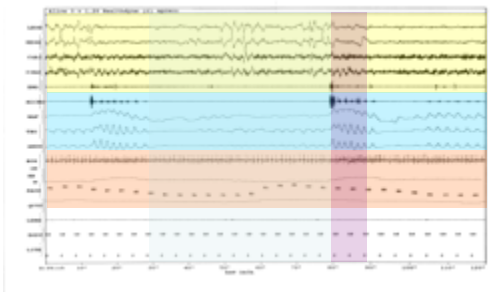
- Recording of several vital functions:
  - EEG
  - EMG
  - EOG
  - Breathing
  - ECG
  - O2 saturation
  - Leg movements

Sleep stage (1, 2 NREM, slow wave sleep, REM) or Wakefulness–HYPNOGRAM –sleep architecture



Hypnogram

Polysomnographic recording
- disordered breathing during night



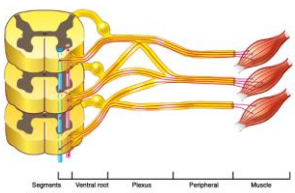
EMG
Electromyography

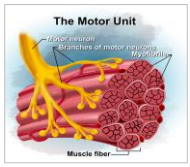
Neurologická klinika
UPJŠ LF Košice

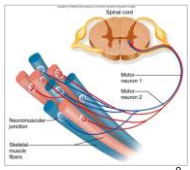
8

Electromyography

- Motorneuron + muscle+ N-M junction







9

EMG

- **Indications:**

- **Myopathies:** muscular dystrophy, inflammatory diseases of muscles - myositis, dermatomyositis

- **Neuropathies:** pinched nerves, multiple peripheral nerve damage - polyneuropathy, spinal root compression/radicular syndrome -radiculopathy, ALS (Amyotrophic lateral sclerosis)

- **Myasthenia gravis and myasthenic syndromes**

10

EMG - 3 methods

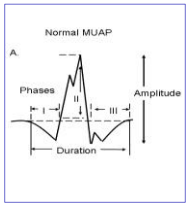
1. Needle EMG
2. STEMG
3. NCS (nerve conduction studies)

11

1. Needle EMG

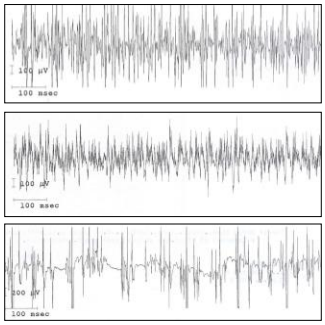
- Muscle electrical activity can be recorded by a needle electrode placed within muscle - **needle EMG**
- The **potential difference** between the outer shaft and inner wire
- **AP** (MUAP, motor unit action potential):

latency /duration: 2 -15 ms
amplitude: 300 uV – 3 mV



12

Needle EMG



Normal pattern

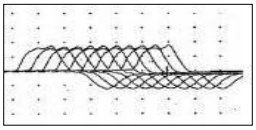
Myopathy

Neuropathy

13

STEMG - repetitive nerve stimulation

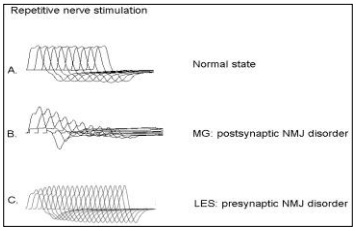
- STEMG: the spinal root of ***accessory nerve (n.XI)*** is stimulated as it crosses the sterno-cleido-mastoid muscle
- Electrode positions: ***trapezius muscle***
- The active recording electrode is placed over the belly of the muscle, and the reference-recording electrode distally over the shoulder



14

STEMG

- Myasthenia gravis - AP amplitude **decrement** (>10% 1. response amplitude) with **3Hz** stimulation

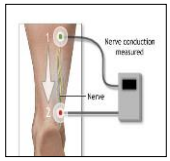


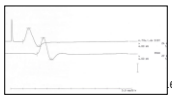
15

Nerve conduction studies - NCS

NCS are used to measure action potentials resulting from **peripheral nerve stimulation** recordable over the nerve (**proximal and distal nerve stimulation**) or **from an innervated muscle**

- used in testing of integrity of the *peripheral nerves*
- the nerve is stimulated at two or more points along its course
- the muscle electrical response is recorded of one of the muscles supplied by this nerve





6

Carpal tunel syndrome

Carpal tunnel syndrome is compression of the median nerve at the wrist, which may result in *numbness, tingling, weakness, or muscle atrophy* in the hand and fingers

Carpal tunnel syndrome is caused by pressure exerted on the median nerve at the point where it passes through the wrist

Evoked potentials

18

Evoked potentials

Evoked Potentials - CNS response to exactly defined stimulus from periphery

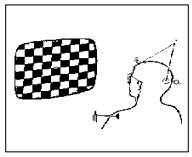
it reflects impulse propagation through neuronal pathway

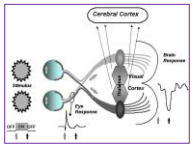
- **VEP: V**isual EP
- **SEP: S**omato -sensory EP
- **BAEP: B**rainstem auditory EP
- **MEP: M**otor EP
- **ERP**: Event-related potentials (Cognitive Eps)

19

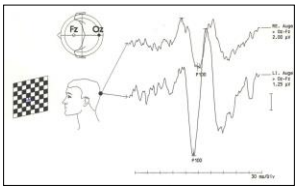
VEP

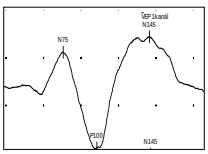
- **Monocular stimulation** generates a cerebral response that is recorded over the **occipital region**
- The seated person looks at the center of a television screen (red spot) on which is displayed a checkerboard pattern of white and black squares
- The pattern reverses at about 1 Hz - so called pattern-reversal stimulus
- Responses to approximately **100 stimuli** are averaged





- **Normal VEP:** a negative-positive-negative complex (N-P-N), recorded in the midoccipital region
- The positivity is the most consistent and has a latency to its peak of approximately 100 msec, so called **P100 response**
- The latency of P100 wave is measured and then the interocular difference in latency is determined





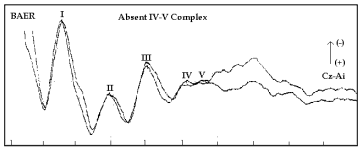
21

BAEP- Brainstem auditory evoked potentials

- The BAEP - reflects function of the **eight cranial nerve (n.VIII) and the central auditory pathways in the brainstem**

- Potentials can be recorded at the vertex of the head (the cortical responses) after auditory stimulation

BAEP

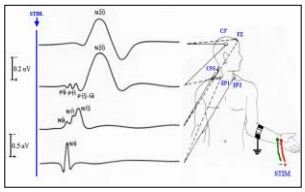


- BAEPs are usually set at approximately **75 dB** and are delivered through earphones while the oposite ear is masked by white noise.
- **2000 clicks** delivered first to one ear and then the other, are recorded through scalp electrodes
- Two trials of **each side stimulation (right and left)** are superimposed to show the replicability of the findings
- The BAEP consists of a series of **up to seven waves** that occur **within 10 msec** after each stimulus

23

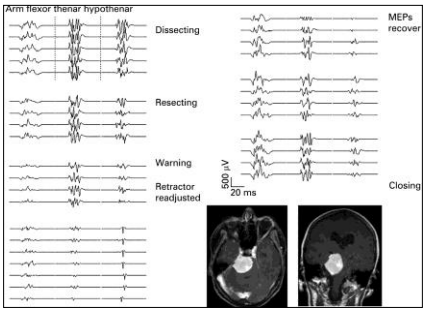
SEP- Somatosensory EP

- Peripheral nerves stimulation (on the limbs)
- Responses are recorded within the **somato-sensory pathway** course

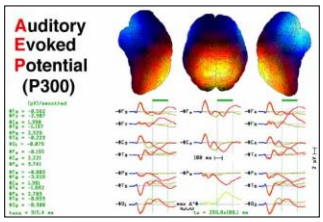


24

Perioperative MEP UL



ERP- Event-related potentials, Cognitive EP



ERP- event-related potentials, latency

Amplitude and sharp of **P300 wave**

Cognitive decline, dementia syndromes, attention problems, ...

26

Neuroimaging

- (RTG)
- CT
- MRI

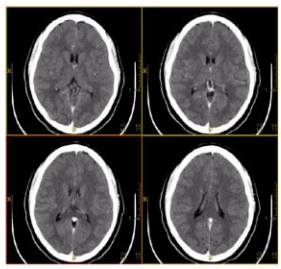
27

Brain CT

- Brain in the scale of grey colour
- Indications
- Strokes
- Brain tumors
- Headache
- Susp. AVM
- Neuroinfections
- Head injury
- Dementia

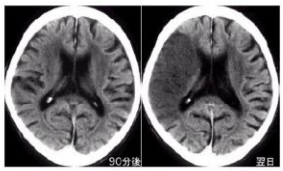
28

Brain CT



29

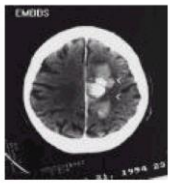
CT - brain infarct



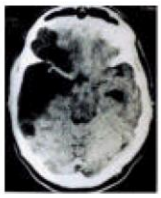
30

Brain CT

Brain haemorrhage



Brain infarct



31

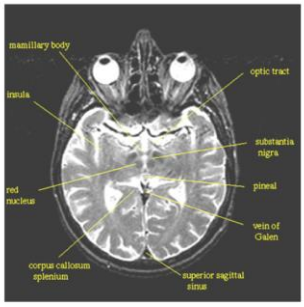
Magnetic resonance imaging – MRI

MRI using nonionizing energy provides better resolution of different structures within the brain and spinal cord.

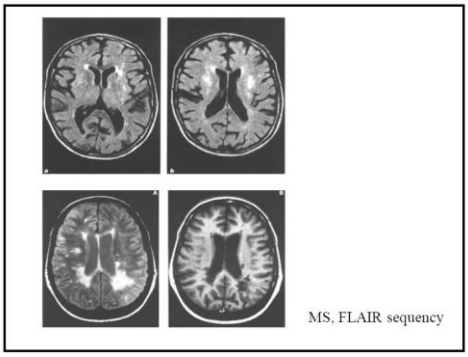
Basic principle: placing the patient within a powerful magnetic field, which causes the protons of tissues and fluids to align themselves in the orientation of the magnetic field.

The images generated by the MRI machines are truly remarkable with high degree of contrast between gray and white matter.

32



33



34

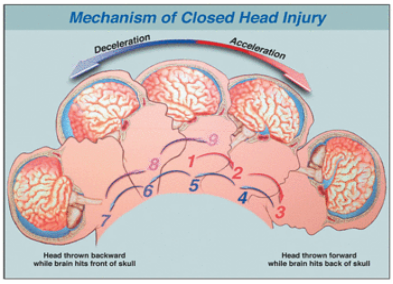
Head injury

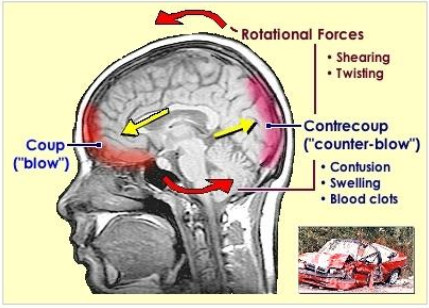
- Trauma is a type of injury which effects the body by external force being applied in a violent and sudden manner. When dealing with motorcycle accidents, it's important to understand the types of forces which a rider is subjected to, the body parts affected by these forces.

Head injury

- First, let's define the different types of trauma.

  1. Penetrating trauma
  2. Blunt trauma
  3. Acceleration/deceleration trauma





Head injury

- Concussion of brain – commotio cerebri
- Compression of brain – subdural, epidural haematoma
- Contussion of brain – intracerebral contussion with bleeding

Commotio cerebri

- Reversible damage
- Generalised asynapsia
- Amnesia – retro or anterograde
- Unconsciousness +- short duration
- Desorientation
- Vomitus, headache

Commotio cerebri

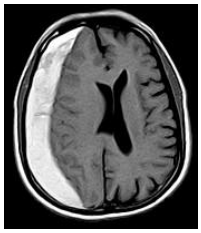
- Take care about patient !!!
- Free interval after head injury
- Development of subdural or epidural haematoma

Signs of subdural and epidural haematoma

- Anizokoria
- Bradykardia
- Hemiparesis
- Focal signs

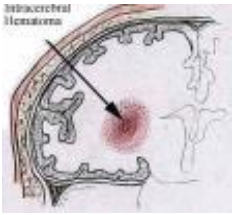
Brain CT

Subdural haematoma

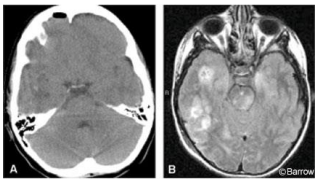


Epidural haematoma

Traumatic intracerebral haemorrhage



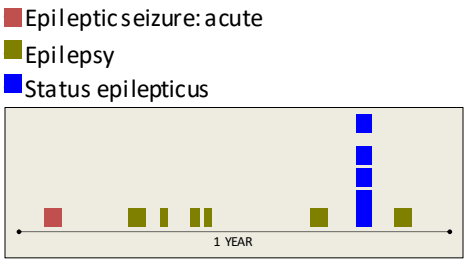
Severe closed head injury



- A) Noncontrasted axial computed tomography (CT) scan
- (B) a fluid-attenuated inversion recovery (FLAIR) magnetic resonance (MR, right) image of a 10-year-old boy 48 hours after he sustained a severe closed head injury.
- The region of hyperintense signal in the brain stem visible on the MR image cannot be detected on the CT scan.

Consequences of head injury

- **Posttraumatic parkinsonism**
- **Posttraumatic epilepsy**
- **Apalic syndrom**
- **Brain death**

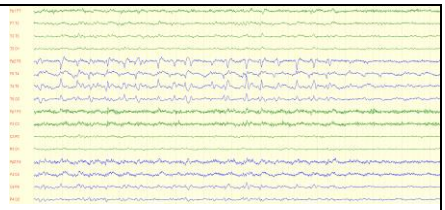


Epileptic seizure

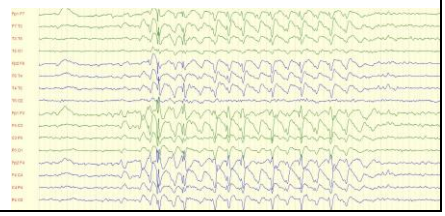
Seizure- symptom, represents the clinical manifestation of an abnormal and excessive synchronized discharge (uncontrolled electrical activity) of a set of cortical nn. in the brain

Mechanisms: Nerve cells transmit signals to and from the brain in two ways by
(1) altering the concentrations of salts (sodium, potassium, calcium) within the cell
(2) releasing chemicals called neurotransmitters (gamma aminobutyric acid). The change in salt concentration conducts the impulse from one end of the nerve cell to the other.

FOCAL
Epileptic discharge
(TLE l. dx.)



GENERALIZED
epileptic discharge
(Abcence s.)



Epilepsy

- from Greek word *epilambanein*, meaning „to seize" or „to attack"

Epilepsy –

- At least two unprovoked (or reflex) seizures occurring more than 24 hours apart
- One unprovoked (or reflex) seizure and a probability of further seizures similar to the general recurrence risk (at least 60%) after two unprovoked seizures, occurring over the next 10 years

Epilepsy is considered to be resolved for individuals who had an age-dependent self-limited epilepsy syndrome but who are now past the applicable age, or for those who have remained seizure-free for the last 10 years, with no seizure medication for the last 5 years.

Prevalence: **1%**

Epilepsy- diagnose

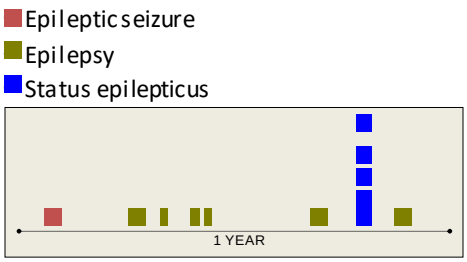
- complete patient **history** (details of birth, childhood, family history, and medication regimen; medical history, history of drug and alcohol use)
- A detailed **description of the seizures** (important to distinguish seizure types)
- **Neurological examination**
- **Electroencephalogram (EEG)**
  EEG is a diagnostic test used to investigate a seizure disorder. It identifies abnormal electrical activity in the brain, provides information about the type of seizure disorder, and locates the area of seizure focus.
- **Neuroimaging**
  Magnetic resonance imaging (MRI scan) or computed tomography (CT scan or CAT scan) are performed when a lesion or other structural cause, such as stroke or tumor, is suspected.

Epilepsy- differencial diagnose

- Neurological
  - Transient ischaemic attack
  - Migraine
  - Sleep disorders
    - Narcolepsy with cataplexy
    - REM behaviour disorder
    - somnambulism
- Cardiac
  - Vasovagal syncope
  - Arrhythmias
  - Hypotension
  - Reflex anoxic seizure
- Endocrine/metabolic
  - Changes of blood glucouse, ions
- Psychological
  - Non-epileptic psychogenic seizures

Epilepsy treatment

- Medication- depends on seizure type
  - Partial seizures- LEVETIRACETAM, LAMOTRIGINE (carbamazepine)
  - Generalized- VALPROATE/ LEVETIRACETAM
  - New generation: topiramate, gabapentin, pregabalin, zonisamide, perampanel, brivaracetam, lacosamide
- Other- Ketogenic Diet , ...
- Surgery
  - VNS
  - Resection of the lesion
  - Calosothomy...



EMERGENCY IN EPILEPSY

- Status epilepticus = seizures lasting for 5 minutes or more or recurrent seizures without recovery of consciousness to baseline between the attacks.
- Refractory SE is defined as SE persisting despite sufficient dose of benzodiazepines and at least one antiepileptic drug, irrespective of time.
- Super refractory SE = SE that continues for 24 hours or more after the use of anesthetic therapy, including cases that recur on weaning of the anesthestic agent.

Look for infection, trauma, consider autoimmune/paraneoplastic origin

Epileptic seizure- first aid