Literature:


Podmienky pre absolvovanie predmetu

- 100 % aktívne zúčastnenie v praktických cvičeniach, v prípade absencie môže sa vymeniť do 3 cvičení za semestr.

- úspešné ukončenie testu, ocenenie A – E (možnosť opakovane ukončiť test 2 razy).

- Successful completion of the test, evaluation A – E (possibility to repeat the test 2 times).
Teachers

- Prof. MUDr. Zuzana Gdovinová, CSc.
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- MUDr. Milan Maretta
- MUDr. Vladimír Haň
Cranial nerves

1. N. olfactorius
2. N. opticus
3. N. oculomotorius
4. N. trochlearis
5. N. trigeminus
6. N. abducens
7. N. facialis
8. N. vestibulocochlearis
9. N. glossopharyngeus
10. N. Vagus
11. N. accessorius
12. N. hypoglossus

mesencefalon
pons
medulla oblongata – bulbar nerves, lateral mixed system
Cranial nerves

Except of I. and II. nerves all other are PERIPHERAL NERVES

Nucleus (body of the nerve in brainstem) + nerve (axons and dendrites) + neuromuscular (gland.) junction

Functions of cranial nerves:

1. Motoric - muscle, gland
2. Sensation - sensitivity
3. Sensory - vision, hearing, balance, smell
The olfactory nerve - n.I.
The olfactory nerve - n.l.

**Anatomy:** fila olf.– bulbus olf. (I.n.)–tractus. olf (II.n.) – trigonum olf., subst.perf.ant., septum pellucidum (prim. subcortical centres) – cortex (III.n.) (temporal lobes)

**Examination:** each nosdril separately – patient sniff the test substance – coffee, soap, etc.

**Pathology:**
- hyposmia, anosmia – partial or complet loss of sense
- parosmia
- Uncinate fits – hallucination of smell
The olfactory nerve - n.I.

- Head injury
- Tumors
- Parkinson’s disease
- Alzheimer disease
The optic nerve - n.II.

**Anat.**: retinal ganglial cells – optic nerve – optic tract – corpus genic. laterale – colliculus sup. laminae quadrig. – tr. geniculocalcarinus (radiatio Gratioleti) – area calcarina (BA 17)
The optic nerve - n.II.

**Examination:**
- Neurologist – counting of fingers, perimeter
- Ophthalmologist:
  1. Visual acuity
  2. **perimeter** (visual field)
  3. **Optic fundus** (vessels, yellow and blind spot, papilla of the n. II.)
Visual aequity

- Refraction problems, cataracta, ...
- Glaukoma
- Disease of retina, DM, ...
- Diseases of optic nerve – inflammation, compression, oedema – blurred vision, atrophy - blindness
Perimeter

Visual field:
deficit = skotoma

Blindness
patchy loss of vision

Diagnosis:
1. Primary open angle glaucoma.

Visual Fields:
OD: Severe field loss. Superior and inferior arcuate defects with central involvement. No further progression.

10-2: Shows severe defect with encroachment on fixation in the superior hemifield, with further progression of the defect in the superior temporal quadrant.
Pituitary Adenoma

- Arise within the adenohypophysis
- Nonsecreting adenomas – mass effect
  Bitemporal hemianopsia
- Secreting adenomas – endocrine syndrome
  Prolactinemia, Cushing's disease
  Acromegaly, Giantism
**Optic fundus**

**Papilla of n. II:**
- **normal** - circular
- light pink
- **oedema** – blurred margines
  - elevated, Dpt (mm)
- **atrophy** – papilla is pale
- with sharp margines, irreversible changes (blindness)
Eye moving nerves

- III.- oculomotor nerve
- IV.- trochlear nerve
- VI.- abducens nerve
The oculomotor nerve - n. III

Anatomy: nuclei in the mesencephalon

- 2 somatomotor
- 2 visceralmotor
  parasympat. (E-W.)
- 1 nucelus Perli
  (accommodation, konvergence)
The oculomotor nerve - n. III
The oculomotor nerve - n. III

- **Intervated muscles**
  - Medial rectus, inferior rectus, superior rectus muscles, inferior oblique muscle and levator palpebrae superioris muscle
  - Ciliary muscle and constrictor pupillae muscle
N. Oculomotorius - n. III

Examination:

1. Position of eyeballs
2. Wideness of eye
3. Movements of eyeball - horiz., vertik., diagon., konvergention
4. Pupils - shape, size, symmetry, reaction to light (direct, indirect) reaction to konvergention
The **trochlear nerve** - n. IV

- **Anat.:**
  - Inervation of the superior oblique muscle
  - Examination: looking downward
The trochlear nerve - n. IV
The abducens nerve – n.VI.

Anat.:
Lateral rectus muscle

Examination: looking to sides
Examination

1. Position of eyeballs -
N. III- ptosis

Mitoch. lesion, bilateral ptosis
N. III - ptosis
Examination

2. Wideness of eye (n.III) - symmetrical (ptosis, exoftalmus, enoftalmus)

3. Movements of eyeballs -
   horizontally (III., VI)
   vertically (III.,)
   diagonally (III., IV.)
   konvergention (III)
Movements of eyeballs (III, IV, VI)
Lesions of III., IV., VI. nerves
5. Examination of pupils

- size
- shape
- reaction of light, convergence
Anizokoria - mydriazis
Temporal herniation

- Compression of mesencephalon and n. III. – *mydriasis on one side, FR: not present*
- Unconsciousness
- Hemiparesis (plegia)
Lesion of n. VI.
Lesion of n. III., IV., VI.

DIPLOPIA – double vision

OFTALMOPLÉGIA:

- OP interna - parasymp. muscles, mydriasis + lost FR + lost accommodation
- OP externa - incompleta
- OP externa completa
- OP totalis = OP interna + OP ext. completa
Conjugate movements of eyeballs

Centres:

A) in pons - nc.paraabducens (PPRF) – reflectoric extravoluntary movements

B) cortical frontal - gy front. medius- FEF- voluntary movements

C) cortical P-O - extravoluntary watching movements of subjects in visual field
Conjugate movements of eyeballs
(frontal centre - FEF)
INOP-anterior, lesion in FLM
Parinaud syndrome

paralysis of upward gaze

CBH sy – Claude Bernard Hornerov Sy

- Lesion of cervical sympathicus centre ciliospinale Budge
- Trias:
  - miosis
  - ptosis
  - enophtalmus
The trigeminal nerve - n. V.

Anatomy – nn. in pons
- Sensit. 2 nn. + motoric 1 nn.
- Inervation:
  n. Ophthalmicus
  n. Maxillaris
  n. Mandibularis
Masseter muscles
- Vegetat.: cornea

Face sensitivity
The trigeminal nerve - n. V.
N. V.

Figure 10-8
Three sensory divisions of the trigeminal nerve: ophthalmic (I), maxillary (II), and mandibular (III).
Examination

1. Sensitivity of face
2. Outlets of n.V. (pain)
3. Corneal reflex (V.-VII.)
4. Tone of masseter muscles
5. Masseter reflex (V.-V.)
Corneal reflex

• afferent part *n.V.* (touching cornea)
• efferent part *n. VII.* (closing of the eye, mimic muscles)
Examination of n. V.
Trigeminal neuralgia
Herpes zoster – n.V.
Trizm – spasm of masseter muscles
The facial nerve – n.VII.

Anat.: nuclei in pons
Inervation:
- **Senzoric**: taste
- **Autonomic**: salivation
- **Motoric**: mimic muscles of face and neck
- **Sensory**: tympanum, external auditory canal, part of the ear (Ramsay-Hunt)
The facial nerve – n.VII.
The facial nerve – n.VII.
Facial nerve - nuclei
Examination of the n. VII.

- **Motor**: mimic of the face, in rest and voluntary mimic, lower and upper branch

- **Autonomic**: salivation - gl. sublingualis, gl. submandibularis, gl. lacrimalis

- **Senzoric**: taste - anterior 2/3 of tongue
Examination function of n. VII. (wrinkles, whistle, smile)
Examination of the upper branch – rise eyebrows frown, shut eyes tightly
Examination of the upper branch blinking
Examination of the lower branch showing the teeth
Bell´s palsy – periferal n. VII. lesion

- Smooth forehead without wrinkles
- Drawn eyebrow
- Lagophthalmus
- Smooth nasolabial curve
- Assymetry of mouth
- Drawn lips on one side
- Not able to show the teeth
- All on one side – homolateral side to lesion
- ± taste
Bell´s palsy – periferal n. VII. lesion

II. Elevation of eyebrows

Patient can elevate both eyebrows

Unable to elevate eyebrow on right
Examination of the taste
Upper motor neuron – type facial weakness
Central lesion of the n. VII.

- Assymetry of mouth
- Drawn lips on one side
- Not able to show the teeth
- On one side – contralateral to affected corticobulbar tract
Axial reflexes – n. VII.

- **Fysiological** – nasopalpebral (V.+VII)
- **Patological**
  1. Nasolabial (nasal)
  2. Mentolabial (mental)
  3. Saccing
    - Fysiological in newborns, important for nutrition
    - Patological in adults: lesion of frontal lobe, atrophy of the brain cortex, lesion of both hemispheres – MTS, TU, ...
Chvostek sign

- Nocking in front of tragus
- Patol. response: contraction of mouth angle, face muscles or nose muscles
- Increased neuromuscular irritation – tetania
Vestibulocochlear nerve – n. VIII
Vestibulocochlear nerve – n. VIII

- After a short distance from the Brainstem, the Vestibulocochlear Nerve splits to become the Vestibular Nerve (balance nerve) and Cochlear Nerve (hearing nerve), as it extends towards the Inner Ear.

- Loss of function on CN8 for one side of the head would leave an individual with Single Sided Deafness (SSD) and some balance issues.

- Loss of function of left and right of the Vestibulocochlear Nerve results in severe balance issues and deafness.
Vestibular nerve

The vestibule is filled with endolymphatic fluid and is responsible for the somatic balance of the Human Body.

It is also innervated by small sensory branches that innervate the parts of the vestibule which include the saccule, the utricle, the anterior, posterior and lateral membrane of the ampulla. Those enter the vestibular ganglion.
Vestibular nerve

1st neuron
bipolar cells from **ganglion vestibulare** in the meatus acusticus internus
The end of these cells – nuclei (4)

2nd neuron
- **tractus vestibulospinalis**
- **tractus vestibuloreticularis**
- **tractus vestibulocerebellaris**
- **tractus vestibulobulbaris**
- **tractus vestibulocorticalis** to temporoparietal cortex
**Cochlear nerve**

- The **cochlea** is responsible for sensory hearing
- The hair cells sit in the spiral organ of corti;
- 1st neuron
- Ganglion spirale cochlæ - nervus cochlearis, through **meatus acusticus internus** of pyramid
- To **nucleus cochlearis anterior** and **posterior** in brainstem
Cochlear nerve

- 2nd neuron
  - lemnisus medialis to colliculus inferior

- 3rd neuron
  - To corpus geniculatum laterale, continue to cortex (gyri temporales transversi) area 41 a 42.
**Vestibulocochlear (statoacusticus) nerve – n. VIII)**

**Vestibular nerve** – *ncl. vestibularis medialis, lateralis, superior, inferior* (4)

**Cochlear nerve** – *ncl. cochlearis anterior, posterior* (2)

**Entrance through** - *meatus acusticus internus*, continue to brainstem
Vestibular syndrome

Lesion of vestibular nuclei and pathways - peripheral

Cause:
...

Symptoms:
- Spinning
- Tilting
- Swaying
- Unbalanced
- Pulled to one direction
- Abnormal or jerking eye movements (nystagmus)

- Feeling nauseated
- Vomiting
- Abnormal or jerking eye movements (nystagmus)
- Headache
- Sweating
- Ringing in the ears or hearing loss
Vestibular syndrome

<table>
<thead>
<tr>
<th>Peripheral</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Nystagmus generally horizontal</td>
<td>• Nystagmus can be horizontal, rotatory or vertical; multi-directional</td>
</tr>
<tr>
<td>• Vertigo as severe as nystagmus</td>
<td>• Vertigo relatively mild or absent</td>
</tr>
<tr>
<td>◦ Response typically fatigues or habituates</td>
<td>◦ persistent</td>
</tr>
<tr>
<td>• More intense feeling of vertigo</td>
<td>• Hearing loss &amp; tinnitus rare</td>
</tr>
<tr>
<td>• Hearing loss &amp; tinnitus frequent</td>
<td>• Associated sensory, motor, cerebellar, &amp; other CN involvement more common</td>
</tr>
<tr>
<td>• Long-tract sensory, motor involvement are unusual</td>
<td></td>
</tr>
</tbody>
</table>

**General: Vestibular Disorders**\(^2,^3\)
Pathology of n. VIII.

- **Hearing loss** - Hypacusis, anacusis
- **Deafness** - Bilateral lesion

- **Tinnitus** - noises in the head, not related to any psychiatric condition. The noise can be heard anywhere in the head or in one or both ears. So far there are no scientific proven cure for tinnitus.

- **Hearing pseudohallucinations** - e.g. hearing of voices

- A pseudohallucination is an involuntary sensory experience vivid enough to be regarded as a hallucination, but recognised by the patient not to be the result of external stimuli.
Audiogram
Glossopharyngeal nerve – n.IX.

- Inervated structures: stylopharyngeal muscle which elevate the pharynx during swallowing and talking
- Examination: together with n. X. – swallowing, talking
- Taste from the posterior 1/3 of tongue
- Sensory function – parotid, salivatory gland
The vagal nerve – n.X.

- Inervated structures: all muscles of the pharynx and soft palate except stylopharyngeal and tensor fascie latae
- Peripheral parasympaticus
- Clinical consideration: unilateral paralysis of palate, pharynx, larynx hoarseness – unilateral lesion – paralysis of the vocal cord PS – slow pulse
Parasympathetic System

- Constricts pupils
- Stimulates flow of saliva
- Constricts bronchi
- Slows heartbeat
- Stimulates peristalsis and secretion
- Stimulates bile release
- Contracts bladder
Lesion of n. IX. a X.

**Figure 18-10**
**Accessorial nerve – n. XI.**

- **Inervated structures:** sternocleidomastoid and trapezius muscles in the neck and back
- **Examination:** turning the neck (cannot turned to opposite side)
- **elevation of the shoulder – displacement of the scapula**
Examination n. XI. - position of scapula, movements of shoulder and SCM
Hypoglossal nerve – n.XII.

- Inervated structures:
  - Tongue

- Examination: protrusion of the tongue

- Pathology – protruded tongue deviates toward the paralysed side
Examination (n.XII)

**Figure 18-12**
Hypoglossal nerve (cranial nerve XII). A. Right XII paralysis, tongue at rest. B. Right XII paralysis, tongue protruding.
Hypoglossal nerve lesion – right side

FIG. 17-3. Nuclear paralysis of muscles supplied by the hypoglossal nerve: atrophy and fasciculations of the tongue in a patient with amyotrophic lateral sclerosis.
Tongue atrophy
Bulbar and pseudobulbar palsy

In both:
- dysarthria
- dysphagia

Differences:

<table>
<thead>
<tr>
<th>Lesion</th>
<th>BULBAR</th>
<th>PSEUDOBULBAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pat. axial. rr</td>
<td>medulla oblongata</td>
<td>both hemispheres</td>
</tr>
<tr>
<td>Masseter.r.</td>
<td>absent</td>
<td>present</td>
</tr>
<tr>
<td>Smiling, crying</td>
<td>normal</td>
<td>increased</td>
</tr>
<tr>
<td>without cause</td>
<td>absent</td>
<td>present</td>
</tr>
</tbody>
</table>

![Brain diagram](image)