

Neuroinfections

- Diseases of the NS cause by **viruses, bacterias, candides, parasites**, sometimes fulminant course of disease and fatal complications

Neuroinfections

- 1. Bacterial
- 2. Viral
- 3. Fungal
- 4. Specific

Neuroinfections

- 1. Meningitis
- 2. Encefalitis
- 3. Meningoencefalitis
- 4. Myelitis
- 5. Neuritis, polyneuritis
- 6. Radiculitis, polyradikuloneuritis

Etiopatogenesis

- Spread of viruses to the CNS
- **by the Hematogeneous or neural route.**
- **Hematogeneous** - the viruses gain the CNS through perivascular spaces, entrance in the CSF is through the epithelial cells of the choroid plexus.
- **Neural** - (Herpes simplex virus - HSV, Varicella zoster virus - VZV).
- **Direct spreading from** – ear, nose, injury

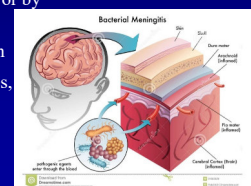
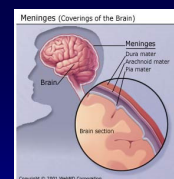
Meningitis

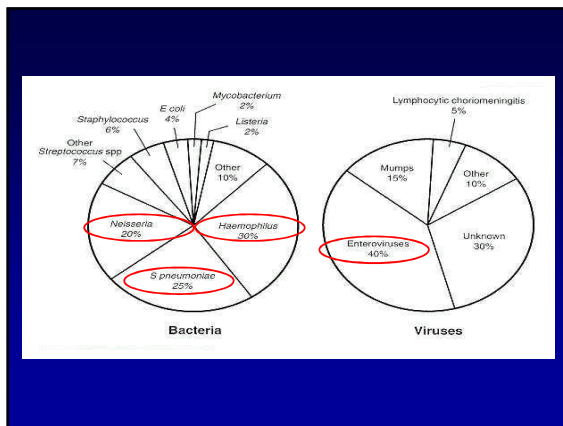
- The germs that cause bacterial meningitis are **very common** and live naturally in the back of the nose and throat.
- People of any age can carry these germs without becoming ill.
- They spread between people by coughing, sneezing and kissing, they cannot live outside the body for long.



Meningitis

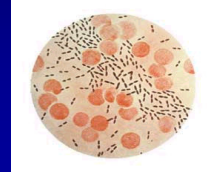
- **Meningitis** is the inflammation of the meninges, the membranes around the brain and spinal cord.
- **Pachymeningitis**, which involves the outermost membrane, is generally caused by trauma, such as a skull fracture, or by extension of an infection.
- **Leptomeningitis**, the more common form, involves the inner membranes, and may be caused by invading bacteria from other organisms.





Meningitis

- Etiological agents
- Streptococcus pneumoniae
- Neisseria meningitidis



Meningitis

- Etiological agents (G-)
- *E. coli*
- *Klebsiella pneumoniae*
- *H. influenzae*
- *Pseudomonas*
- *Enterobacter* species
- *Listeria monocytogenes*

Meningitis

- Enteroviral inf. – Echovirus, Coxsackie /Aug, Sept/
- Mumps (late winter and spring)
- Herpes simplex, typ 2, Epstein-Barr
- Lymphocytic choriomeningitis (winter)
- Adenovirus infections
- HIV

Patogenesis

- Bacteria from the place of primary infection → to blood, from blood → to CSF through chorioid plexus of the lateral ventricles, or other areas of altered HEB permeability
- Germs multiply rapidly in the subarachnoid space. Recruitment of inflammatory cytokines (IL-1, TNF), recruitment of polymorphonuclear leukocytes

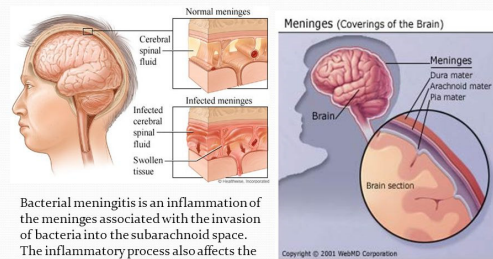
Patogenesis

- Result – purulent exudate in subarachnoid space, which is the basis of the neurological complications
- Obstruction of flow of CSF
- Adherence of leukocytes to the cerebral capillary endothelial surface increase the permeability of cerebral vessels → allowing for leakage of plasma proteins through open intercellular junctions → vasogenic brain edema

Patogenesis

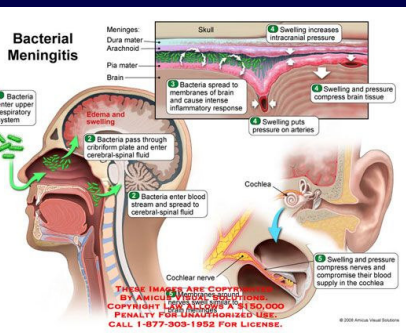
- The leukocytes → **cytotoxic edema**
- The purulent exudate → decrease resorption through the arachnoid granulations → transependymal movement of the fluid into the brain parenchyma → **interstitial edema**
- **Cerebral perfussion pressure is affected**
- → cerebral blood flow begins to decrease (also loss of cerebral autoregulation)

What is bacterial meningitis?

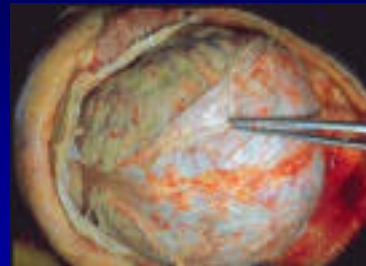


Bacterial meningitis is an inflammation of the meninges associated with the invasion of bacteria into the subarachnoid space. The inflammatory process also affects the brain parenchyma and the ventricles.

MEDICAL EMERGENCY !



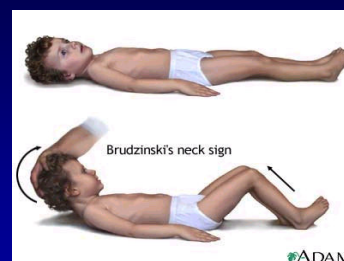
Pneumococcal meningitis



Clinical features

- Headache
- Fever ↑ (↓ - sepsis)
- Neck stiffness (not present in sepsis !)
- Photophobia
- Vomitus
- Intracranial hypertension
- Altered level of consciousness
- Seizures

Meningeal syndrome



Kernig – flexion of passive extended LE

Petechial rash in meningococemia (Neisseria meningitidis) – develops in few hours



(trunk, LE, mucous membranes, conjunctiva, palms, soles)

Meningococcal meningitis



Clinical feature



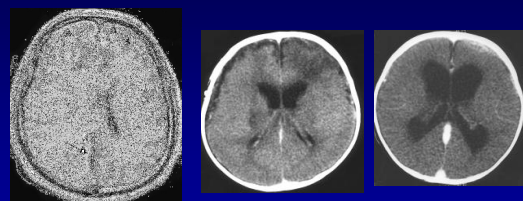
Clinical features – neonates !

- Fever or hypothermia
- Lethargy
- Seizures
- Irritability
- Bulging fontanel
- Poor feeding
- Vomitus
- Respiratory distress
- Absence of meningeal syndrom – can be

CSF

- Increased pressure
- Viral meningitis
- Pleocytosis – ↑ lymphocytes, proteins +-, sugar is normal – viral
- Bacterial meningitis
- Pleocytosis – polymorfonuclear leukocytes
- ↑ proteins, ↓ sugar
- Blood - ↑ Leu, FW, CRP

Brain CT



Therapy

- The 3rd.-generation Cephalosporins
- Ampicilin
- Dexamethason – inhibits the syntesis of inflammatory cytokines – IL-1, TNF
- Antiedematous treatment – Manitol
- Symptomatic therapy

TBC

- TBC – frequent in 20th century
- Chopin, Keats, Paganini, Modigliani, Thomas Wolf – died because of TBC
- 90-ties of 20th century – again increased number of TBC

TBC meningitis

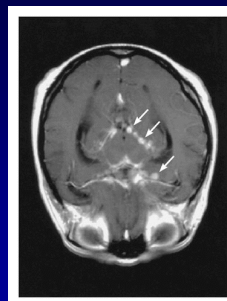
- Etiology - **Mycobacterium tuberculosis**
- During dissemination from caverna - exudate, which is located predominantly in **basilar cystems**, surrounds the cranial nerves and major blood vessels at the base of the brain

TBC meningitis

- Headache
- Meningeal syndrome
- Cranial nerves lesions - VI, III, IV, VII
- Changes in behaviour, desorientation
- Hydrocephalus
- Brain edema

CSF

- Increased pressure
- Pleocytosis – Ly
- ↓↓ sugar, ↑ proteins
- Positive cultivation
- PCR



- Contrast-enhanced T₁-weighted axial MRI
- diffuse, thick, and sometimes nodular enhancement of the basal meninges (arrows), presumably due to inflammation.

Therapy

- **INH, Rifampicin, Pyrazinamid**
- **Corticosteroid**
- **Manitol**
- **Symptomatic therapy**

Encephalitis

- Frequently with meningitis
- Impairment of consciousness – confusion, stupor, coma
- Seizures
- Aphasia, hemiparesis, involuntary movements, cerebellar ataxia, polymyoclonus, cranial nerves
- Except herpetical - seasonal, epidemic form

Encephalitis

- Herpetic encephalitis
- Epstein-Barr virus encephalitis
- Tick-borne encephalitis
- CMV encephalitis
- Varicella zoster encephalitis

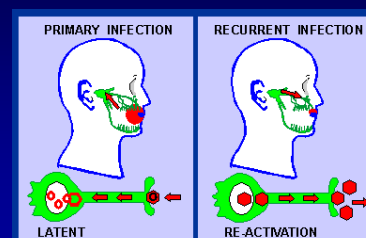
Herpes simplex encephalitis

- Herpes simplex virus 1
- Incidence – 4/ 1 million people/year
- Most severe, most frequent
- Without therapy – mortality 70%

Herpes simplex encephalitis

- After primoinfection – most often oropharyngeal – virus is transported to ganglion Gasseri, virus survives latent for all life
- In the case of reactivation - there is retrograde transport of the virus by rough of n.V.

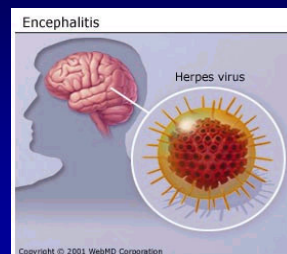
Herpes simplex encephalitis



Herpes simplex encefalitis



Herpes simplex encephalitis



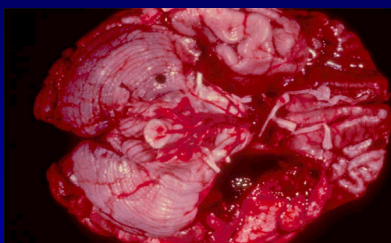
Herpes simplex encephalitis

- Clinical feature
- High fever
- Headache, vomitus
- Desorientation, confusion, memory problems
- Focal neurological symptoms
- Seizures

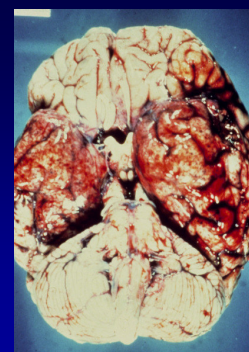
Herpes simplex encephalitis

- Brain edema – can be temporal herniation
- Signs from **temporal lobe** – changes in personality and behaviour, aphasia, seizures
- Inflammation, **bleeding and pannecrosis of nearly all tissue elements**

Herpetic encephalitis necrosis of temporal lobe



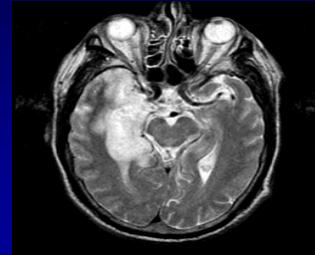
Herpetická encefalitis



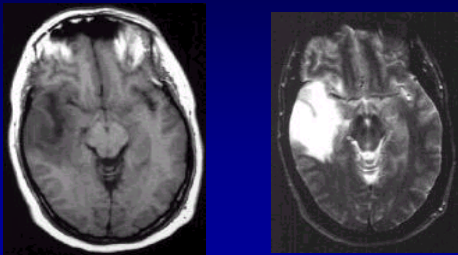
Herpes simplex encephalitis - diagnosis

- **CSF** – ↑ Ly, proteins
- **CT, MRI**
- **EEG** – high, periodical waves in temporal regione, and complex of slow waves in intervale 2-3 sec.
- ½ of patients – do not survive
- **Th:** Acyclovir 30 mg/kg/D 14 days – the better prognosis after soon beginning

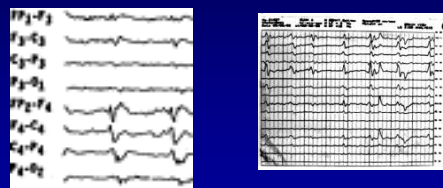
Herpetic encephalitis



Herpetic encephalitis



EEG



Therapy

- **Th:** Acyclovir 30 mg/kg/day 14 days
- Antiedematous therapy
- Symptomatic

Tick-borne encephalitis

- TBE is caused by tick-borne encephalitis virus (TBEV), a member of the family Flaviviridae.
- Transmitted by Ixodes ricinus
- initially isolated in 1937
- **Clinical course** – non-specific with symptoms that may include fever, malaise, anorexia, muscle aches, headache, nausea, and/or vomiting

Tick-born encephalitis

- The central nervous system - symptoms of meningitis (e.g., fever, headache, and a stiff neck) or encephalitis (e.g., drowsiness, confusion, sensory disturbances, and/or motor abnormalities such as paralysis) or meningoencephalitis
- Menigoencephalitis, myelitis
- Consequences – 10% patients

Tick-born encephalitis

- CSF - an increase in the number of white blood cells in the cerebrospinal fluid
- Low white blood cell count (leukopenia) and a low platelet count (thrombocytopenia)
- There is no specific drug therapy for TBE.
- Anti-inflammatory drugs, such as corticosteroids, may be considered

Encephalitis

- Varicella zoster encephalitis (VZV)
- through n.V.
- Epstein-Barrovej virus (EBV)
- EBV in 90% people
- Manifestation – mononukleosis, with meningitis, encephalitis
- CMV encephalitis
- Immunodeficient people - AIDS

Spirochete infections

- **Boreliosis (Lyme disease)**
Borrelia burgdorferi
- **Syphylis (Lues)**
Treponema pallidum

Borrelia burgdorferi



Lyme disease

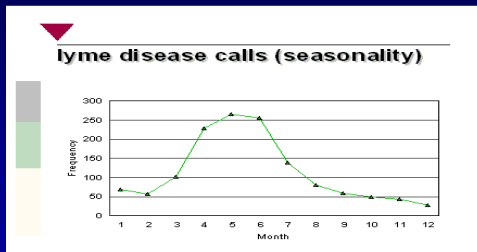


After tick bite

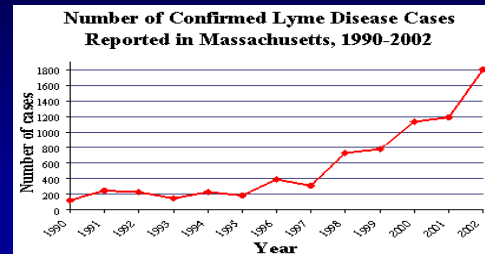


Skin lesion

Lyme disease



Lyme disease



Lyme disease - patogenesis

- Spreading – by spirochetemia, spreading in all the body
- CNS – **clinical feature**
- **Early syndromes**
meningitis, facial nerve palsy (less other cranial nerves), radiculoneuritis
- **Late syndromes**
encephalopathy
senzorimotor polyradiculoneuropathy

Lyme disease - meningitis

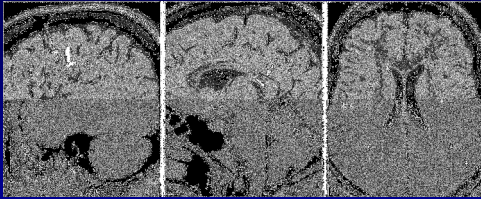
- Within 12 weeks of infection
- **Headache, fatigue, myalgia, artralgia**
- **CSF: pleocytosis – Ly, ↑ proteins**
sugar – normal
intrathecal production of BB antibodies (IgG, IgA)
- PCR

Lyme disease – facial palsy

- In 4 weeks from erythema migrans
- **Unilateral or bilateral facial palsy**
- Other cranial nerves - rarely
- ELISA
- **CSF: pleocytosis – Ly, intrathecal production of antibodies (about 10 %)**
- **Th: Doxycycline (2x100 mg/D, 2W) CSF negat.**
- i.v. ceftriaxone – CSF pozit.



A 50-year-old woman with a history of tick bite and erythema migrans rash treated with doxycycline, who had recurrent erythema migrans rash with headache, fever, nausea, and nuchal rigidity.



P. Hildenbrand et al. AJNR Am J Neuroradiol 2009;30:1079-1087

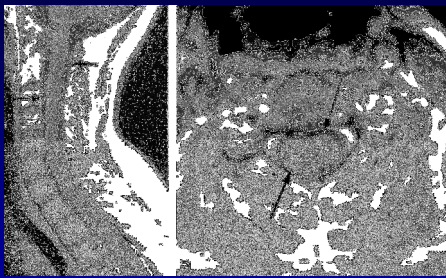
©2009 by American Society of Neuroradiology

AJNR
AMERICAN JOURNAL OF NEURORADIOLOGY

Lyme disease - radikuloneuritis

- Severe, sharp, jobbing or deep and boring pain, in a **radicular nerve distribution**
- Within days, weeks: **sensory loss, weakness, hyporeflexia**, if there is myelitis – sphincter dysfunction, + Babinski
- **CSF: Ly, ↑ proteins**, intrathecal production of antibodies
- **EMG: axonal lesion**

A 56-year-old woman with neck, bilateral shoulder, and bilateral arm pain.



P. Hildenbrand et al. AJNR Am J Neuroradiol 2009;30:1079-1087

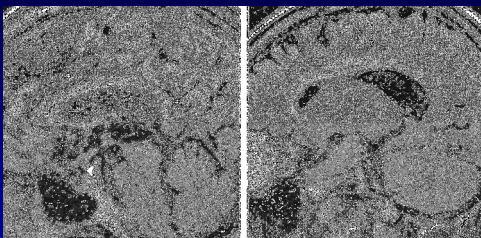
©2009 by American Society of Neuroradiology

AJNR
AMERICAN JOURNAL OF NEURORADIOLOGY

Lyme disease - encephalopathy

- In patients with systemic manifestation and arthritis
- **Confusional state, memory and cognitive slowing**
- **CSF – only in 5 % pozit. Ly**
less than in 50 % pozit. antibodies

A 74-year-old man with 2-year cognitive decline and memory loss.



P. Hildenbrand et al. AJNR Am J Neuroradiol 2009;30:1079-1087

©2009 by American Society of Neuroradiology


AJNR
AMERICAN JOURNAL OF NEURORADIOLOGY

Lyme disease– sensorimotor polyradiculoneuropathy

- Chronic radiculoneuropathy – **sensory symptoms, particularly distal paresthesias in a stocking and glove distribution, less severe than in acute polyradiculoneuritis G.-B.**
- **EMG – axonal lesion**
- **Likvor – frequently negat.**

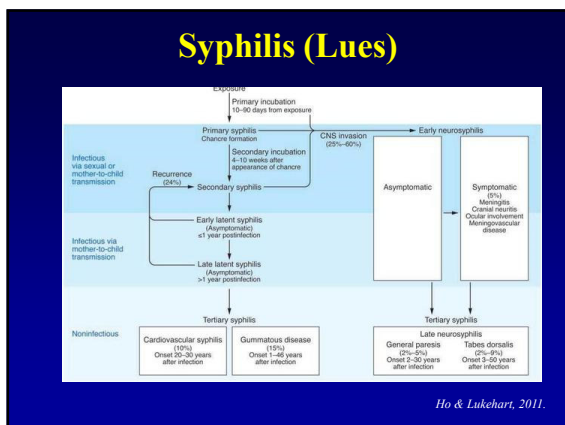
Syphilis (Lues)

- 1/3 nontreated patients – neurovascular complications of syphilis



Neurosyphilis

- **Patogenesis**
- Perivascular **infiltration of the meninges**, focal meningeal inflammation – formation of hypertrophic meninges, or gumma,
- Inflammatory cells invade blood vascular wall – **arteritis (luminal occlusion)**
- **Parenchymal involvement – gliosis in late stages**
- **Ly infiltration of preganglionic portion of dorsal roots and posterior columns atrophy of posterior columns**

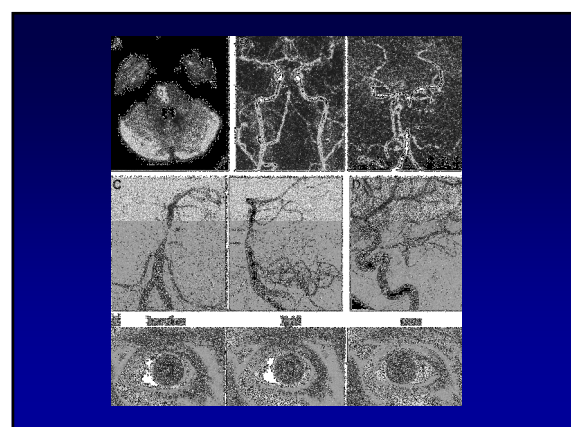


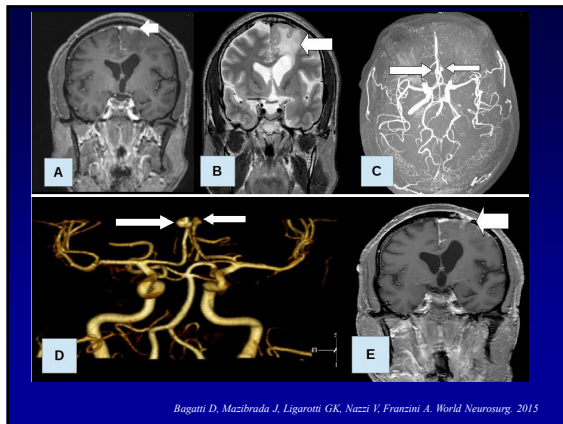
Neurosyphilis – acute symptomatic meningitis

- **Headache, nauzea, vomitus, neck stiffness**
- **Abnormalities of cranial nerves II, VI, VII, VIII**
- **CSF: Ly, decreased sugar, ↑ proteins**
- **Pozit. TP-TA (*Treponema pallidum* particle agglutination) test**

Neurosyphilis - meningovascular

- Within 5 – 7 years after initial infection
- **Inflammatory obliterative endarteritis involving small and medium-sized arteries (MCA)**
- Focal signs from local ischemia
- **CSF: Ly, increased proteins, pozit. VDRL**
- **AG: diffuse narrowing of arteries**
- **MRI: multiple areas of narrowing**
- **Spinal arteries – transversal myelitis**



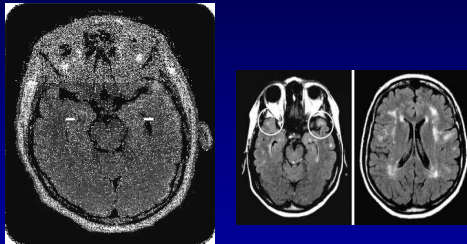


Bagatti D, Mazibrada J, Ligarotti GK, Nazzi V, Franzini A. World Neurosurg. 2015

Neurosyphilis

- Fig. 1. A and B – T1 weighted coronal MRI (after contrast) and T2 weighted coronal MRI (without contrast) showing a left fronto-parasagittal lesion surrounded by an edematous interemispheric area. Both in the cortical and subcortical areas, a marked hyperintensity on T2-weighted sequences can be appreciated (B). After contrast, it is possible to notice marked leptomeningeal enhancement in the left frontal and interemispheric regions (A). C and D – MRA and MRA-3D Reconstruction showing 2 aneurysms of distal A2 segment of both ACAs. The right-sided aneurysm is about 5 mm in diameter, while the left-sided aneurysm measures approximately 3 mm in diameter and is located in the terminal part of A2 hypoplastic ipsilateral segment. E – T1 weighted coronal MRI (after contrast) performed after biopsy, showing signs of previous surgery, with left frontal craniotomy and an underlying cavity. In respect to the previous neuroimaging investigations, the absence of frontal cortical swelling is evidenced. After contrast, the leptomeningeal enhancement persists, extending along the frontal and interemispheric areas.

MRI



Neurosyphilis

- Treatment
- PNC, ceftriaxone – 2 weeks
- Meningovascular – also antitrombotic therapy

Acquired immunodeficiency syndrom (AIDS) Human immunodeficiency virus (HIV)

- **Neurological complications**
- Aseptic meningitis
- Cognitive disturbances – adults
- Progressive encephalopathy – children
- Myelopathy
- Neuropathy (inflammatory demyelinating polyneuropathy, brachial plexopathy, mononeuritis)
- Myopathies – myopathy, myositis

AIDS


- **tumors**
- **Primary lymphoma of CNS (PCNSL)**
most frequent, children, adult – 5%
clinical feature – headache, confusion, impaired memory, seizures, cran. nn.)
Dg.: MRI
- **MTS non-Hodgkin lymphoma into CNS**
- **Kaposi sarcoma**

AIDS

- **Opportunistic infections**
- **Bacterial** – (Mycobacterium tuberculosis, Treponema pallidum, Nocardia, ...)
- **Viral** – (Cytomegalovirus, Herpes simplex, Varicella zoster, JC, ...)
- **Fungal** – (Cryptococcus neoformans, candida, ...)
- **Protozoa** – (Toxoplasma gondii, ...)

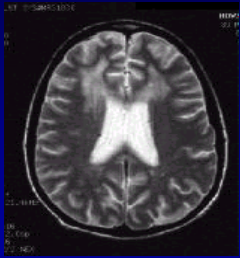
AIDS dementia complex (ADC)

brain atrophy, wide ventricles and subarachnoid space



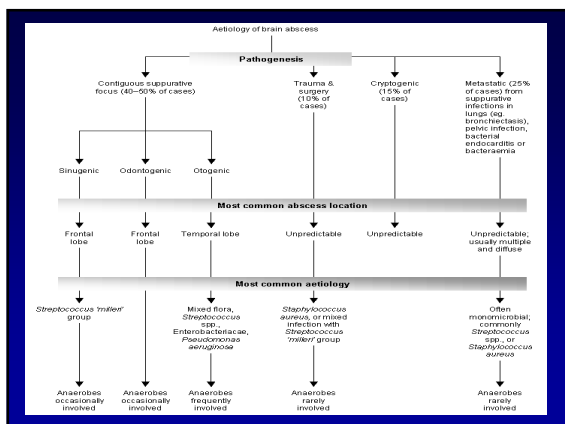
AIDS dementia complex (ADC)

- **T2- MRI:**
- Enlargement of ventricles, hyperintensity in subcortical white matter of both frontal lobes



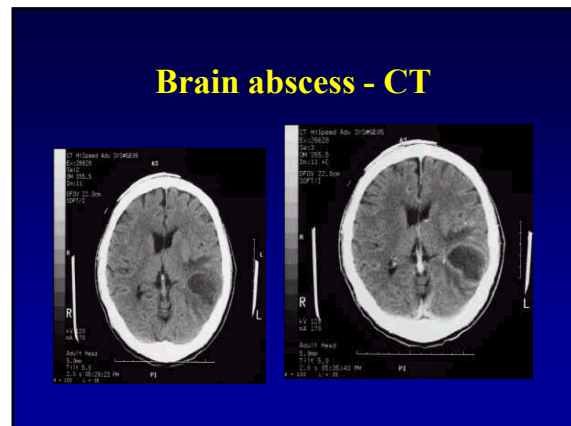
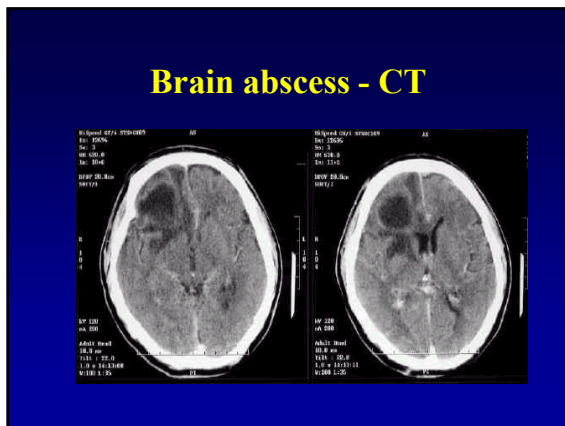
Brain abscess

- A rare complication in immunocompetent individuals
- AIDS
- Chronic corticosteroid therapy
- Immunosuppression after bone marrow transplantation



Clinical feature

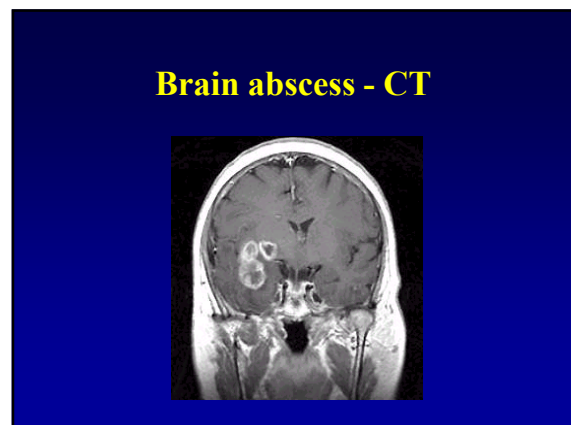
- Headache
- Fever
- Vomitus
- Focal neurological deficit
- Focal or generalized seizures
- ICH – lethargy, confusion, coma,
- Papilledema
- Palsy of cranial nerves III, VI., or both



Brain abscess - CT

Brain abscess in 2 years old child
Ptosis, fever, papilloedema

60 ml of pus Gram + and Gram - bacteria



Diagnosis and therapy

- CT
- CSF – lumbar puncture – **contraindicated in brain abscess**
- Therapy:
- **Aspiration or extirpation abscess + antibiotics**

Herpes zoster (shingles)

- Varicella zoster virus
- Incidence 3-5 /1000/ year – old people, with malignancies, mainly lymphoma and M. Hodgkin
- Reactivation of varicella virus – latent in senzoric ganglia after the primary infection with chicken post

Herpes zoster

- Radicular pain – sometimes before eruption
- Vesicular cutaneous eruptions spread over two or three dermatomes on one side
- Most often - thoracal part
- Cranial ganglia – ophthalmic paresis
Ramsay Hunt - n. VII. palsy, vertigo, deafness

Herpes zoster



Credit: NIAID



Credit: NIAID

Herpes zoster



Credit: NIAID



b

Herpes zoster

- CSF – ↑elements and proteins
- Pain 1 – 4 weeks
- Later – **postherpetic neuralgia**
- **Treatment** – Acyclovir **800 mg 5x /day, 7 days**
reality – 5 x 200 mg

Herpes zoster

- **Postherpetic neuralgia**
- **Pain in territory of herpes zoster, lasting minimally 3 month after eruptions**
- 10 -15% patients
- **Treatment** – **Gabapentin 3 x 300 – 3 x 1200 mg**, pregabalin
Common analgetics are not effective!