

**O.O.Bogomolets National Medical University
department of pediatric infection diseases**

Acute infections of central nervous system

Yevtushenko V.

Types of acute CNS infections

Meningitis - infections of the membranes surrounding the brain.

Encephalitis – infection of the substance of the brain.

Brain abscesses - localized lesions within the brain.

Mortality

The mortality rate for viral meningitis is less than 1%.

The mortality rate for bacterial meningitis is about 25%.

Among the common causes of acute bacterial meningitis:

for *S pneumoniae* meningitis 19-26%,

for *H influenzae* meningitis 3-6%,

for *N meningitidis* 3-13%,

for *L monocytogenes* 15-29%.

The mortality rate for encephalitis is 5-75%

Causes of CNS infections

Syndrome	Usual causes
Meningitis	Bacterial, viral, fungal
Encephalitis, Encephalomyelitis	Mainly viral
Brain abscess	Mainly bacterial

Routes of CNS infections

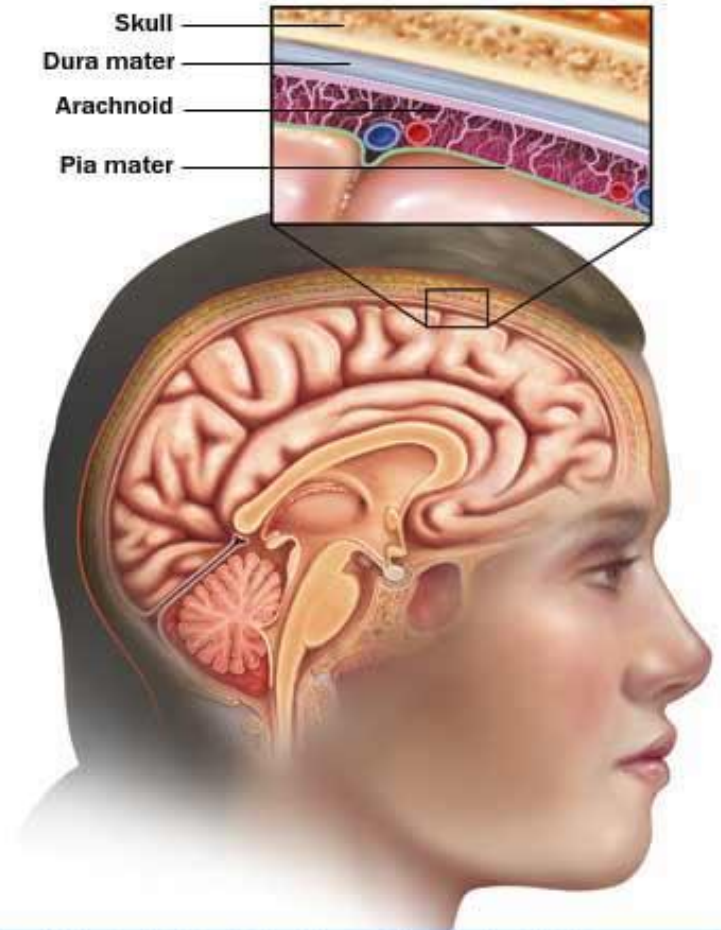
Route	Agent
Hematogenous	Most agents
Contiguous (sinus, ear, face)	Bacteria
Direct inoculation (trauma)	Bacteria
Via nerves	HSV, VZV, rabies

Common symptoms

Syndromes	Symptoms
Meningitis	fever, severe headache, neck stiffness, photophobia
Encephalitis, Encephalomyelitis	altered behavior patterns, altered state of consciousness, seizures, palsies
Brain abscess	fever, severe headache, nausea, disturbed vision, focal neurological signs

Meningitis

Meningitis -
inflammation of
the meninges, the
membranes
covering
the brain and
spinal cord.



Common causes of meningitis

Bacterial meningitis:

Neisseria meningitidis (meningococcus)

Streptococcus pneumoniae (pneumococcus)

Haemophilus influenzae b (haemophilus, Hib)

Listeria monocytogenes (listeria)

Viral meningitis:

Enteroviruses

Mumps virus

HHV

Fungal meningitis

Noninfectious meningitis:

Allergies

Cancer

Lupus

Bacterial pathogens by age

< 3 month

Streptococcus agalactiae,
Enterococcus,
Staphylococcus aureus,
Salmonella,
Escherichia coli,
Klebsiella,
Proteus,
Pseudomonas,
Listeria monocytogenes,
Citrobacter,
Flavobacterium,
Bacteroides,
Candida species

Bacterial pathogens by age

3 mo – 3 yr

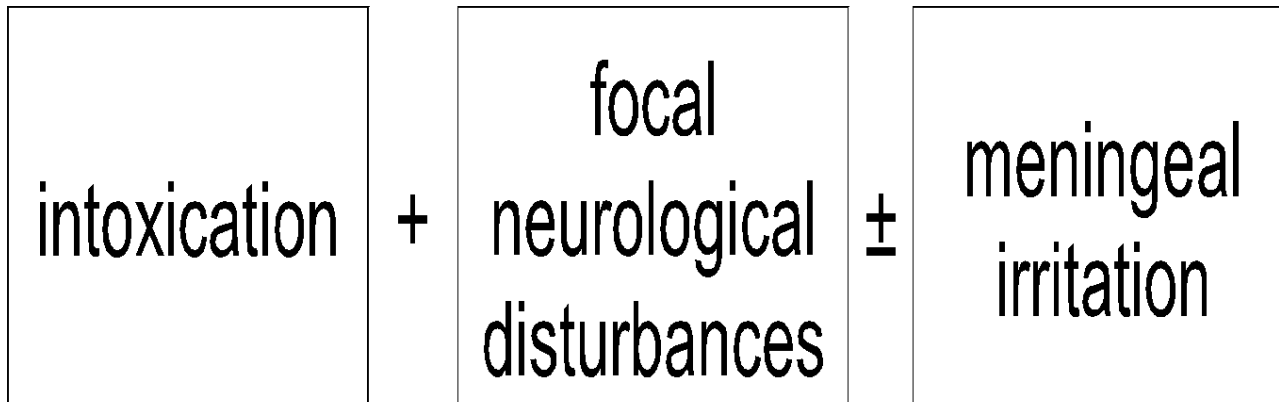
Neisseria meningitidis,
Streptococcus pneumoniae,
Haemophilus influenza
Group B streptococcus

> 3 years

Neisseria meningitidis,
Streptococcus pneumoniae,
Haemophilus influenza

Meningitis

Clinical Picture



Meningeal posture

Computed tomography
(CT or CAT scan) of the brain



© ADAM, Inc.

Diagnosis

intoxication

+

focal
neurological
disturbances

±

meningeal
irritation

Meningitis. CSF profiles

	Viral	Bacterial	Tuberculosis
WBC	Lymphocytes (hundreds)	Neutrophils (hundreds-thousands)	Lymphocytes (hundreds)
Glucose	Normal	Low	Low
Protein	Slightly high	High	High
Gram stain	Negative	Often positive	Negative

Cerebrospinal fluid



Complications of lumbar puncture (LP)

- Respiratory compromise
- Bleeding
- Herniation
 - Bacterial meningitis can cause herniation even without an LP
- Contraindications
 - Mass lesion, cardiorespiratory instability, infection at LP site

Complications of bacterial meningitis

Early

Cerebral edema

Hydrocephalus

Hemorrhage

Ventriculitis

Cerebral infarction

Necrotizing lesions

Late

Hearing loss

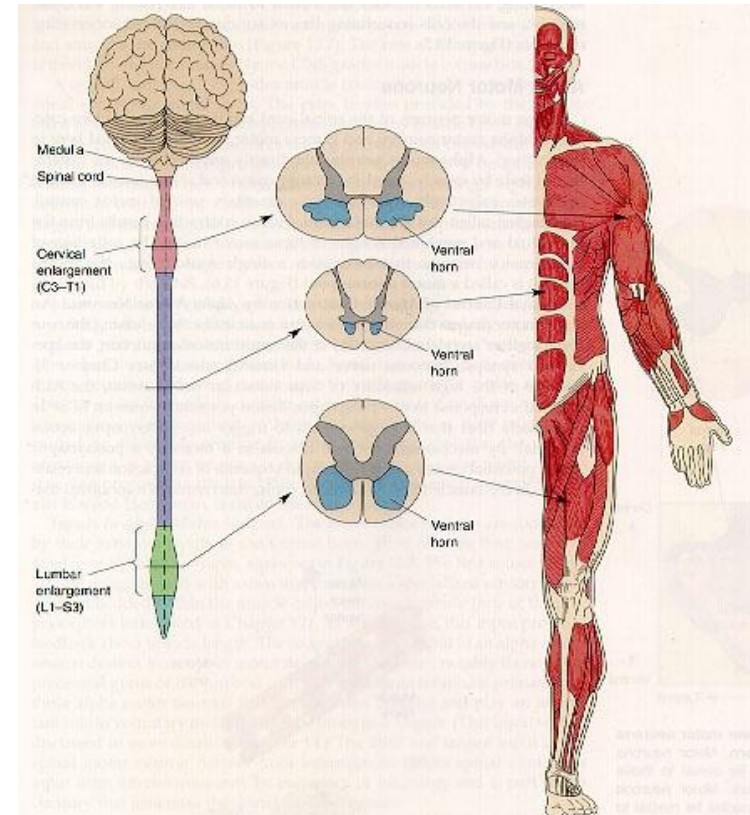
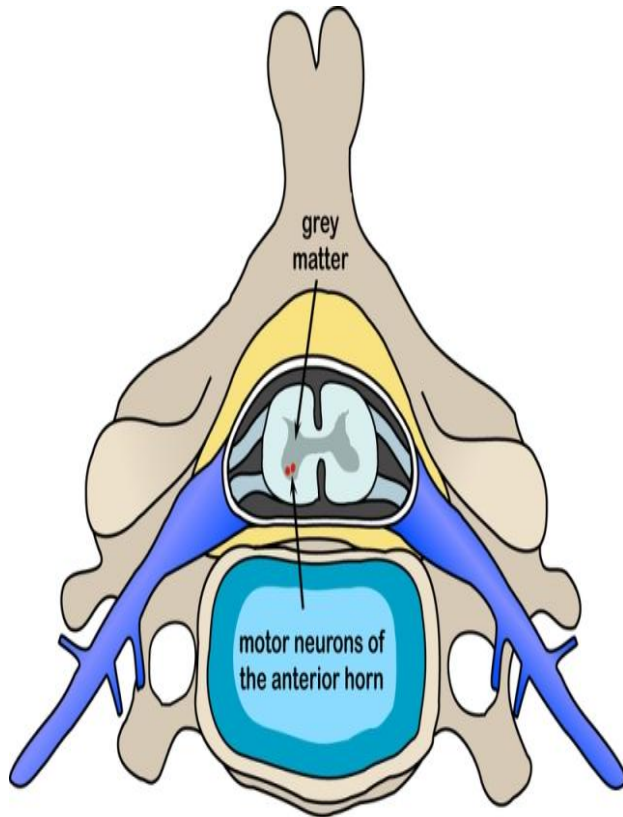
Physical and mental retardation

Epilepsy

Changes in eye sight

Learning difficulties

Hydrocephalus

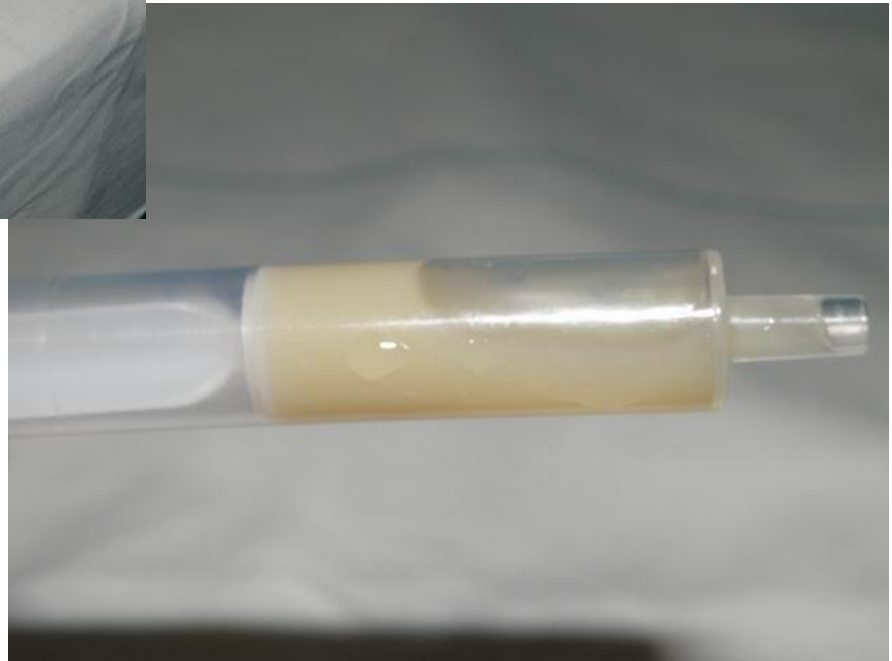


Ventriculitis



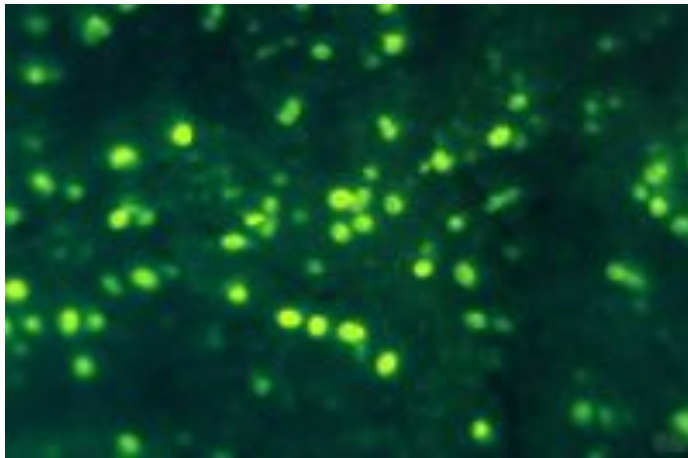
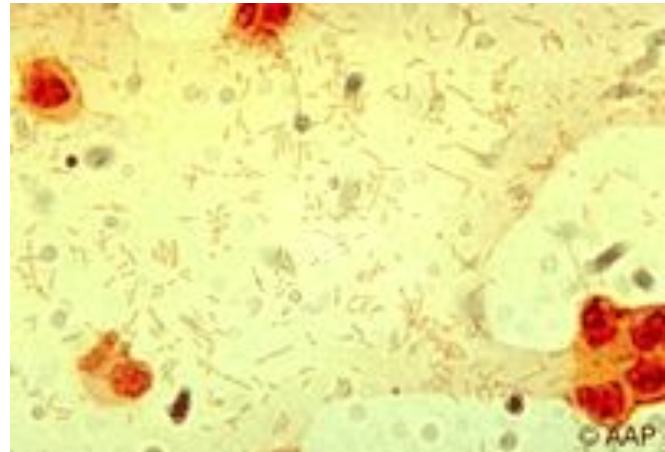
External shunt

**Pus from
ventricles**

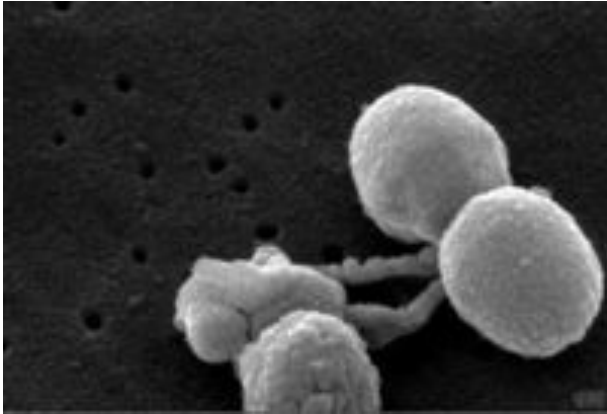


Haemophilus influenzae type b (Hib)

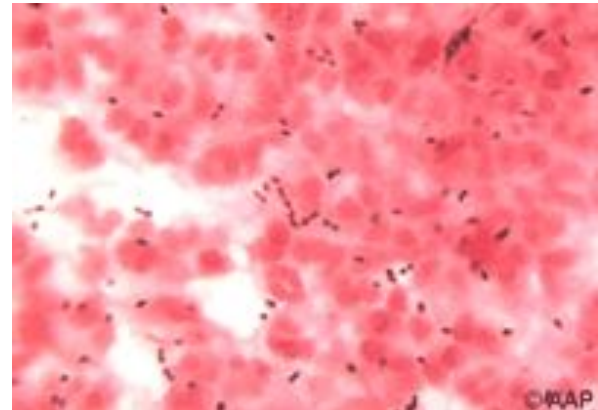
Haemophilus influenzae
is a pleomorphic
gram-negative
coccobacillus



Pneumococcal infection



Streptococcus pneumoniae (pneumococci) are lancet-shaped, gram-positive diplococci. At least 90 pneumococcal serotypes have been identified.



Meningococcal infection

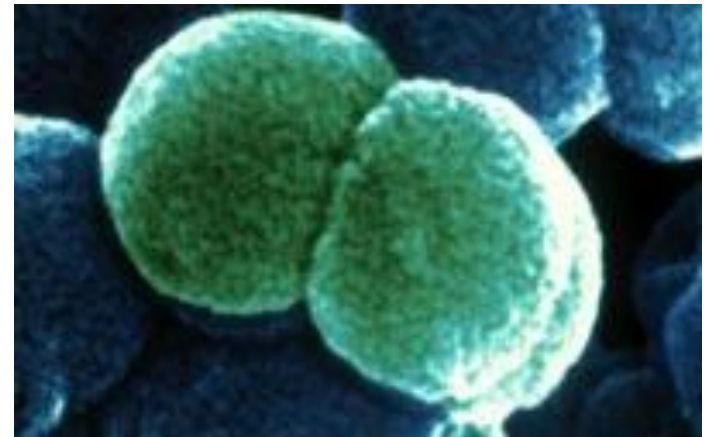
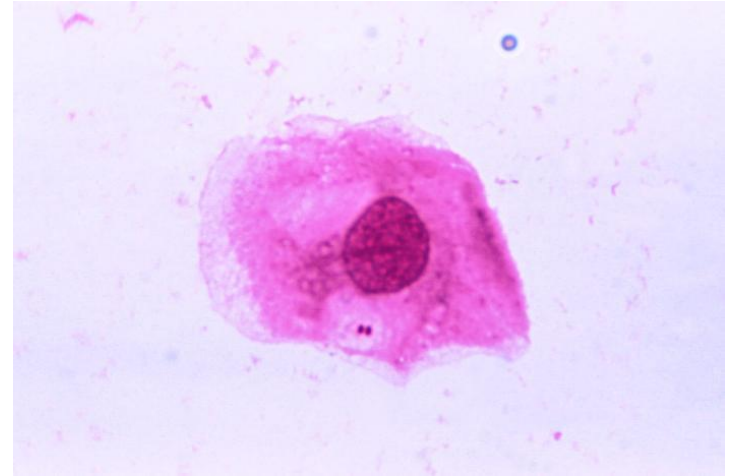
Etiology:

Neisseria meningitidis

Gram (-) diplococci

13 serogroups

Most frequent: A, B, C, Y, W135.



Clinical forms of MI

Localized forms:

Nasopharyngitis;
Asymptomatic carriage.

Generalized forms:

Meningitis;
Meningococccemia

Rare forms (carditis, arthritis, choroiditis)

Meningococcal Nasopharyngitis



Nonspecific clinical picture.

Diagnosis made by bacteriological tests

Hemorrhagic rash

(meningococccemia)



Tumbler test for hemorrhagic rash



Hemorrhagic rash

(meningococccemia)



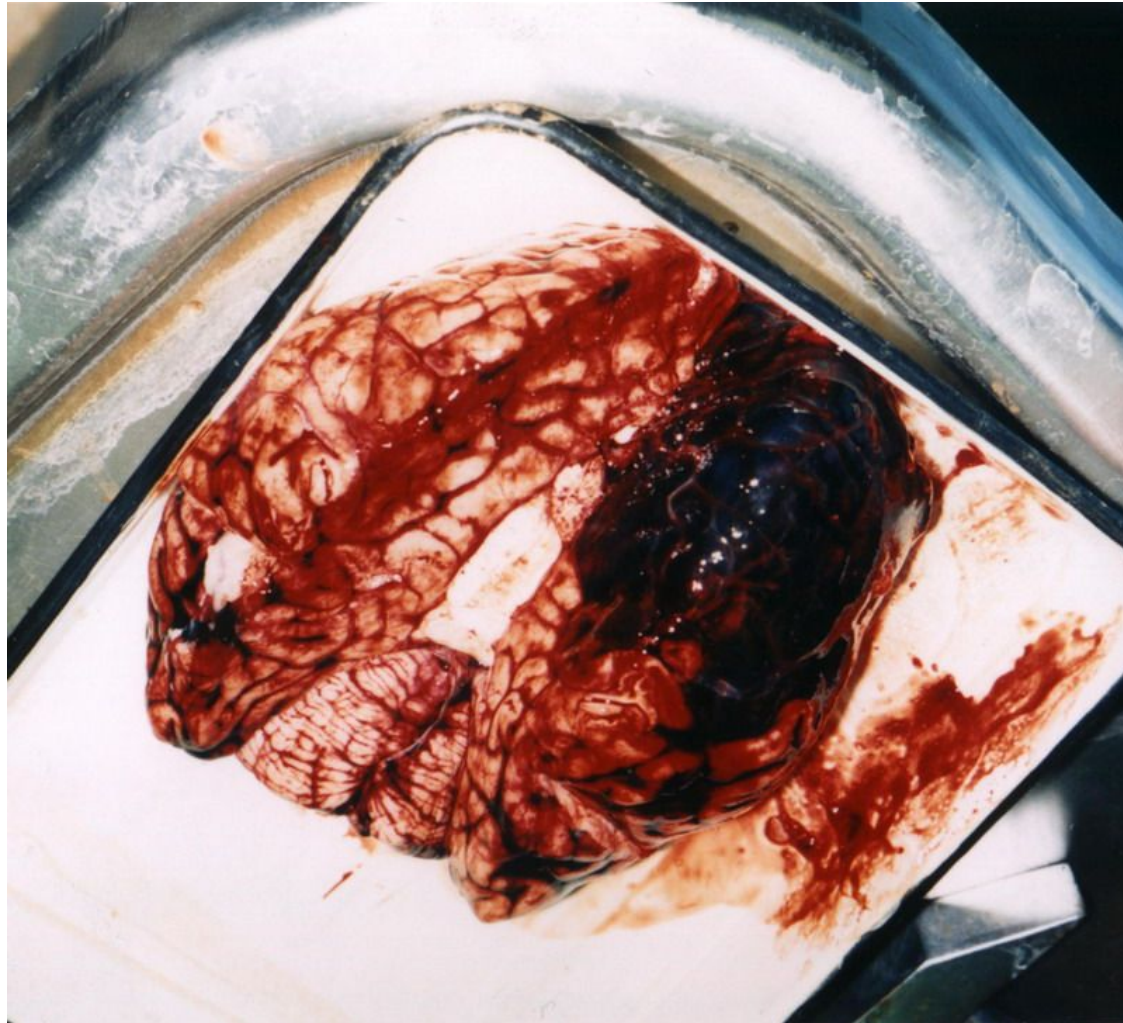
Cyanosis

(meningococccemia)

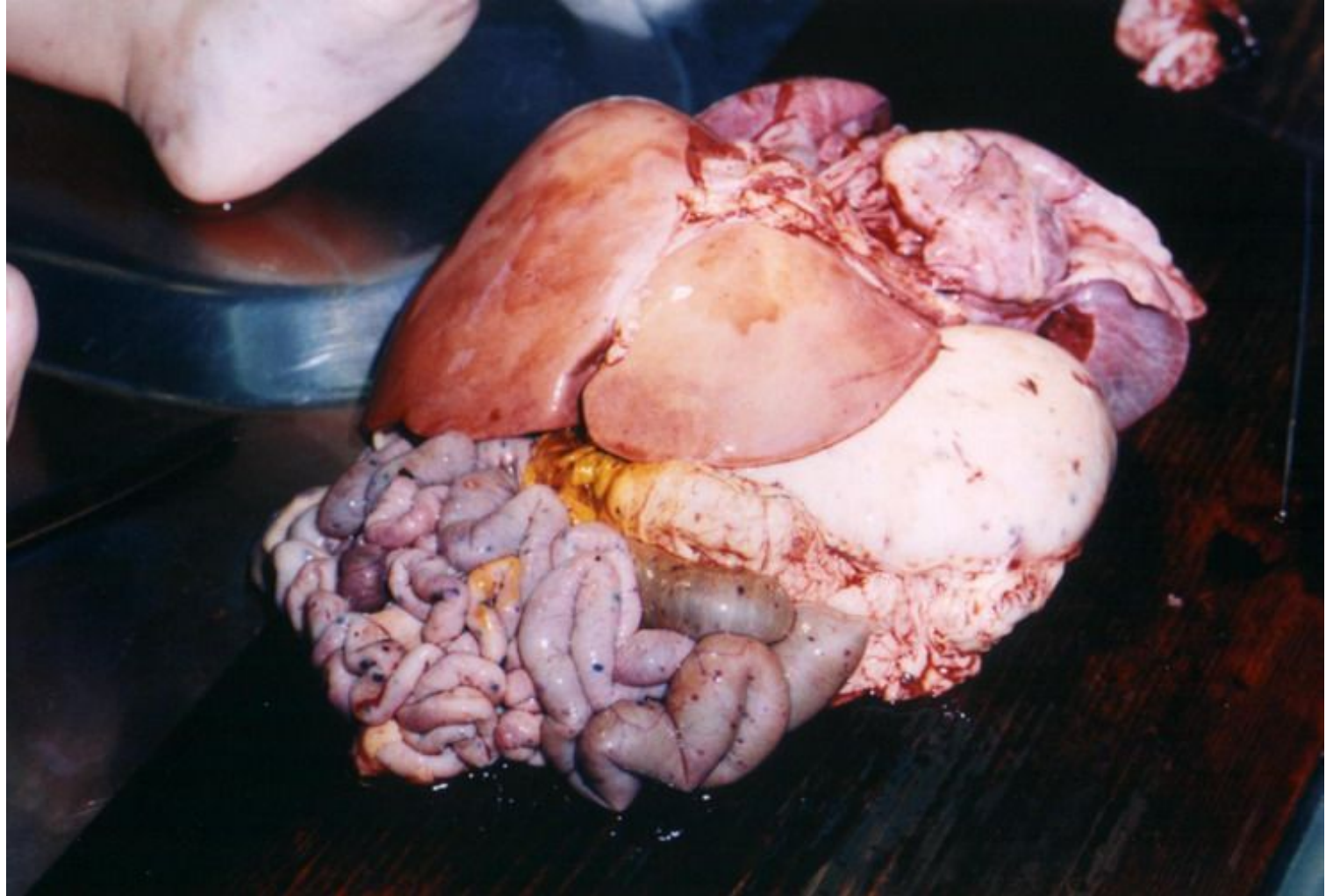


Brain damage

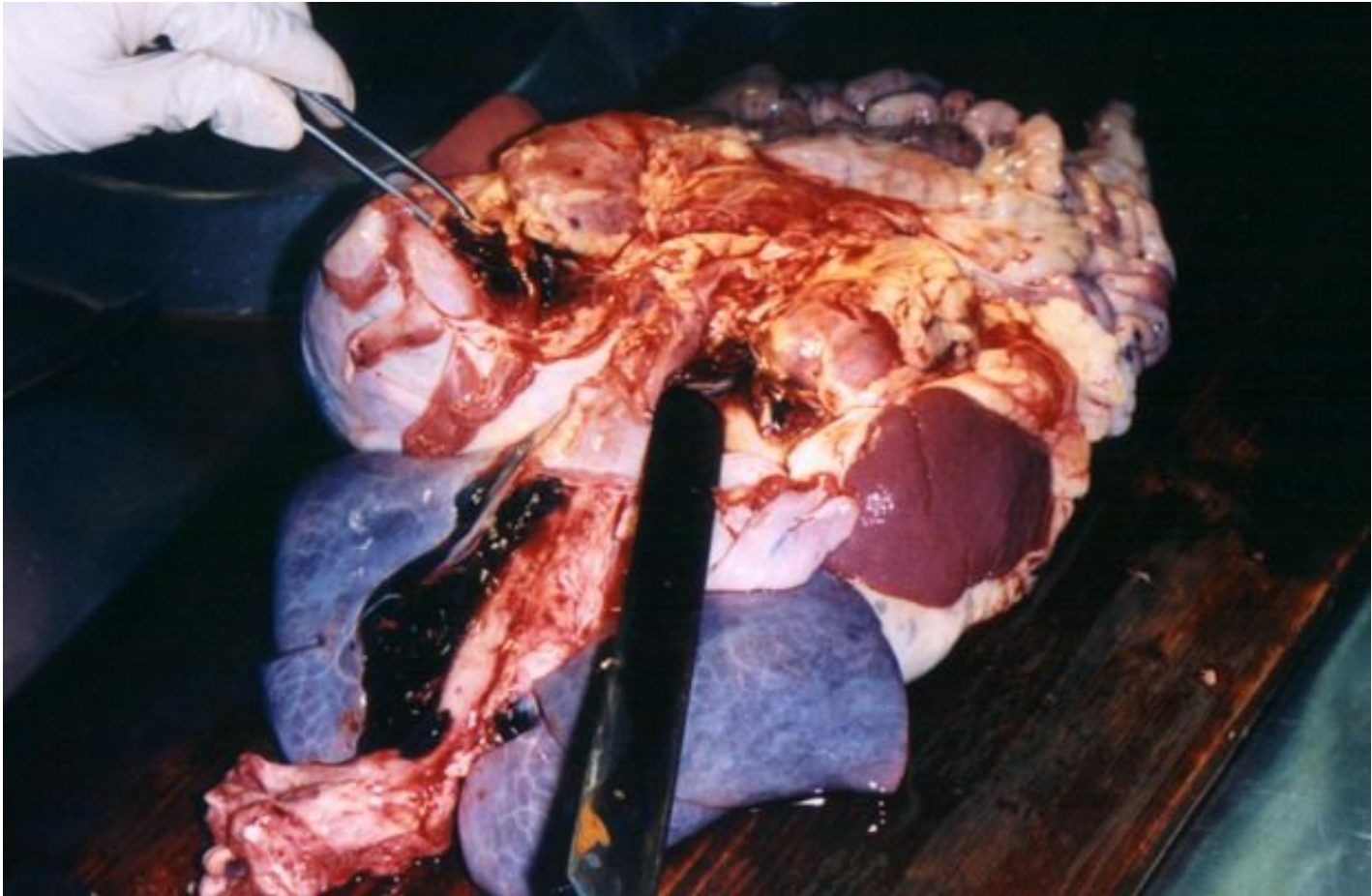
(meningococccemia)



Visceral hemorrhagic lesions



Suprarenal glands hemorrhagic lesion



Marmoreal skin's color (shock)



Treatment

Viral meningitis – usually symptomatic

Bacterial meningitis – antibacterial therapy

Fungal meningitis – antifungal therapy

Bacterial meningitis.

Antibacterial treatment

Undefined etiology – empirical treatment depends on suspected pathogen (age related)

Age	Antibiotic
0-1 mo	Ampicillin + Cefotaxim + Aminoglycoside
1-3 mo	Ampicillin + Cefotaxim (Ceftriaxone)
3 mo-18 yrs	Cefotaxim (Ceftriaxone)

Defined etiology

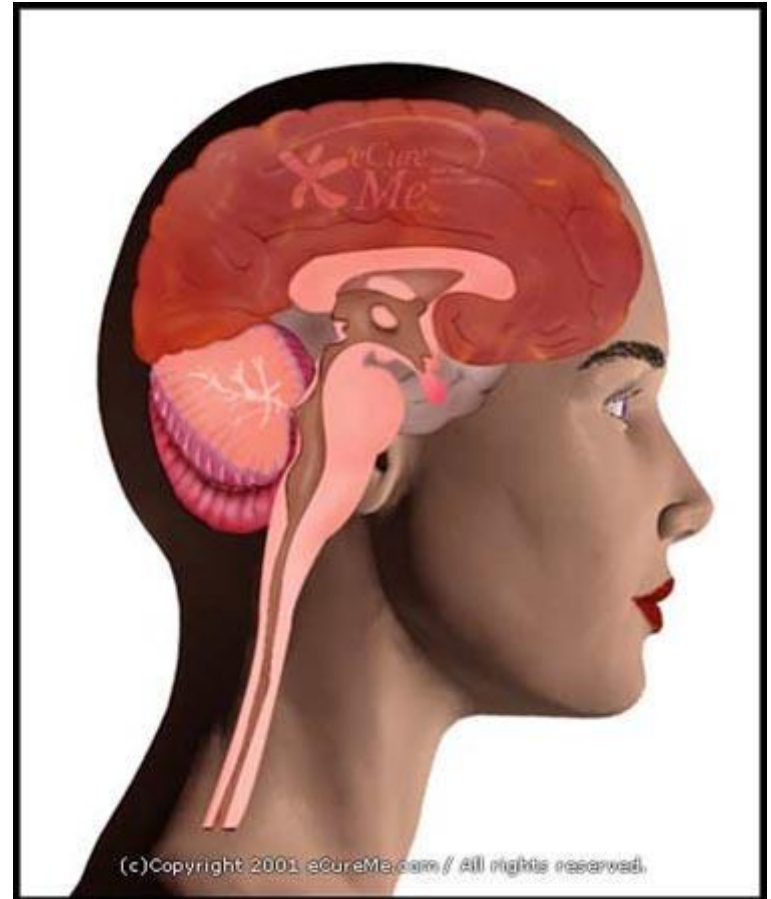
Pathogen	1-st line antibiotic	Alternative
<i>S. pneumoniae</i>		
Penicillin-sensitive	Penicillin G Ampicillin	Ceftriaxone (cefotaxim) Levomycetin
Penicillin-resistant or unknown sensitivity	Ceftriaxone (cefotaxim) + Vancomycin	Cefepim Meropenem
<i>H. influenzae</i>	Ceftriaxone (cefotaxim)	Cefepim Meropenem Ampicillin Levomycetin
<i>N. meningitidis</i>	Penicillin G Ceftriaxone (cefotaxim)	Levomycetin Ampicillin
<i>S. aureus</i>	Oxacillin	Vancomycin, Rifampicin, Co-trimoxazole

Defined etiology

<i>S. epidermidis</i>	Vancomycin + Rifampicin	
<i>L.monocytogenes</i>	Ampicillin or Penicillin G + Aminoglycoside	Meropenem Co-trimoxazole
<i>S. agalacticae</i>	Ampicillin or Penicillin G + Aminoglycoside	Ceftriaxone (cefotaxim) Vancomycin
<i>Enterobacteriaceae</i> (<i>Salmonella, Proteus, Klebsiella</i>)	Ceftriaxone (cefotaxim) + Aminoglycoside	Ampicillin Meropenem Co-trimoxazole
<i>Pseudomonas aeruginosa, Acinetobacter</i>	Ceftazidime or Cefepim + Aminoglycoside	Ciprofloxacin + Aminoglycoside, Meropenem
<i>Candida albicans</i>	Fluconazol	Amphotericin B
<i>Enterococcus (faecalis, faecium)</i>	Ampicillin + Aminoglycoside	Vancomycin + Aminoglycoside

Encephalitis

Encephalitis -
inflammation of the
brain tissue



Etiology

Enteroviruses,
Herpes simplex virus types 1 and 2,
Human herpes viruses types 3 (varicella), 4 (EBV),
5 (CMV), 6.
Morbillivirus (measles),
Rubivirus (rubella),
Influenza,
Rabies virus,
Arboviruses,
Lyme disease,
Post-infective encephalitis (often occurs 2 to 3
weeks following the initial viral infection).

Encephalitis

Clinical Picture



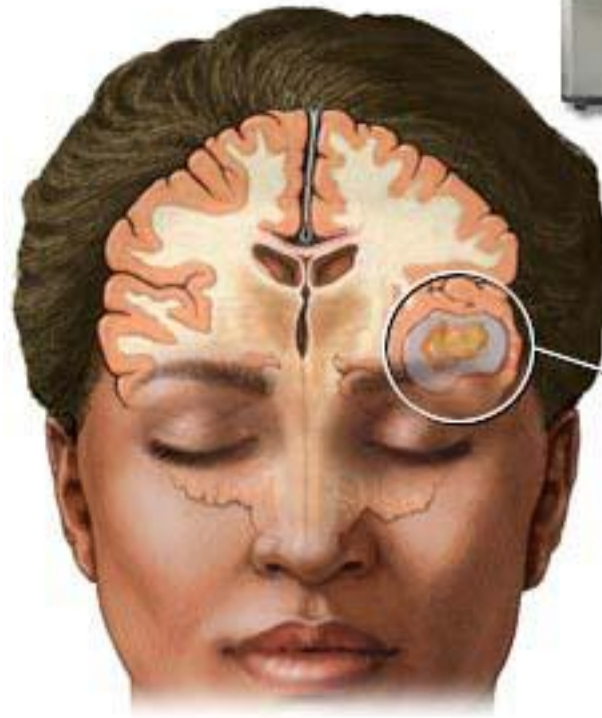
Encephalitis

Signs:

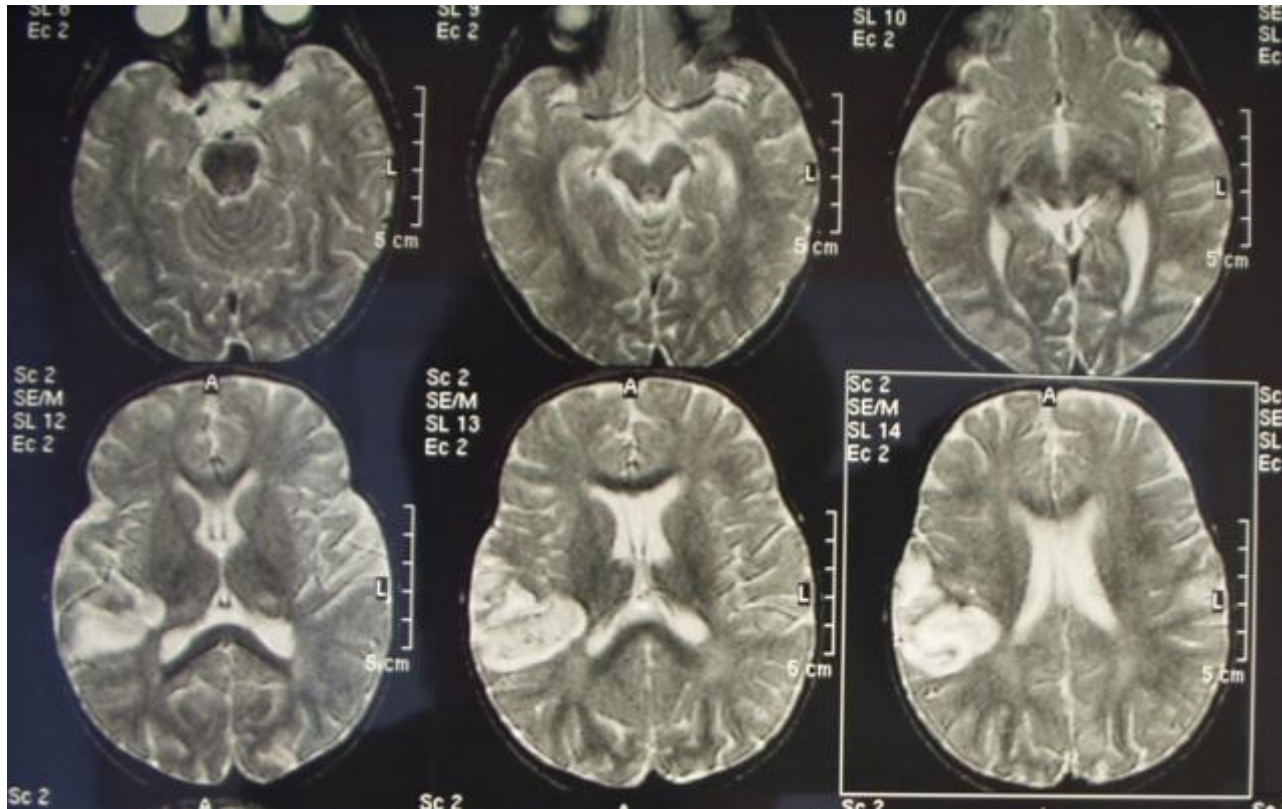
fever,
headache,
chills,
sweats,
malaise;
focal neurological deficits (paresis,
aphasia),
alteration of mental status,
low consciousness,
seizures.

Brain scanning - MRI and CT imaging

Computed tomography
(CT or CAT scan) of the brain



Encephalitis. Brain lesion



Treatment

Etiology

HSV 1/2, VZV, EBV

Acyclovir

CMV

Gancyclovir

Other

Mainly

supportive

Poliomyelitis

Etiology

Poliovirus is an RNA virus that belong to Enterovirus family. Three serotypes are able to cause human infection - poliovirus type 1 (PV1), type 2 (PV2), and type 3 (PV3) .

Transmission - through the oral-fecal route or by ingestion of contaminated water.

Clinical forms

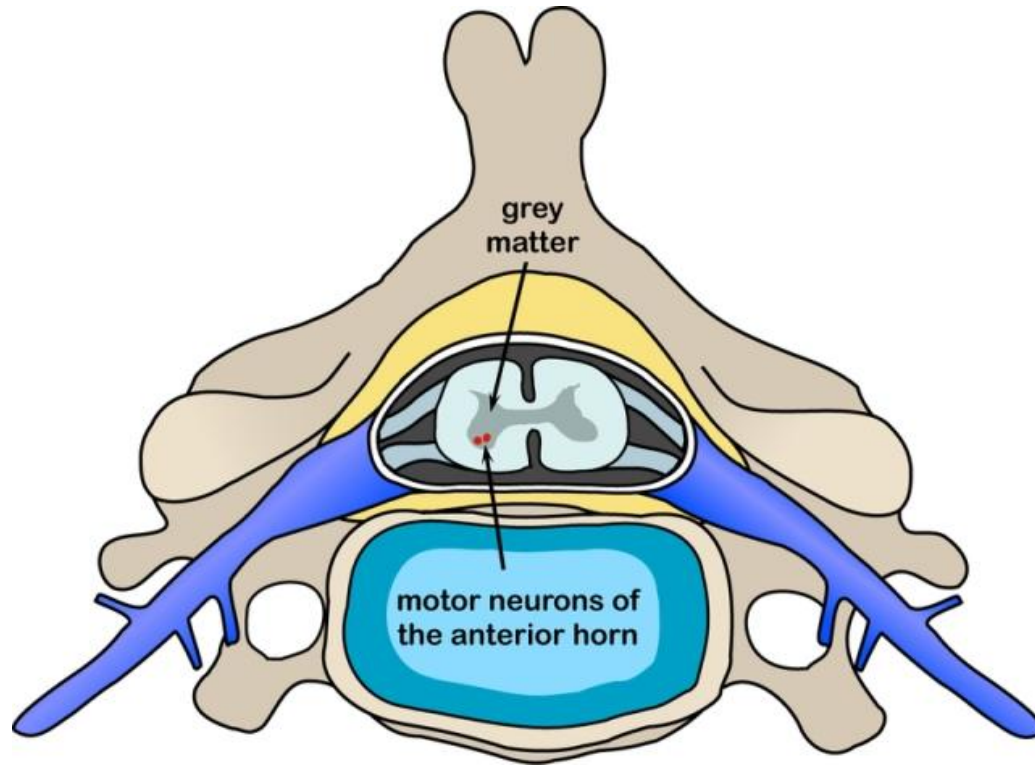
Inapparent infection (usually asymptomatic),

Abortive disease (frequently sore throat and gastrointestinal disorders),

Nonparalytic poliomyelitis (aseptic meningitis),

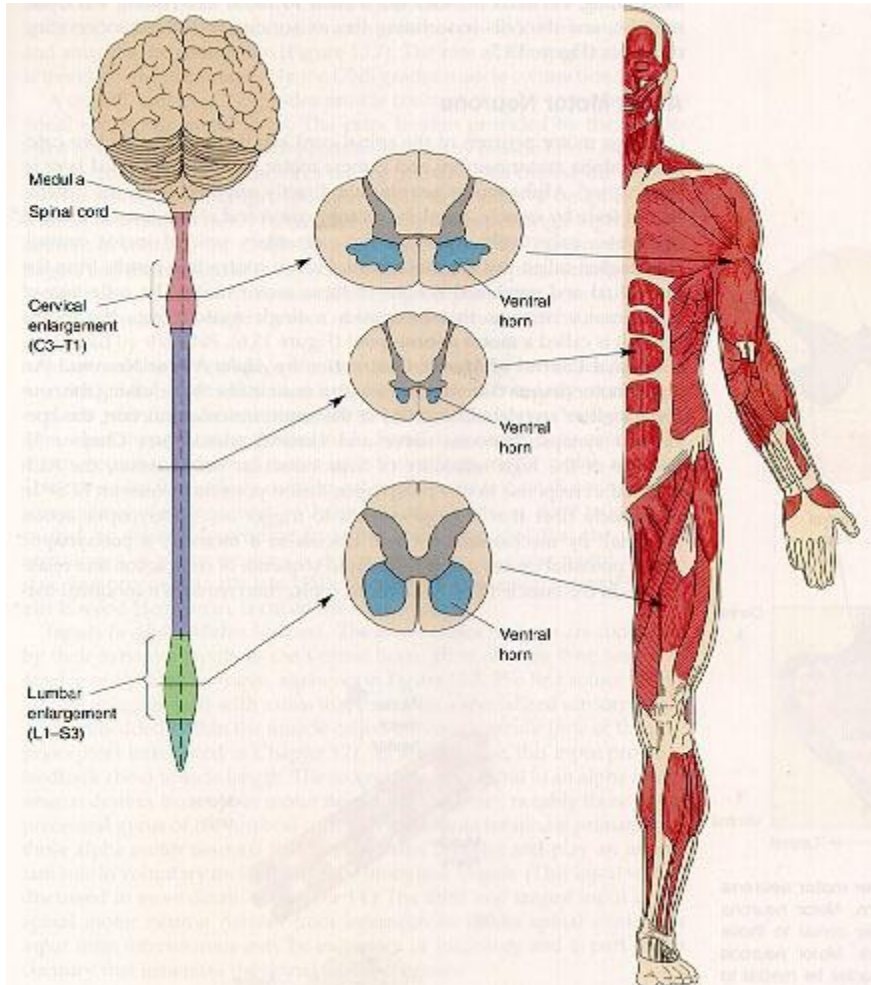
Paralytic disease.

Paralytic disease



Virus produces destruction of the motor neurons in the anterior horn and brainstem

Paralytic disease



1. Spinal paralytic poliomyelitis: paralysis or paresis of trunk muscles or muscles responsible for movement of the limbs.
2. Bulbar paralytic poliomyelitis: weakness of muscles innervated by the cranial nerves (difficulty in swallowing, loss of voice quality, and sometimes tongue and facial paralysis).
3. Bulbospinal paralytic poliomyelitis: generally leads to severe respiratory impairment.

Treatment and prevention

Treatment

Supportive therapy

Prevention

Polio immunization (vaccine) effectively prevents poliomyelitis in most people (immunization is over 90% effective).

Two vaccines are currently used in the global campaigns to control and to eliminate poliomyelitis:

Oral Polio Vaccine (OPV), a live polio vaccine, is taken orally and more resembles the fecal-oral route of transmission of the virus

Inactivated Polio Vaccine (IPV), a killed polio vaccine, is administered subcutaneously via injection while.