Laboratory diagnostics of CNS inflammation

- CNS inflammation does not change peripheral blood composition due to blood-brain barrier
- CSF (cerebrospinal fluid) is required

CSF test

Indications:

- infections
- autoimmune disorders
- tumour
- bleeding

Contraindications:

- local infection at the sampling site
- bacetiremia
- increased intracranial pressure (papillar edema)
- risk of bleeding

CSF functions

- Defense of CNS
- Transport of nutrients and metabolites
- Hormone transport
- Regulations of intracranial pressure
- (protection against acute BP changes)

Liquor production

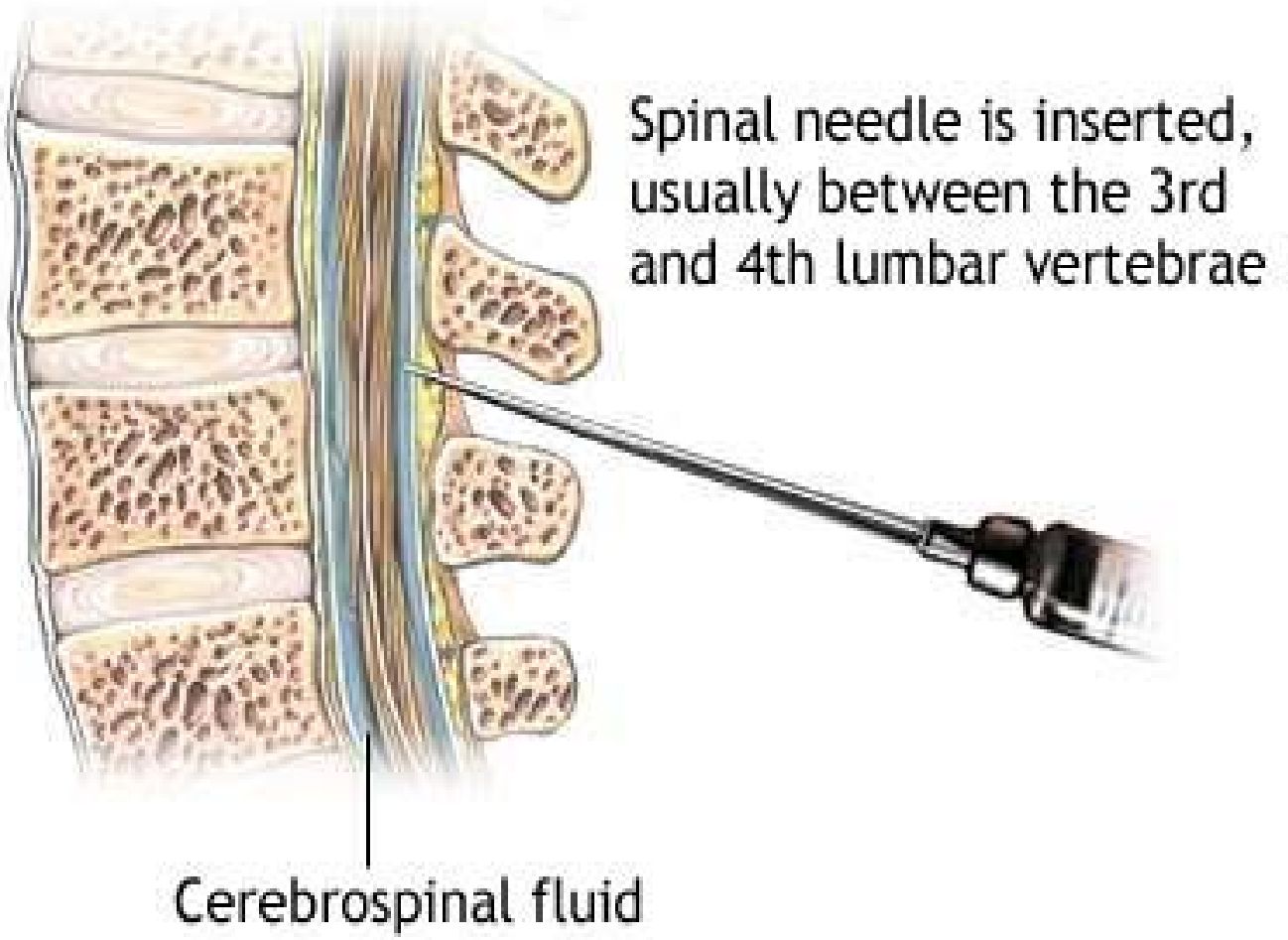
- Location: chorioid plexus
- Cca 500 ml per day
- Amount required for one test: 10 – 15 ml

CSF sampling

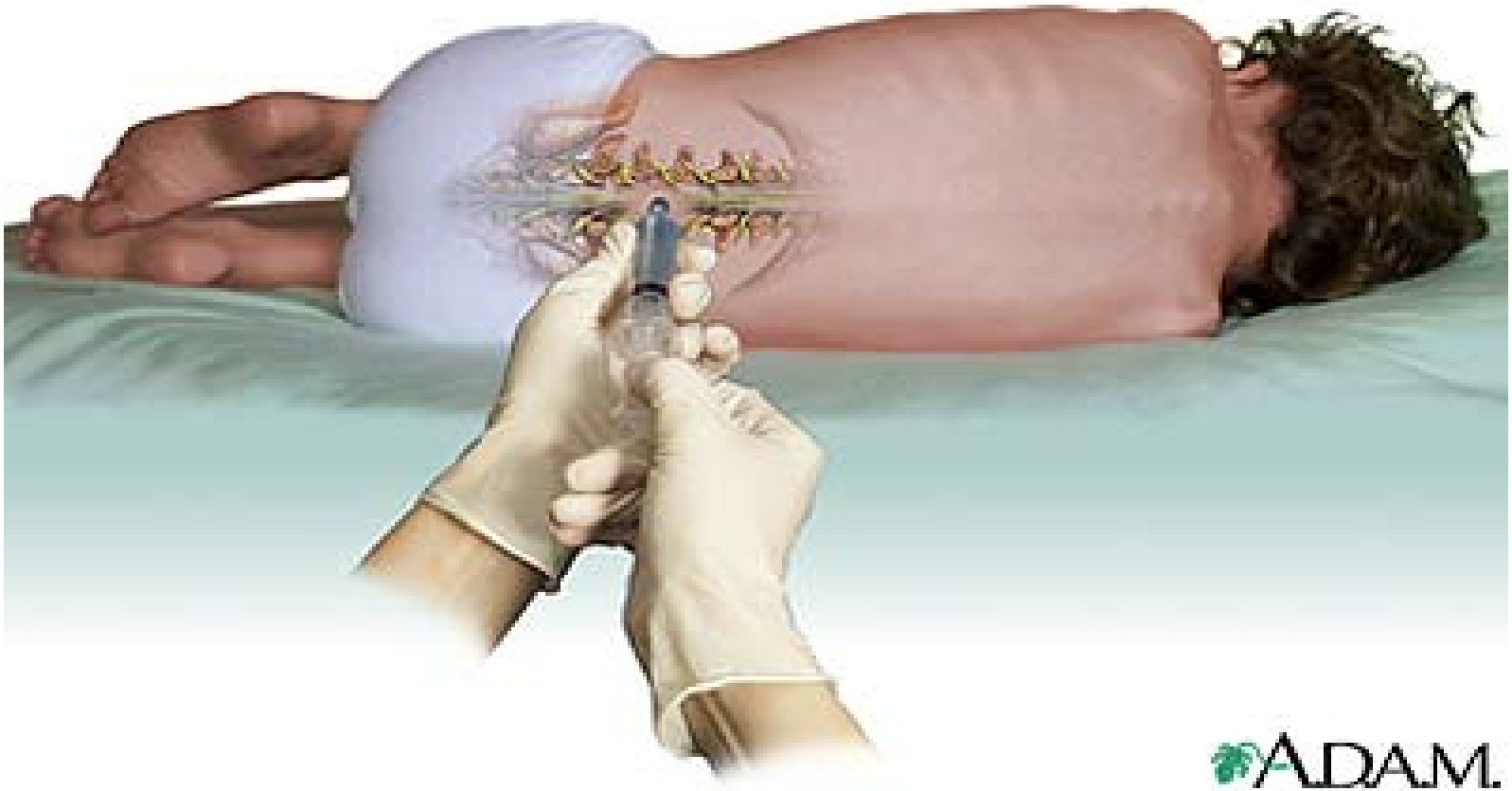
- Dominantly: LUMBAR
- Rarely: ventricular punction, drain,
- The composition of CSF depends on the site of sampling

IMPORTANT:

SIMULTANEOUSLY BLOOD SHOULD BE TAKEN (ALBUMIN & GLUCOSE)


Spinal needle is inserted, usually between the 3rd and 4th lumbar vertebrae
Cerebrospinal fluid

A.D.A.M.



ADAM.

Steps of CSF

- Pressure of CSF measurement
- Samples to 4 glass tubes (2-2 ml)
  - The first 5-6 drops should be separated (arteficial bleeding)
  - Tube 1. : chemistry and cell count (smear)
  - Tube 2. : culture (room temperature!)
  - Tube 3. : optional

To be transported to the lab ASAP.

CSF pressure

Ref value:

9~18 cmH2O in the adult, 1~10 cmH2O in the child

Increased:

tumour (inhibits reabsorption)

bleeding, infection (RBC & WBC block tiny channels).

congenital

heart failure / increased venous pressure

brain edema

CAUTION: high pressure (20-30 cmH2O) – risk of intracranial wedging

Inspection

CSF: clear, colourless & transparent.

Colours:

-opalescent:

- High protein levels (>2 g/l)
- WBC: > 0.2 G/L
- RBC: > 0.4 G/L
- pathogens

-red: acute bleeding (artificial bleeding should be excluded)

-xantochrom (yellowish):

- a.) jaundice (see blood!!)
- b.) subarachnoideal bleeding (decomposition of hemoglobin originated from RBCs)
- c.) carotenes, drug therapy

-zöldes: meningeal infiltration, Pseudomonas-infection

Differentiation between artificial & pathological bleeding

Artificial bleeding	Pathological bleeding
Sequential tubes: the CSF is clearing with consecutive tubes. May form thrombus while standing the sample.	Each fraction is constantly bloody; the sample remains fluid while standing.
Microscopically: intact RBCs, present in clusters. Ratio of RBC & WBC is 700:1.	RBCs may decrease in size, present separately. (Relative) increase in WBC count.
CSF becomes clear after centrifuge	Yellowish (415 nm)

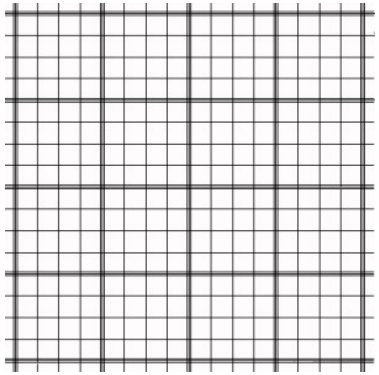
Microscopical inspection

Cell count:

Using Fuchs-Rosenthal or Bürker chambers

Naive CSF: total cell count
Then: acetate is given

RBCs are lysed and just WBCs remain



Cell counts in CSF

- Normally WBC count: 0~5 /ul.

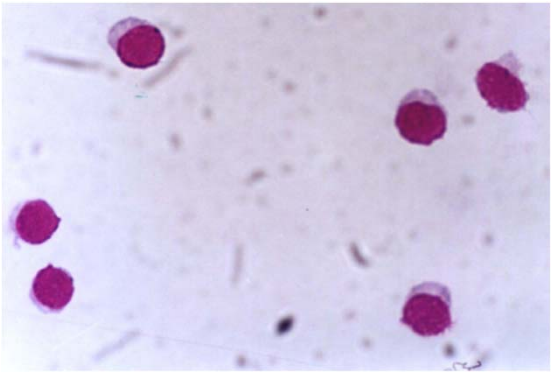
Qualitative assessment: specific sedimentation, dye or automated .

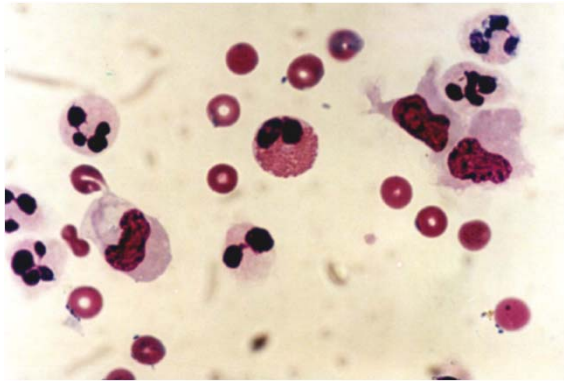
- Increased neutrophil count:

  Meningitis, brain abscess, empyema, CBS bleeding/ stroke, seizures

- Increased lymphocyte / plasma cell count:

  TB meningitis, syphilis meningitis, sclerosis multiplex, parasites, Guillain-Barré syndrome, sarcoidosis, viral infections





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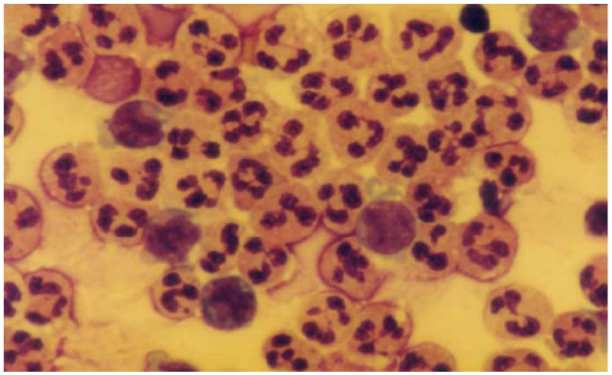

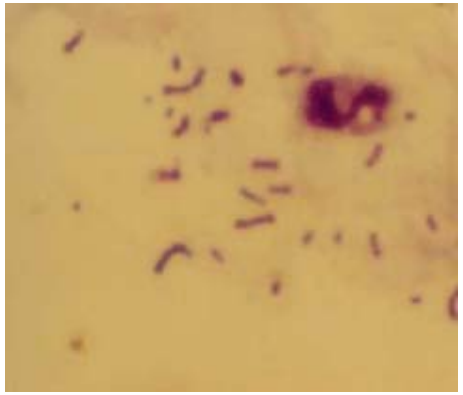

CSF glucose content

IMPORTANT: blood glucose should be measured and related to

CSF glucose levels: cca 60% of plasma glucose

Emelkedett liquor glükózszint: emelkedett vércukorszint is lehet.

Low CSF glucose levels (<0.5 CSF/plasma ratio):

in the presence of CSF infections

(increased glucose uptake in arachnoids, by WBCs and bacteria

impaired blood-CSF glucose transport)

several weeks until the normalization

CSF protein content

Pandy-reaction:

One drop of CSF into Carbol acid :

‘clouding’: Pandy + / ++ / +++; indicates globin content

Currently: exact protein measurements

In healthy:

concentration: 0.15 – 0.45 g/l

Liquor / serum albumin ratio: 1:200.

300 different proteins

majority originate from serum

Increased protein content in bleedign: 10 mg/l when RBC =1 G/l

CSF protein content

+ Intrathecally produced proteins (produced by lymphocytes, glia cells and neurons)

DOMINANTLY: ImmunglobulinS

+ CSF protein levels increase: damaged blood-brain barrier (infection, inflammation, autoimmune reaction)

In clinical practice:

Determination of immunglobulin, & albumin CSF/serum ratios

CSF: other clinical chemistry tests

Lactate levels:

Proportional to glycolysis. Increased: meningitis, intracranial bleeding, malignant hypertension, hepatic coma, hypoglycemic coma.

LDH value:

Increased in bacterial meningitis

CSF: microbiological testing

- Gram-dyeing of smear (& Ziel-Nielsen dyeing whent TB suspected)
- Culture (store & transport at room temperature, to be processed within 1 h)
- Serological tests (agglutination tests) for antigen detection
- Molecular biological tests

TAKE HOME MESSAGE

- A local inflammatory response should be detected using a sample of systemic circulation
- Parameters change rapidly in time
- Parameters may indicate different aspects of inflammation
- Should be related to CLINICAL STATUS