

**Institute for Microbiology, Medical Faculty of Masaryk University
and St. Anna Faculty Hospital in Brno**

Agents of neuroinfections

Importance of central nervous system infections

- **CNS infections** – relatively **rare**, but can have a very **serious course**
- **Incidence**
bacterial meningitis: 2/100.000/year
viral meningitis: 10/100.000/year
- **Lethality**
bacterial meningitis, non-treated: >70 %
treated: ~10 %

Penetration into CNS

- **From a peripheral focus:**
 - by means of blood** (meningococci)
 - per continuitatem** (pneumococci or haemophili from the middle ear)
 - along nerves** (HSV, rabies virus)
- **Directly:**
 - after an injury** (pneumococci, staphylococci, nocardiae, aspergilli)



Severe headache



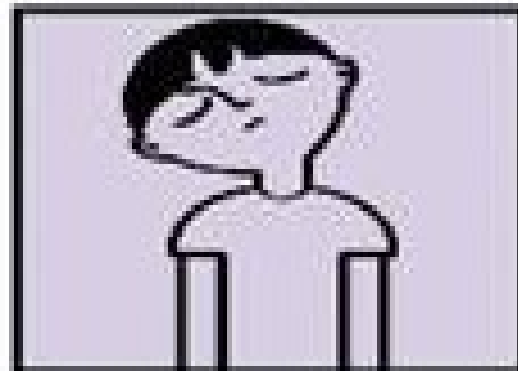
Stiff neck



Dislike of
bright lights



Fever/vomiting



Drowsy and less
responsive/
vacant



Rash (develops
anywhere on
body)

Etiology of CNS infections

It depends on the **type** and the **duration** of the disease, therefore it is different in

1. acute bacterial **meningitis**
2. acute viral meningitis
3. chronic meningitis
4. **encephalitis**
5. acute brain **abscess**
6. chronic brain abscess

Etiology of acute meningitis – I

Always distinguish **purulent** meningitis (nearly always of bacterial origin)

from **aseptic** one (usually of viral origin)

Anamnesis

Clinical disease

Laboratory – above all the **examination of CSF**

cytology (appearance and number of cells)

biochemistry (proteins and glucose)

microbiology (microscopy, antigens, culture)

Etiology of acute meningitis – II

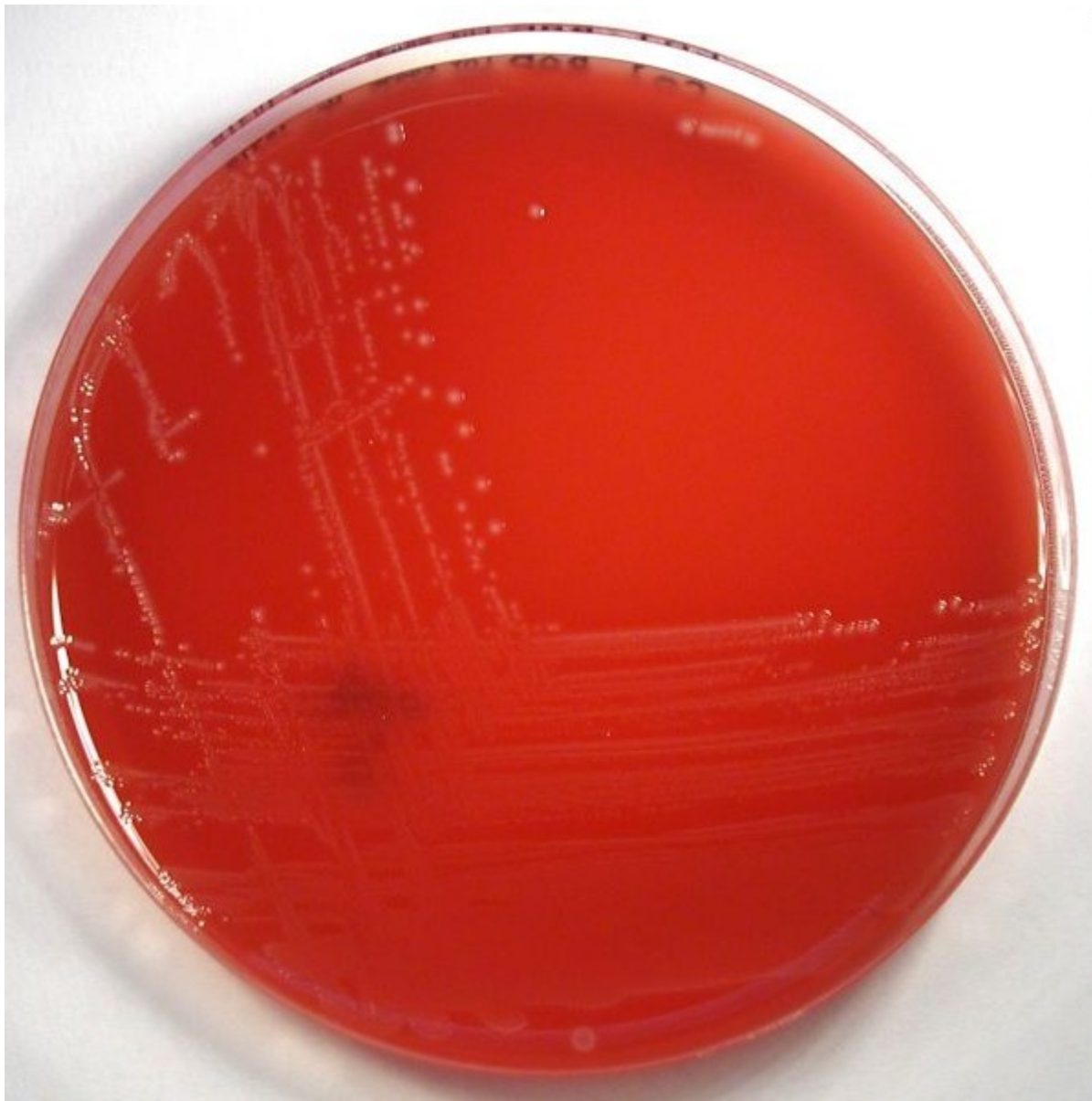
Cytology and biochemistry of CSF

marker	norm	purulent meningitis	aseptic meningitis
cells	0-6/ μ l	↑↑↑ (>1000)	↑↑ (100-500)
proteins	20-50 mg/100 ml	↑↑ (>100)	↑ (50-100)
glucose	40-80 mg/100 ml	↓ (<30)	~ (30-40)

Etiology of acute meningitis – III

Etiology of purulent meningitis by the age in %

age	GBS					
0-1 m.	50					
1-4 y.						
5-29						
30-59						
≥60						

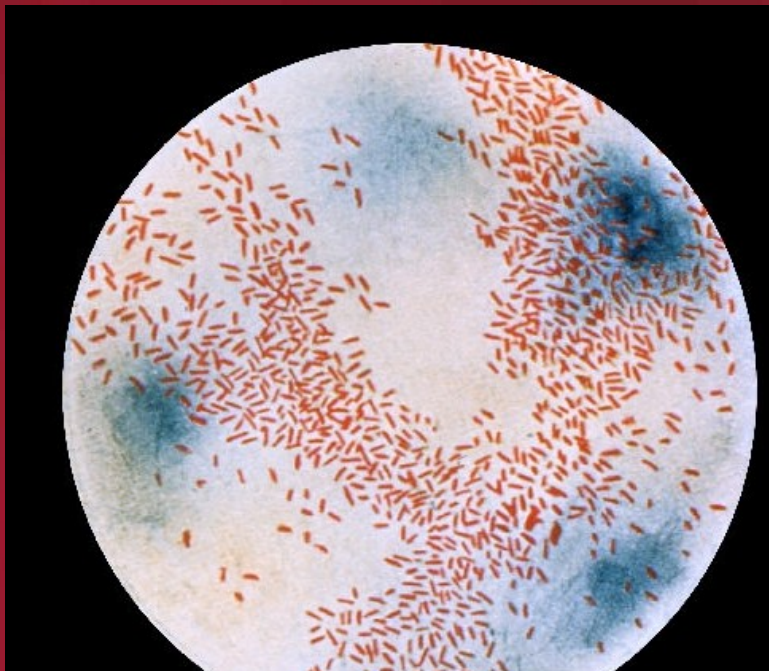
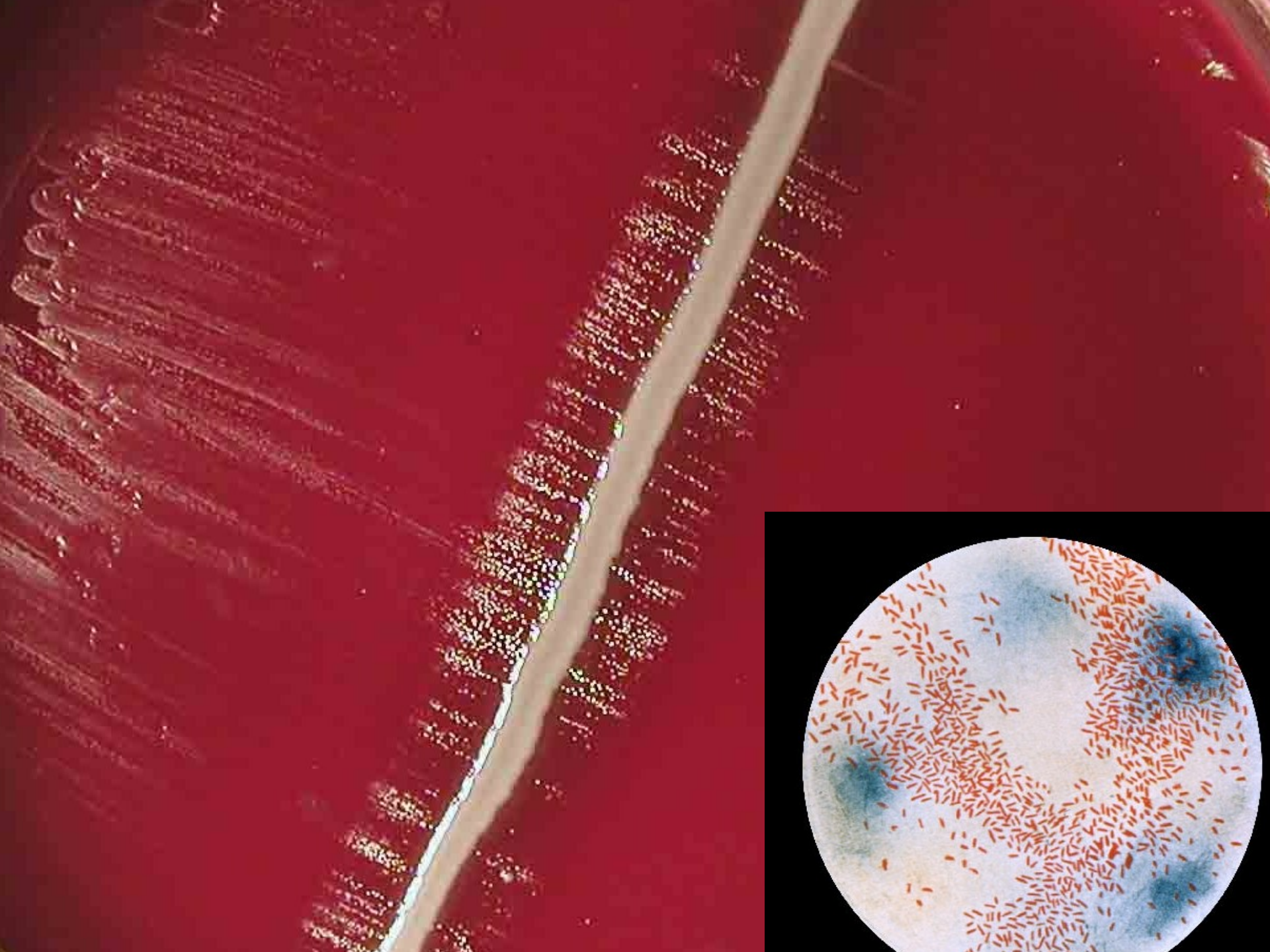


www.bakteriologieatlas.de

Etiology of acute meningitis – IV

Etiology of purulent meningitis by the age in %

age	GBS	Haem. infl. b				
0-1 m.	50					
1-4 y.		70				
5-29						
30-59						
≥60						



Etiology of acute meningitis – V

Etiology of purulent meningitis by the age in %

age	GBS	Haem. infl. b	Neiss. men.			
0-1 m.	50					
1-4 y.		70				
5-29			45			
30-59						
≥60						



Etiology of acute meningitis – VI

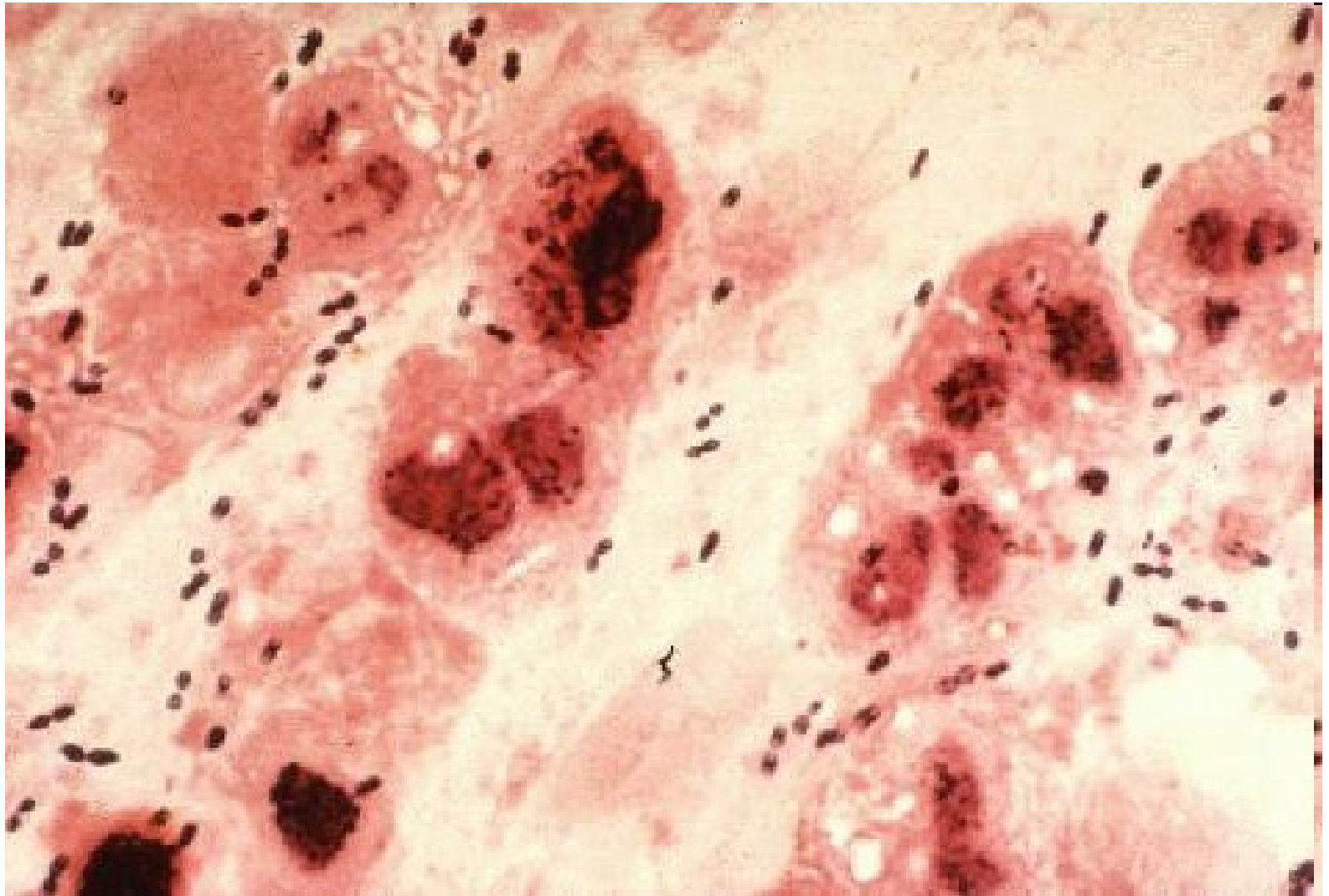
Etiology of purulent meningitis by the age in %

age	GBS	Haem. infl. b	Neiss. men.	other		
0-1 m.	50					
1-4 y.		70				
5-29			45			
30-59				40		
≥60						

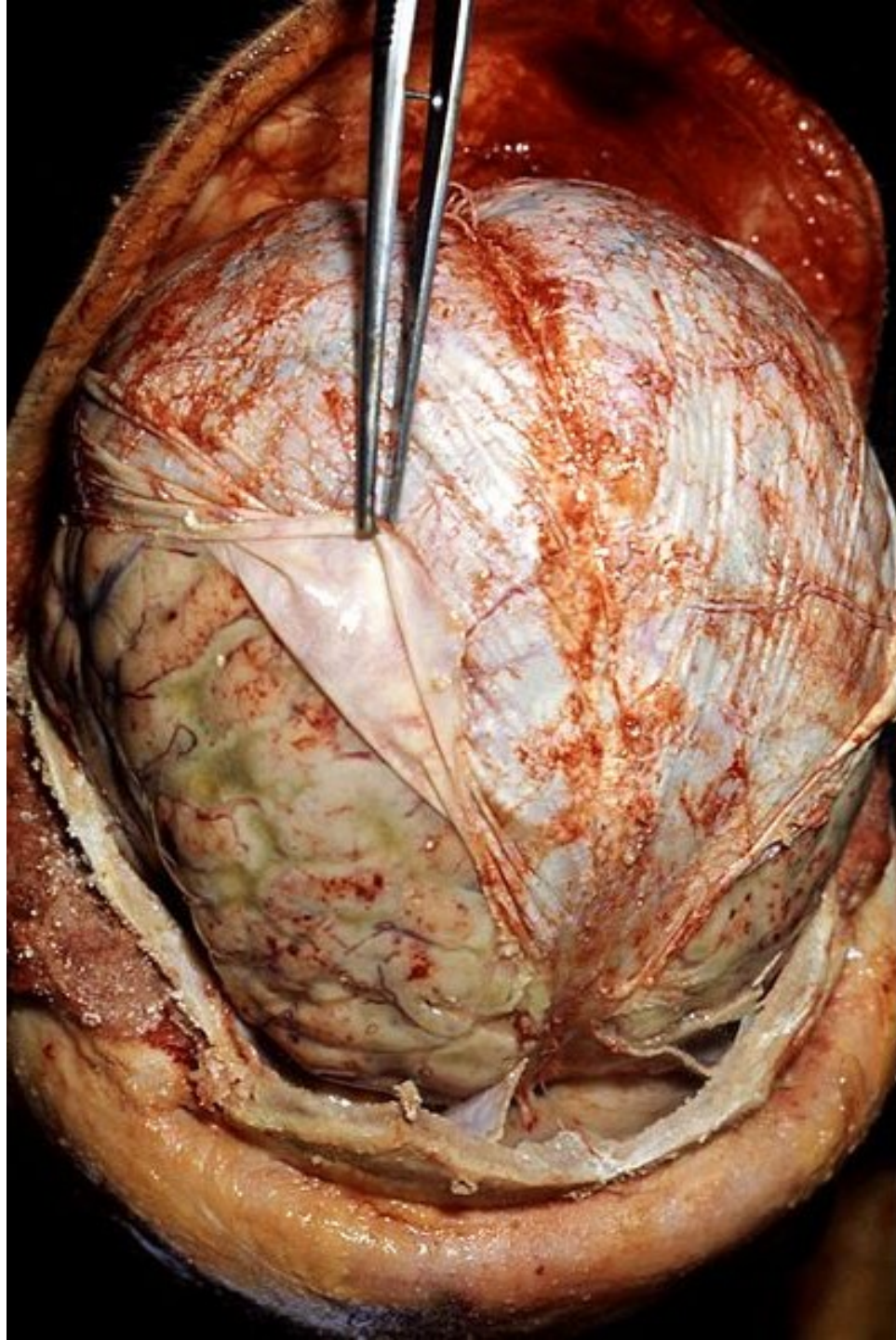
Etiology of acute meningitis – VII

Etiology of purulent meningitis by the age in %

age	GBS	Haem. infl. b	Neiss. men.	other	Str. pneu.	
0-1 m.	50					
1-4 y.		70				
5-29			45			
30-59				40		
≥60					50	



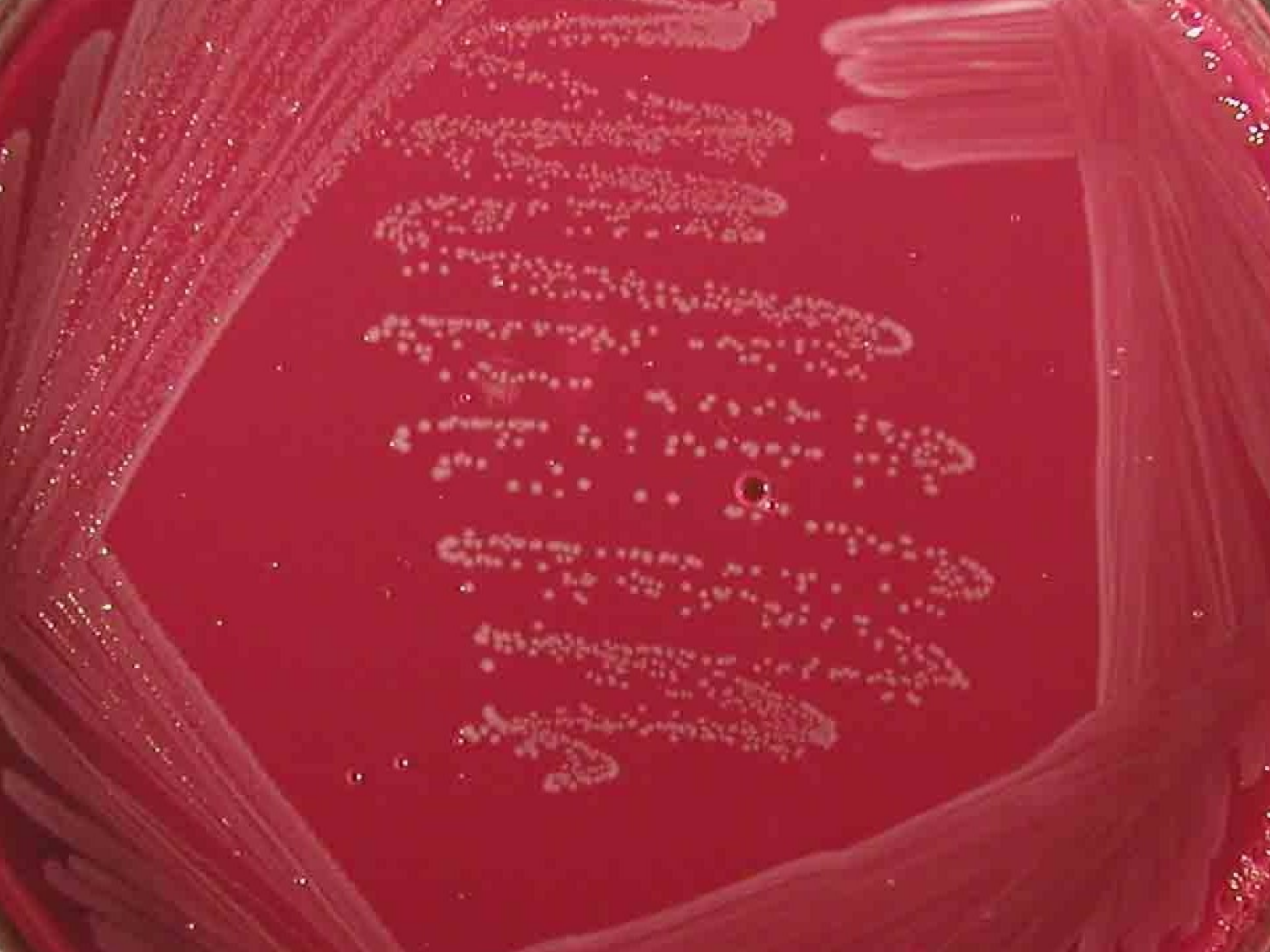
<http://bioinfo.bact.wisc.edu>



Etiology of acute meningitis – VIII

Etiology of purulent meningitis by the age in %

age	GBS	Haem. infl. b	Neiss. men.	other	Str. pneu.	List. mono.
0-1 m.	50			33		10
1-4 y.		70	15		10	
5-29			45	25	20	
30-59			10	40	33	
≥60				25	50	15



Etiology of acute meningitis – IX

Importance of purulent meningitis according to etiology

(lethality and sequelae)

importance	GBS	Haem. infl. b	Neiss. men.	other	Str. pneu.	List. mono.
lethality					†	†
sequelae		+++		+	+	+

Etiology of acute meningitis – X

The most common agents of **aseptic** meningitis:
viruses

mumps virus (but CNS infection is clinically silent)

enteroviruses: echoviruses (30 serotypes)

coxsackieviruses (23 + 6 serotypes)

tick-borne encephalitis virus (TBEV)

rarely HSV and VZV and other neuroviruses

rarely some bacteria

leptospirae, borreliae, Mycobacterium tuberculosis

Overview of Central-European neuroviruses

tick-borne enceph. v. *

enteroviruses: polio *

coxsackie

echo

mumps v.*

HSV, VZV *, CMV

rabies v. *

other arboviruses

LCMV

/morbilli v./*

/EBV/

/polyomaviruses JC & BK/

/HIV/

/prions/

* Preventable by vaccination

Arboviruses in Central Europe – I

<i>Genus or family :</i> arbovirus	Disease	Antibodies only
<i>Flavivirus:</i> TBEV	+	
WNV	+	
<i>Orbivirus:</i> Tribeč	+	
<i>Bunyaviridae:</i> Ťahyňa	+	
Batai (Čalovo)	?	
Uukuniemi	?	
<i>Alfavirus:</i> Sindbis		+
<i>Coltivirus:</i> Eyach		+

Arboviruses in Central Europe – II

Arboviruses isolated in Czech Republic, probably **nonpathogenic** for humans:

Bunyaviridae: Lednice
Sedlec

Other **European pathogenic** arboviruses, which may be imported:

dengue v. (flavivirus, Greece)

CCHFV (nairovirus, Ukraine, Bulgaria)

Toscana v. (phlebovirus, Italy)

Bhanja v. (bunyavirus, Slovakia)

chikungunya v. (alphavirus, Italy)



Etiology of chronic meningitis

Bacteria: *Mycobacterium tuberculosis*
(meningitis basilaris)

Moulds and yeasts:
aspergilli
Cryptococcus neoformans



Cystic lesions resulting from accumulation of organisms in perivascular spaces



©Omnis Agamemolis MD

Etiology of encephalitis

Encephalitis – only **acute**, of **viral** origin:

- **tick-borne encephalitis v.**
- **HSV**
- **enteroviruses**
- **mumps v.**

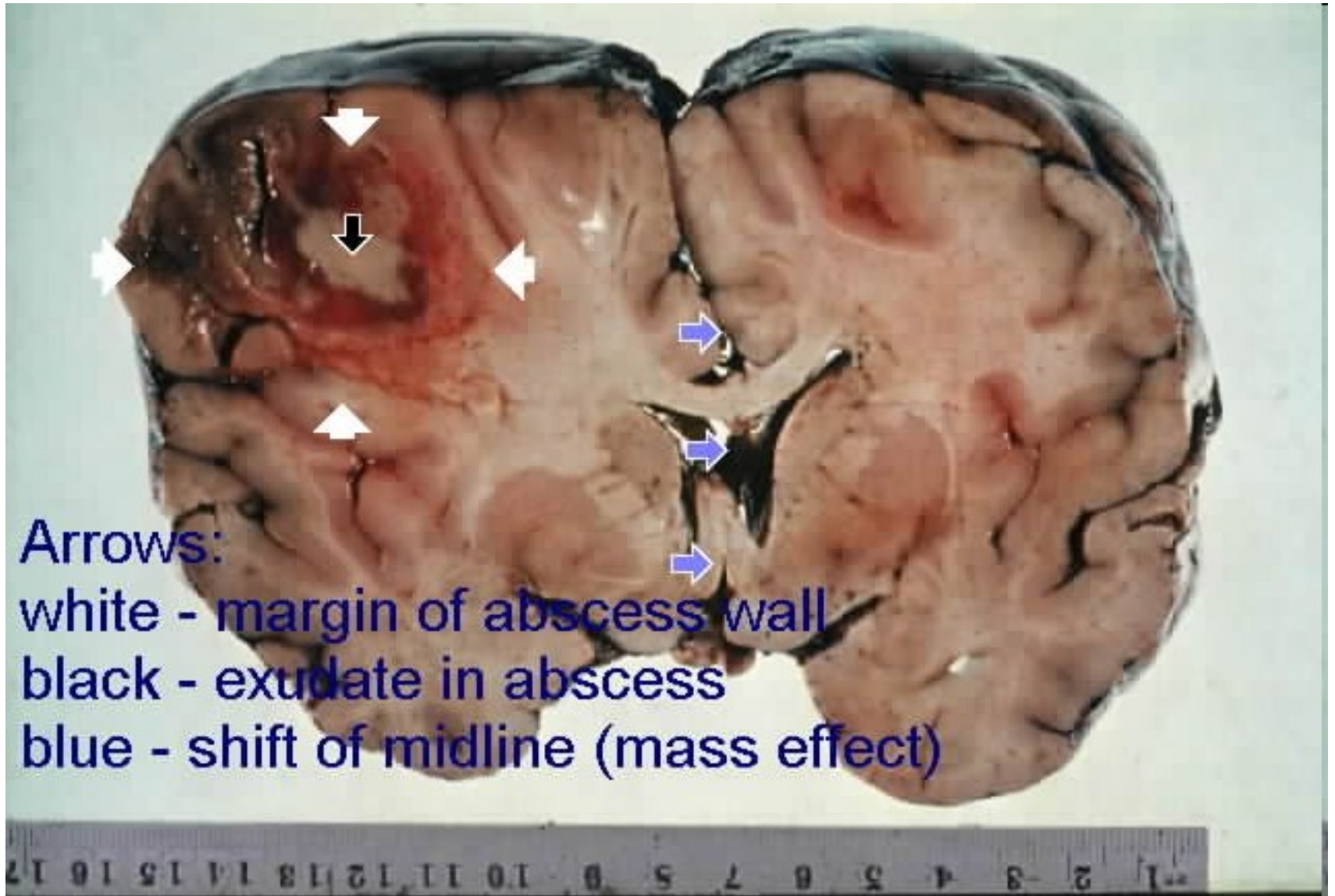


Mumps parotitis with cervical and presternal edema and erythema

Etiology of acute brain abscess

Acute brain abscesses are only of **bacterial** origin:

- **mixed** anaerobic and aerobic **flora**
- **staphylococci** (both *S. aureus* and coagulase negative staphylococci)
- group A and D **streptococci**



Arrows:
white - margin of abscess wall
black - exudate in abscess
blue - shift of midline (mass effect)

Etiology of chronic brain abscess

Bacteria:

Mycobacterium tuberculosis

Nocardia asteroides

Mycotic organisms:

Cryptococcus neoformans (yeast)

Parasites:

Cysticercus cellulosae (tissue form of pork tapeworm *Taenia solium*)

10 cm



www.medicine.cmu.ac.th



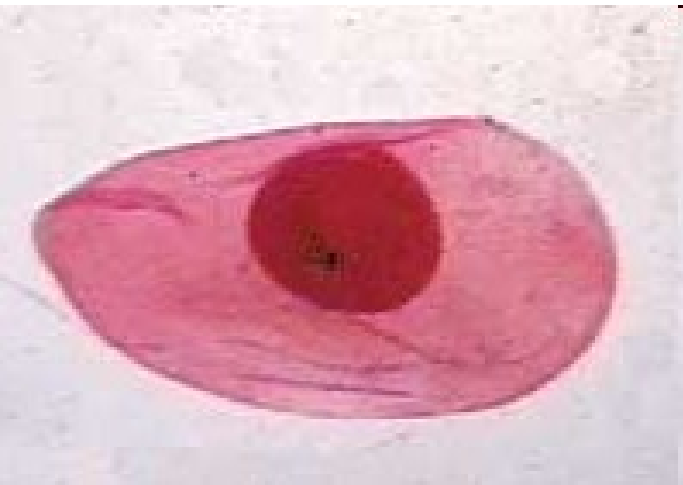
Top: *Taenia solium cysticerci* in the brain of a nine-year-old girl who died during cerebrospinal fluid extraction to diagnose her headaches.

This was in the 1970s - if it had happened 10 years later, noninvasive computerized tomography would have given an accurate diagnosis, and the parasites could have been killed with drugs.

(Image courtesy of Dr. Ana Flisser, National Autonomous University of Mexico.)

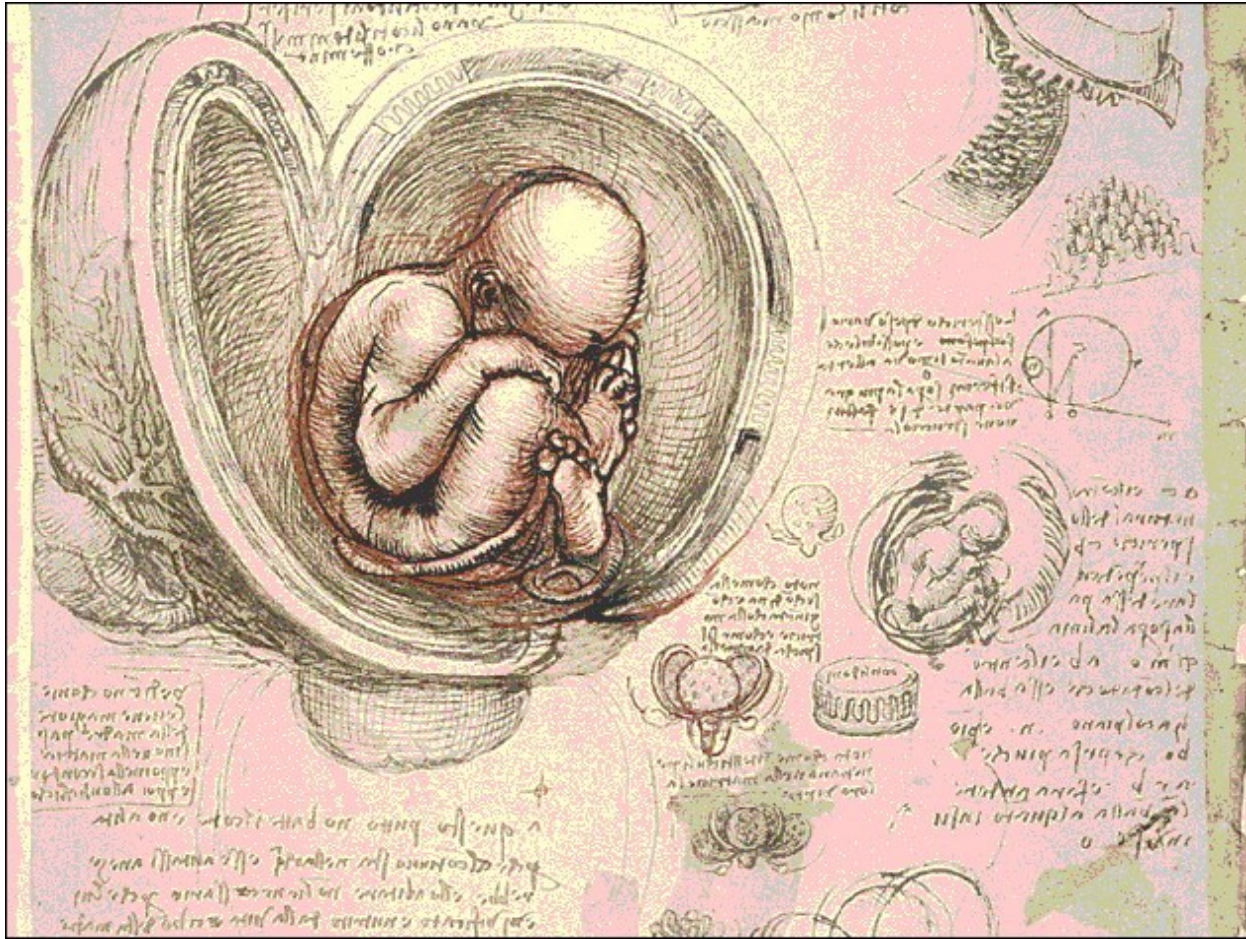
Left: A pork tapeworm (*T.solium*) cysticercus, the form in which the tapeworm is found in an infected brain.

(Colorized image by P. W. Pappas and S. M. Wardrop, courtesy of P. W. Pappas, Ohio State University.)



Homework 2 – solution

Leonardo da Vinci (1452-1519): Fetus in the Womb
(between 1510-1512)



Homework 3

Who painted this picture and what is its name?

