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

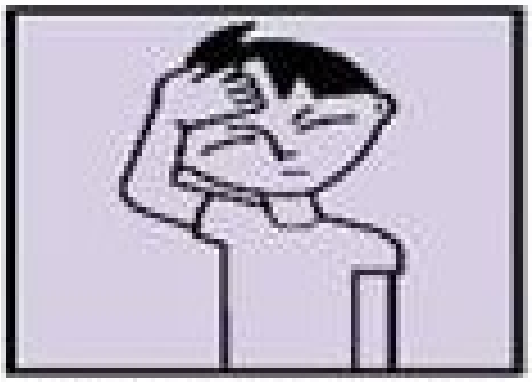
Agents of neuroinfections

Importance of central nervous system infections

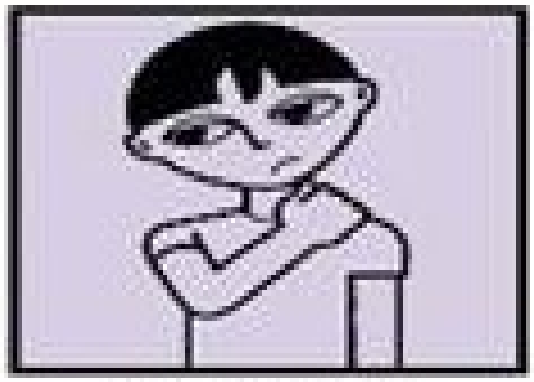
- **CNS infections – relatively rare, but can have a very serious course**
- **Incidence**
  bacterial meningitis: 2/100.000/year
  viral meningitis: 10/100.000/year
- **Lethality**
  bacterial meningitis, non-treated: >70 %
  treated: ~10 %

Penetration into CNS

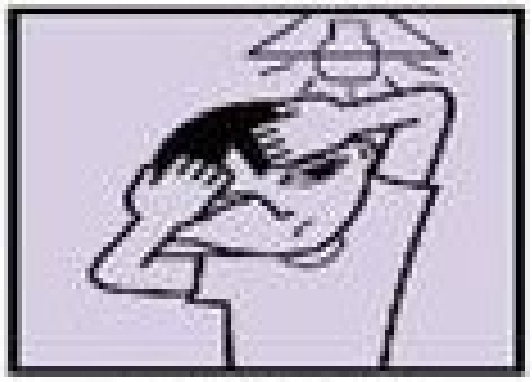
- From a peripheral focus:
  - by means of blood (meningococci)
  - per continutitatem (pneumococci or haemophili from the middle ear)
  - along nerves (HSV, rabies virus)
- Directly:
  - after an injury (pneumococci, staphylococci, nocardiae, aspergilli)



Severe headache

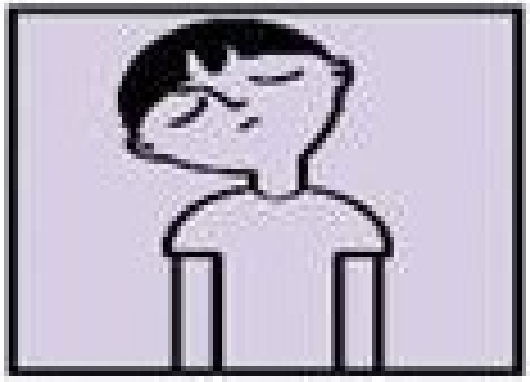


Stiff neck



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

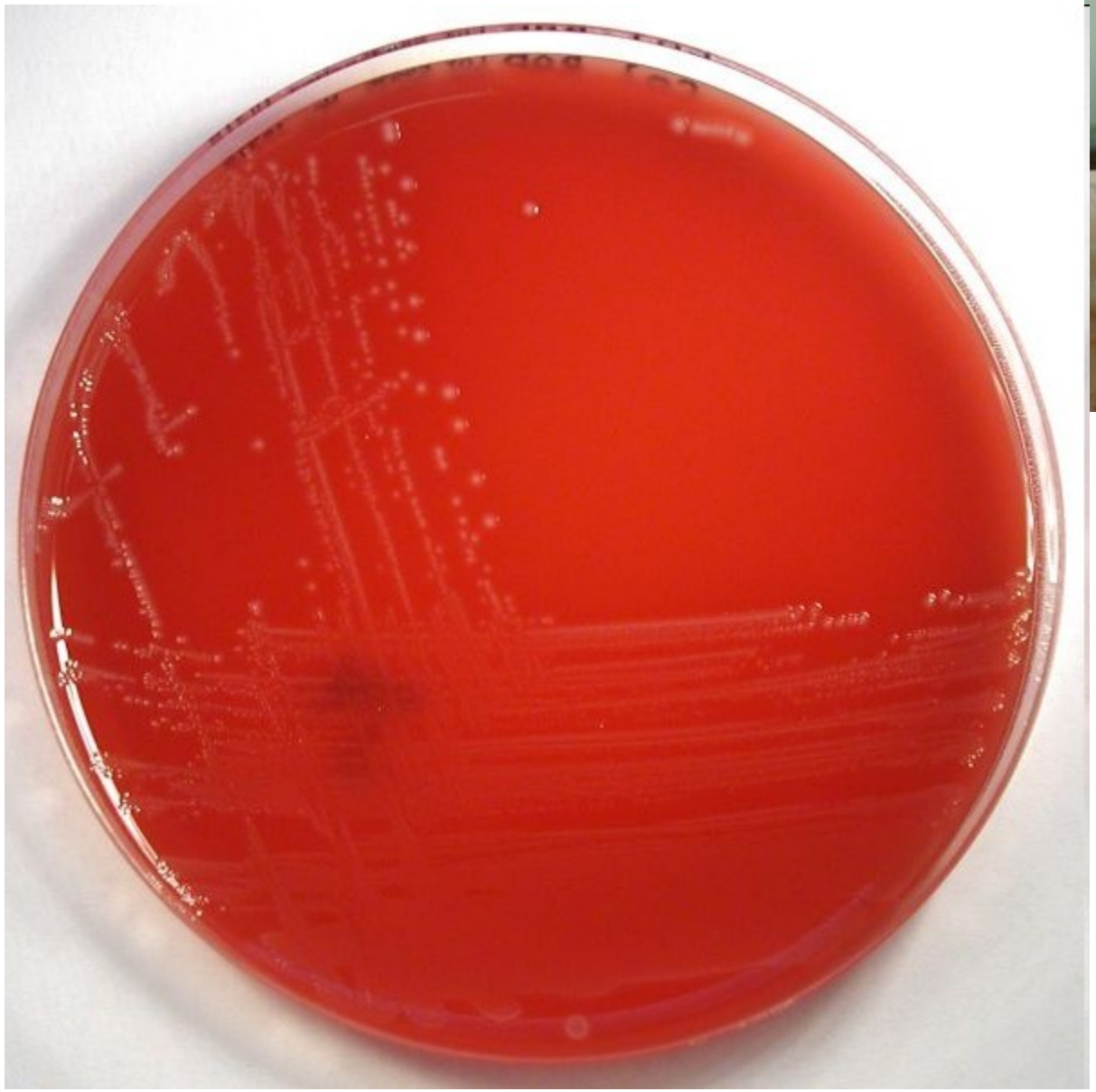
Cytology and biochemistry of CSF

marker	norm	purulent meningitis	aseptic meningitis
cells	0-6/μl	↑↑↑ (>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						

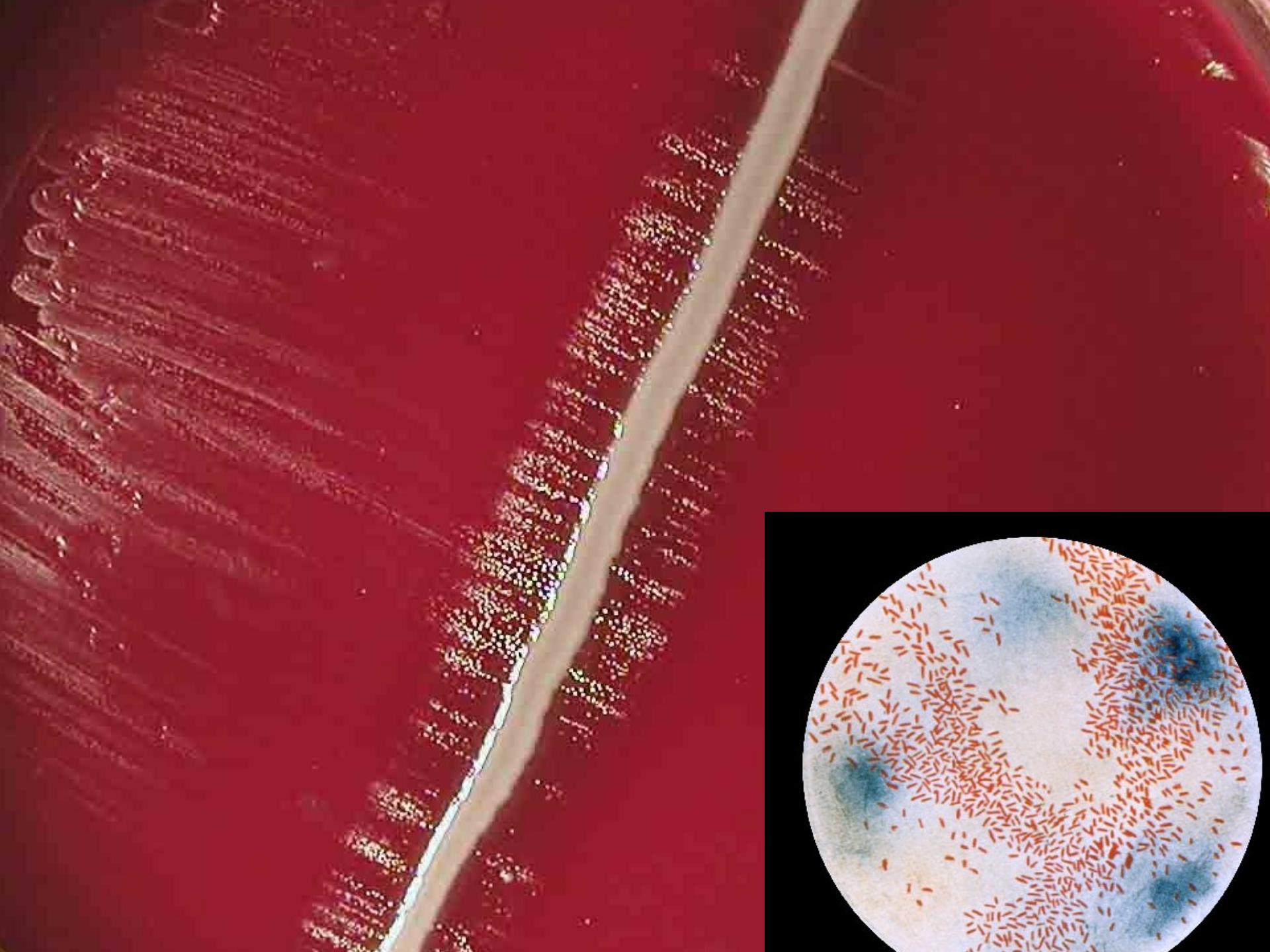


www.bakteriologieatlas.de

Etiology of acute meningitis – IV

Etiology of purulent meningitis by the age in %

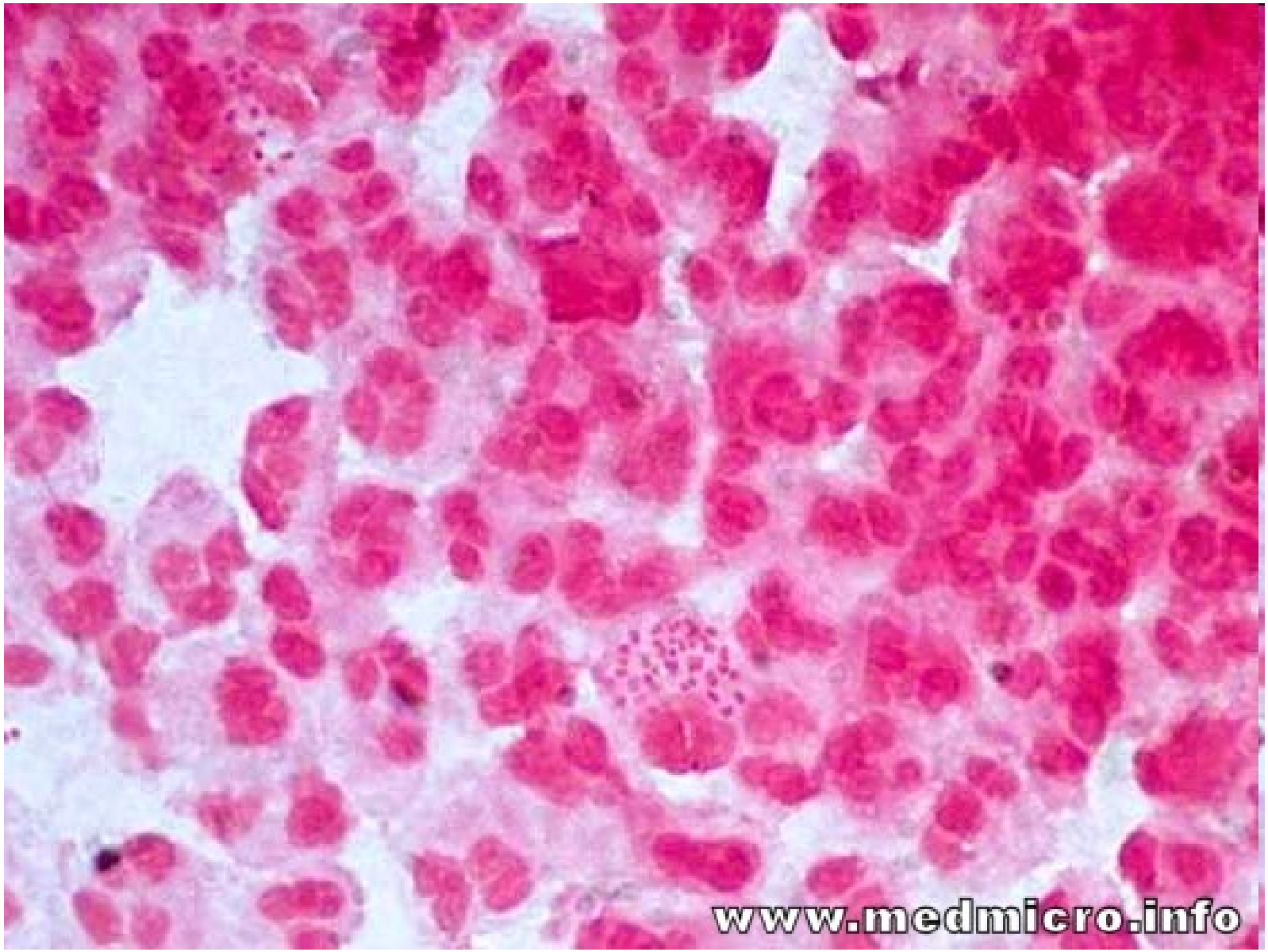
age	GBS	Haem. infl. b				
0-1 m.	50					
1-4 y.		70				
5-29						
30-59						
≥60						



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						


www.medmicro.info

Etiology of acute meningitis – VI

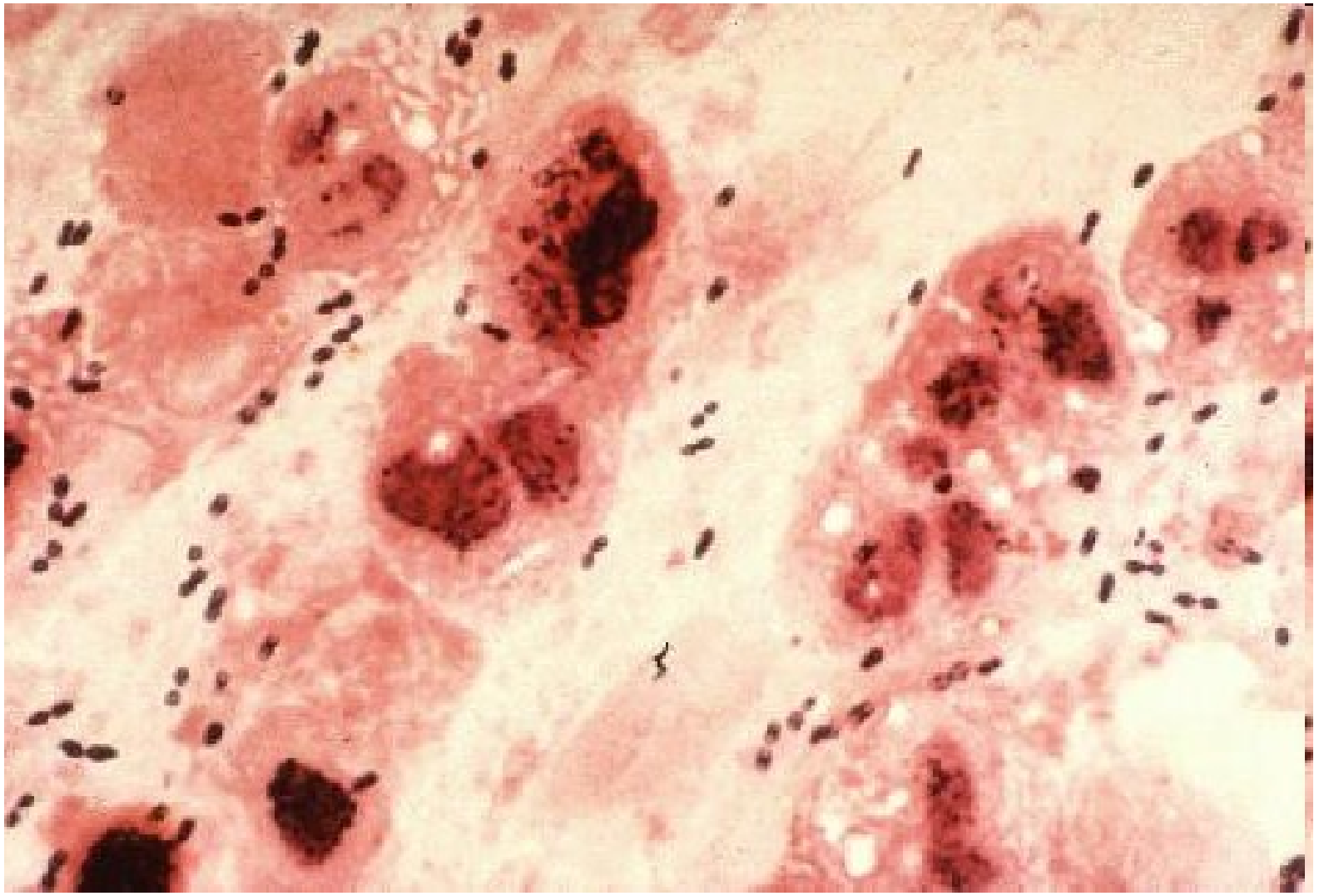
Etiology of purulent meningitis by the age in %

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

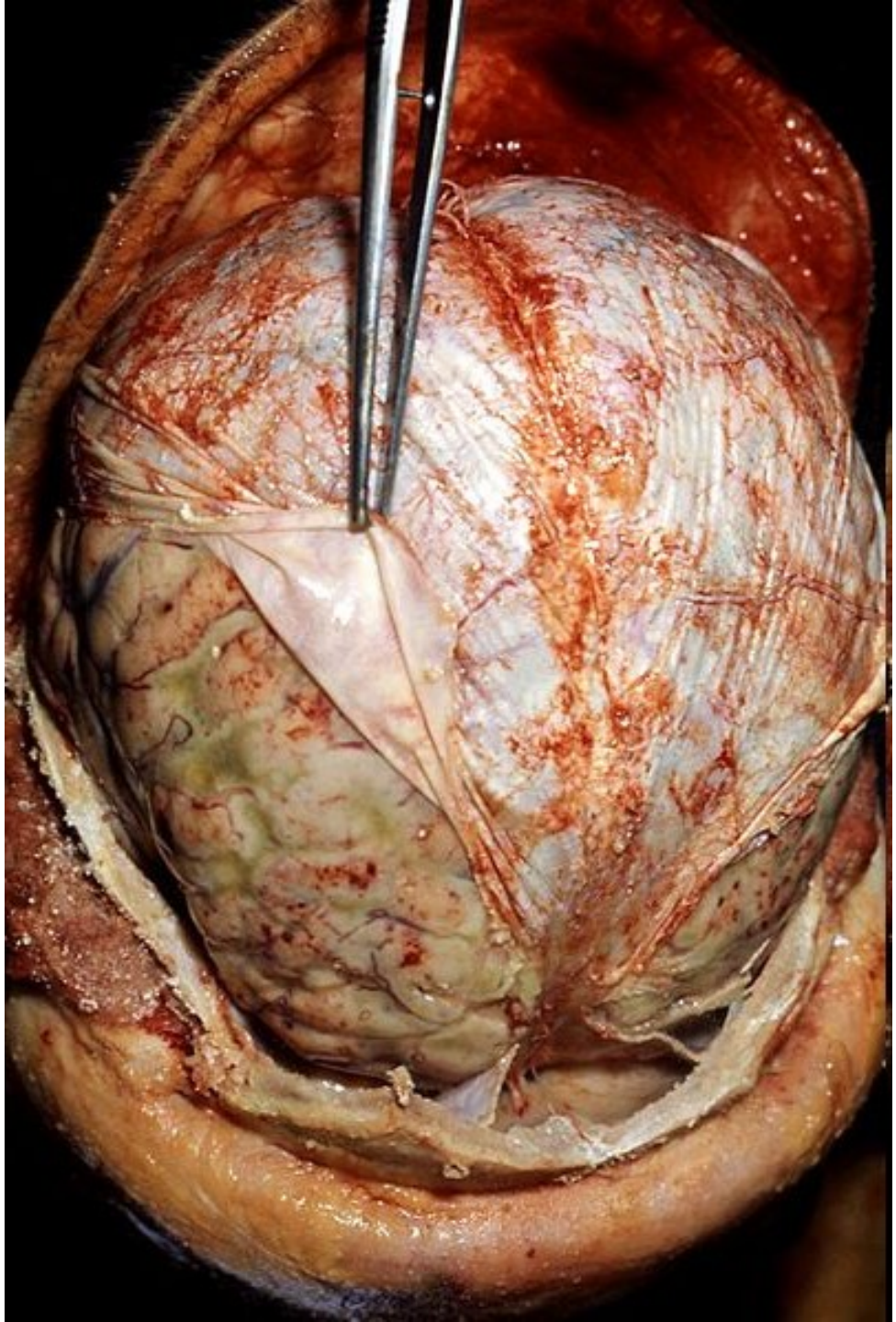
Etiology of acute meningitis – VII

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

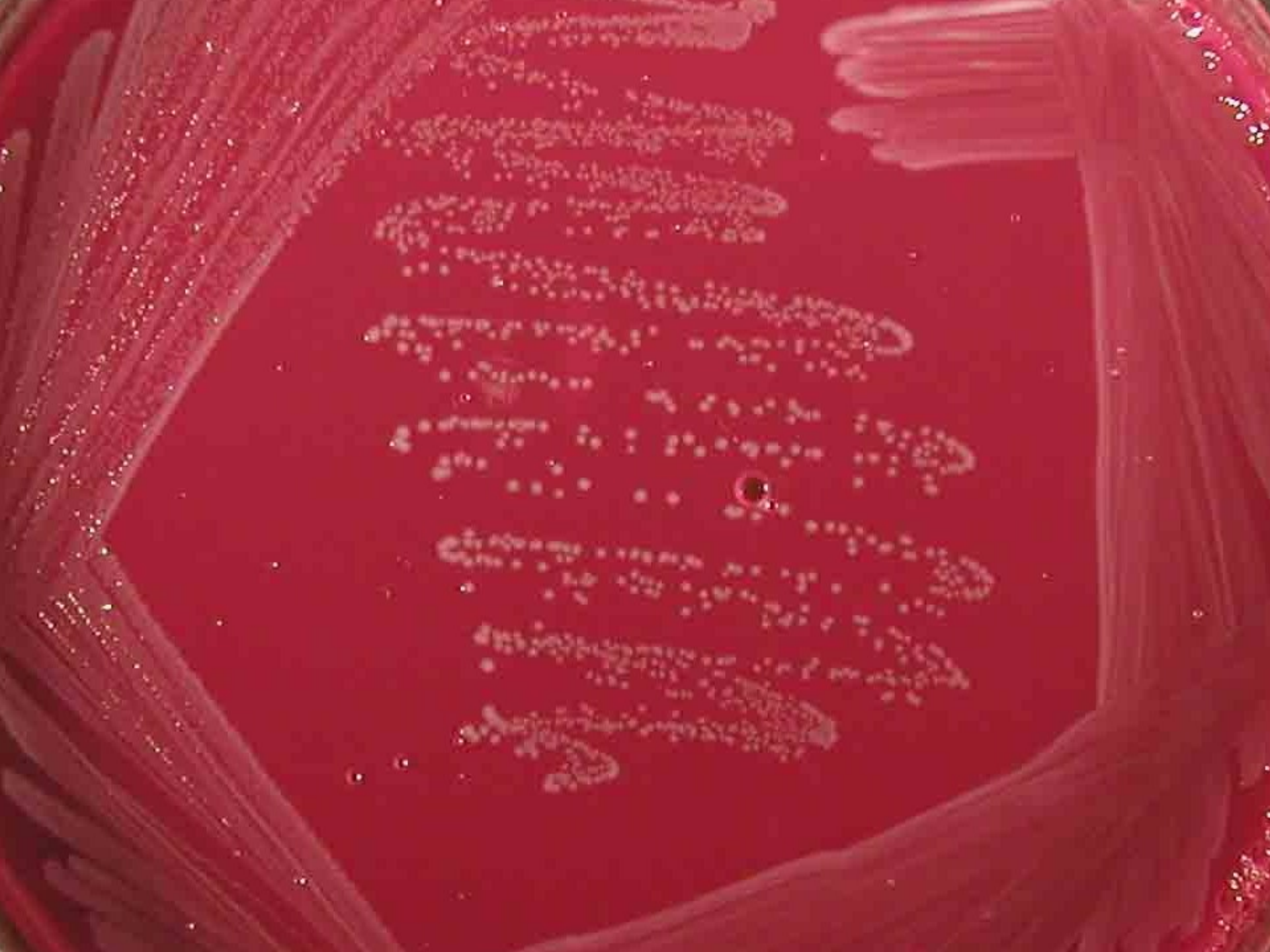


http://images.google.cz

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)

impor-tance	GBS	Haem. infl. b	Neiss. men.	other	Str. pneu.	List. mono.
letha-lity					†	†
seque-lae		+++		+	+	+

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

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


CCHFV
(nairovirus,
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chikungunya v.
(alphavirus)
Toscana v.
(phlebovirus,
Italy)
dengue v.
(flavivirus,
Greece)

Etiology of chronic meningitis

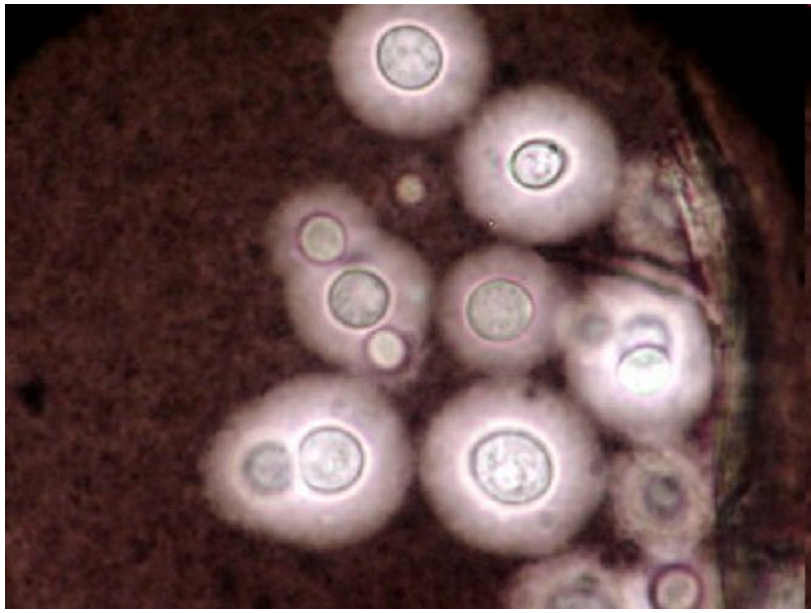
Bacteria: ***Mycobacterium tuberculosis***

(meningitis basilaris)

Moulds and yeasts:

aspergilli

Cryptococcus neoformans



http://www.icu.cn

Cystic lesions resulting from accumulation of organisms in perivascular spaces

aapredbook.aappublications.org

Etiology of encephalitis

Encephalitis – only acute, of viral origin:

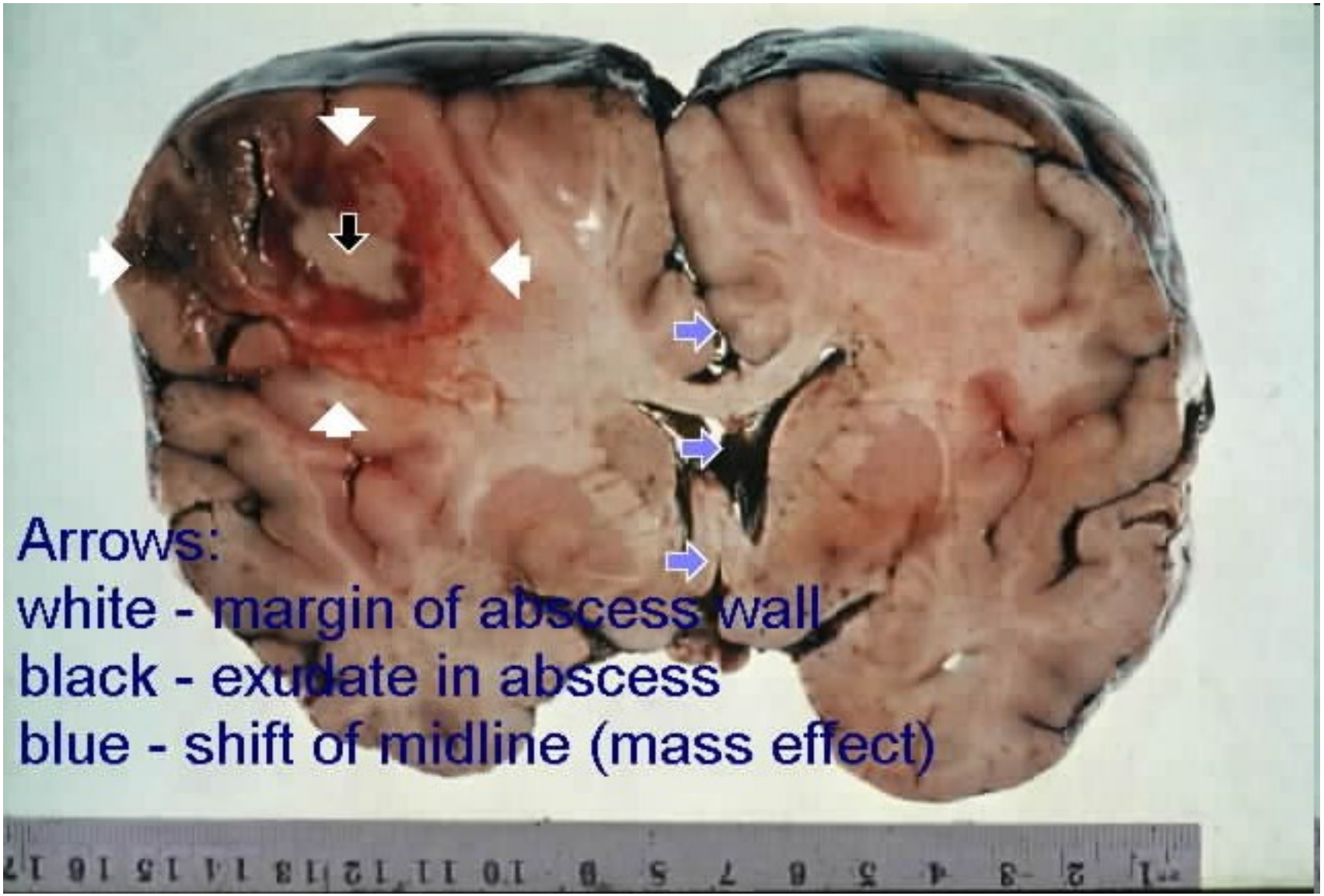
- **tick-borne encephalitis v.**
- **HSV**
- **enteroviruses**
- **mumps v.**

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



http://www.pathology.med.ohio-state.edu

Etiology of chronic brain abscess

Bacteria:

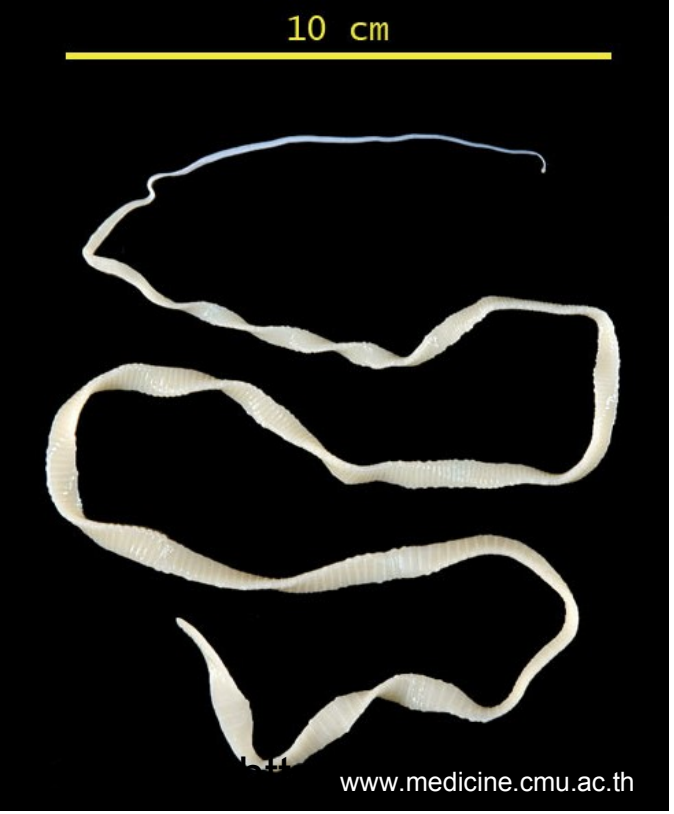
- ***Mycobacterium tuberculosis***
- ***Nocardia asteroides***

Mycotic organisms:

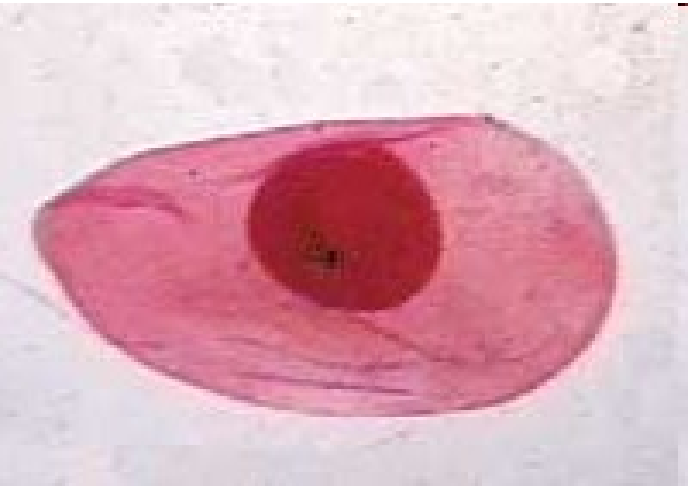
- ***Cryptococcus neoformans*** **(yeast)**

Parasites:

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



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.)

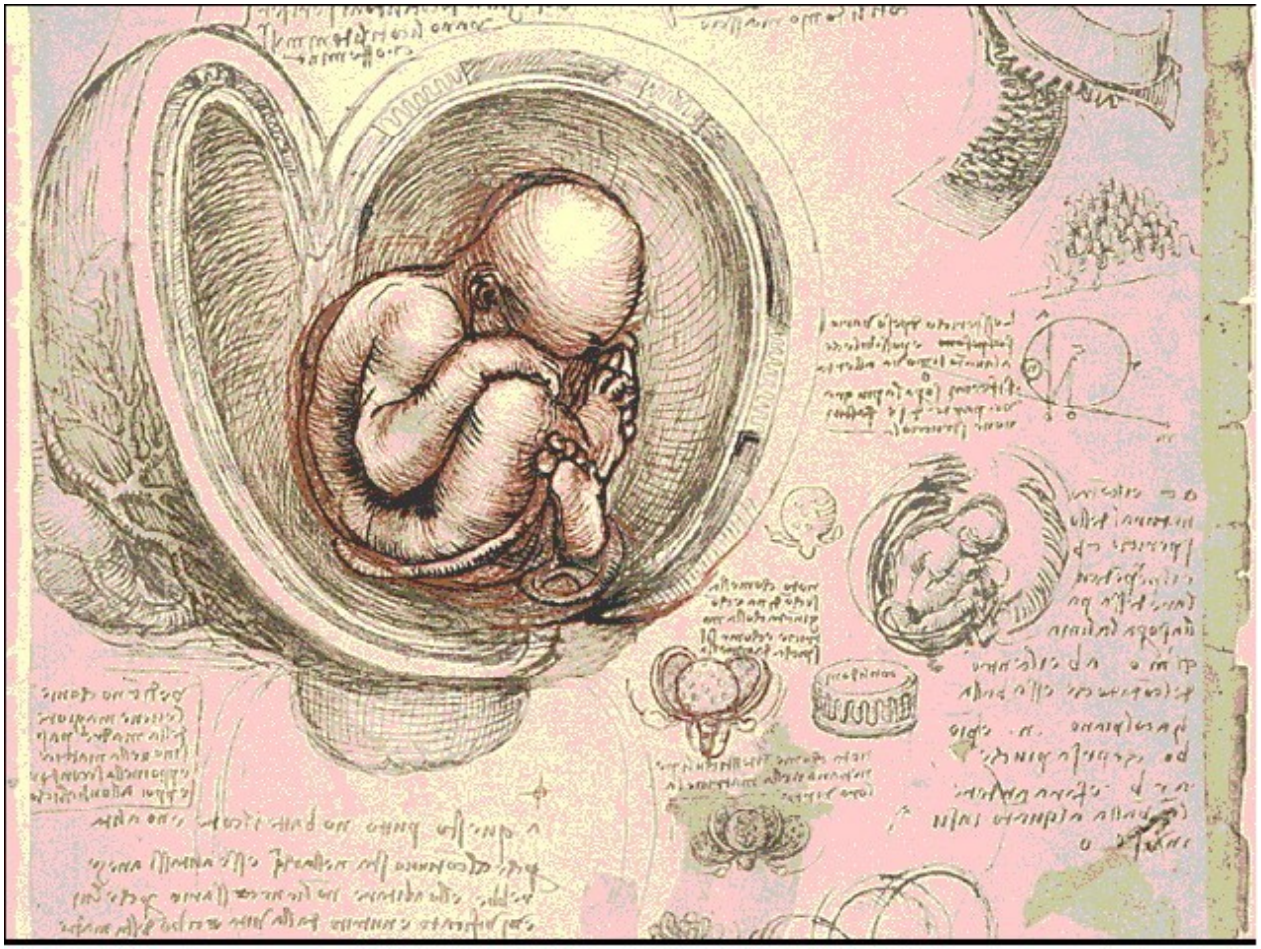
Left: A pork tapeworm (*T.solium*) cysticercus, the form in which the tapeworm is found in an infected brain.

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

http://eands.caltech.edu/articles/LXVI4/brainworms.html

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?