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

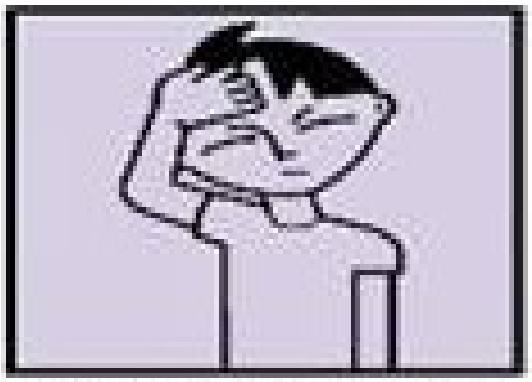
Agents of neuroinfections

Central nervous system infections

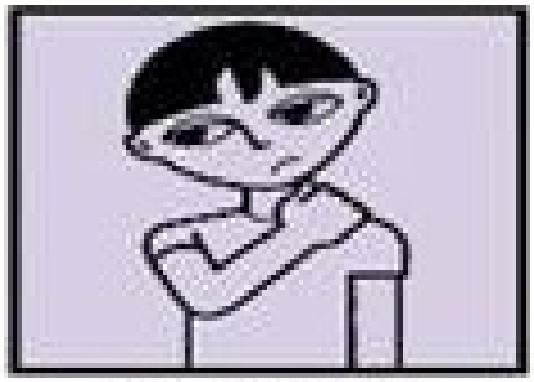
- relatively rare
- can have a very serious course
- Incidence
  bacterial meningitis: 2/100.000/year
  viral meningitis: 10/100.000/year
- Lethality
  bacterial meningitis, non-treated: >70 %
  treated: ~10 %

Penetration into CNS

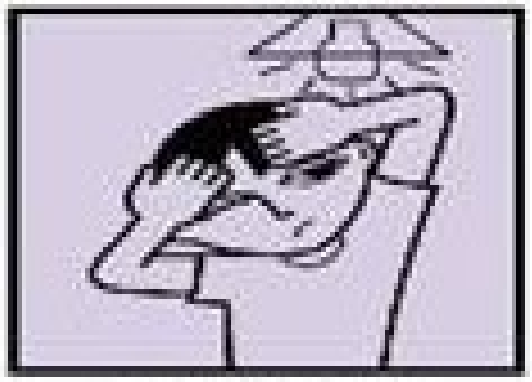
- **From a peripheral focus:**
  by means of blood (meningococci)
  per continuitatem (pneumococci or haemophili from the middle ear)
  along nerves (HSV, rabies virus)
- **Directly:**
  after an injury (pneumococci, staphylococci, nocardiae, aspergilli)



Severe headache

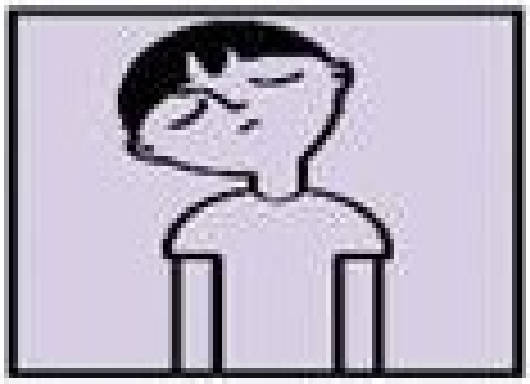


Stiff neck

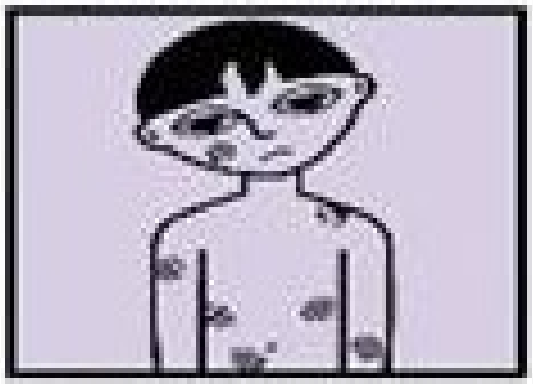


Dislike of bright lights

Fever/vomiting



Drowsy and less responsive/ vacant



Rash (develops anywhere on body)

http://www.dcu.ie

Etiology of CNS infections

...depends on the type and the duration of the disease, different in....

1. meningitis
- acute bacterial (purulent)/viral (aseptic)
- chronic
2. encephalitis
3. brain abscess – acute or chronic

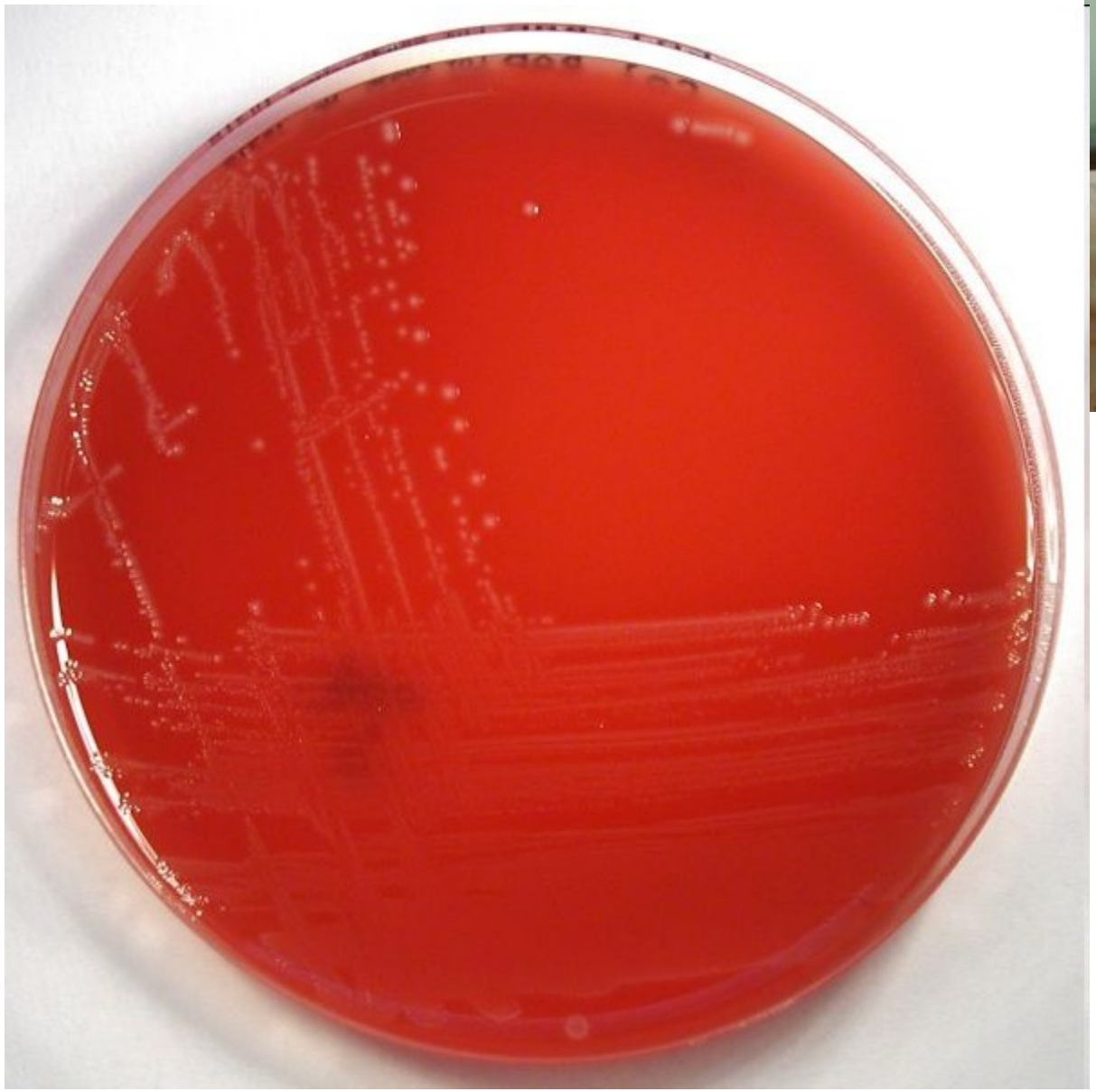
Cytology and biochemistry of CSF

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 – I

Etiology of purulent meningitis by the age in %

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

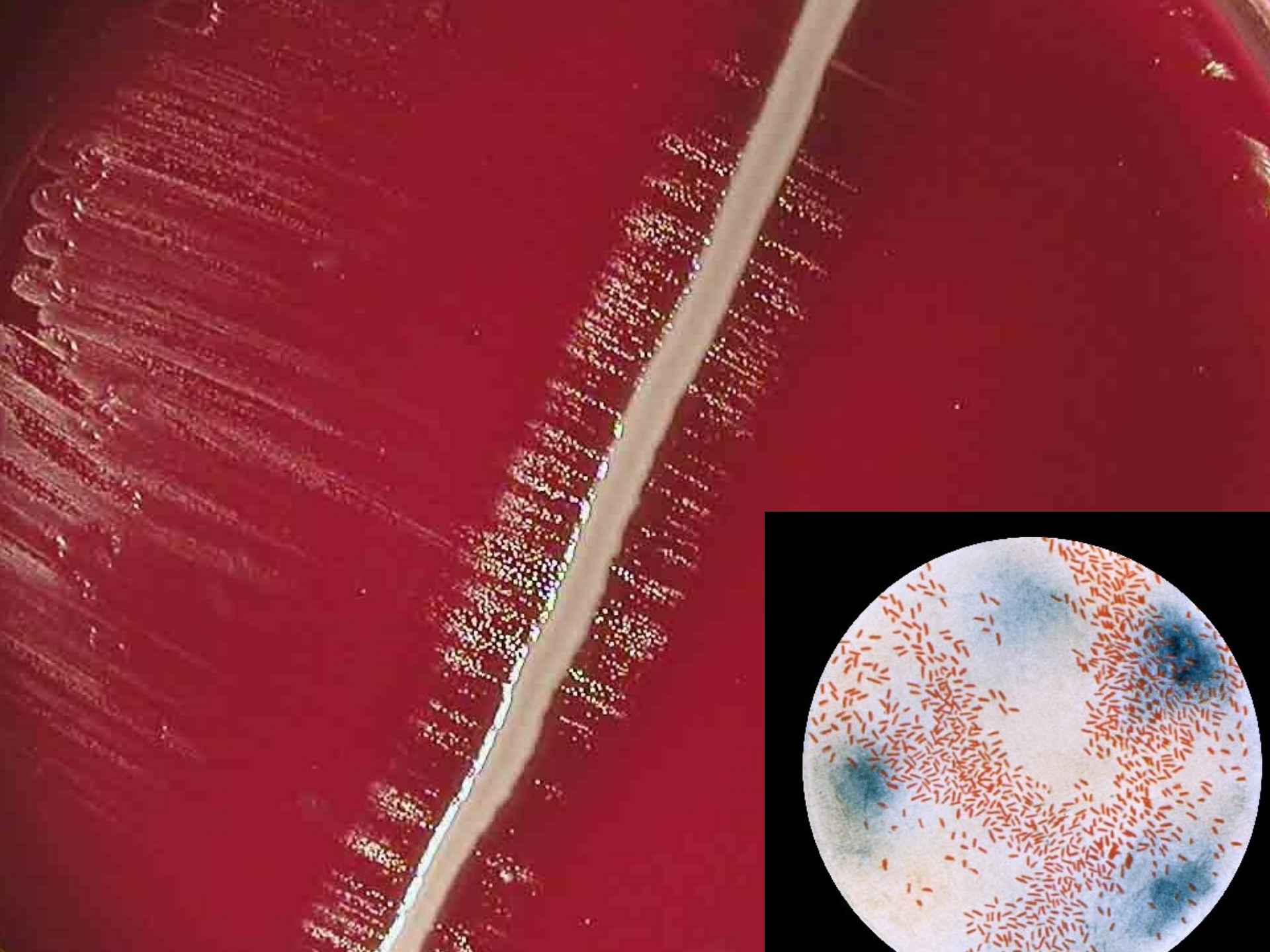


www.bakteriologieatlas.de

Etiology of acute meningitis – II

Etiology of purulent meningitis by the age in %

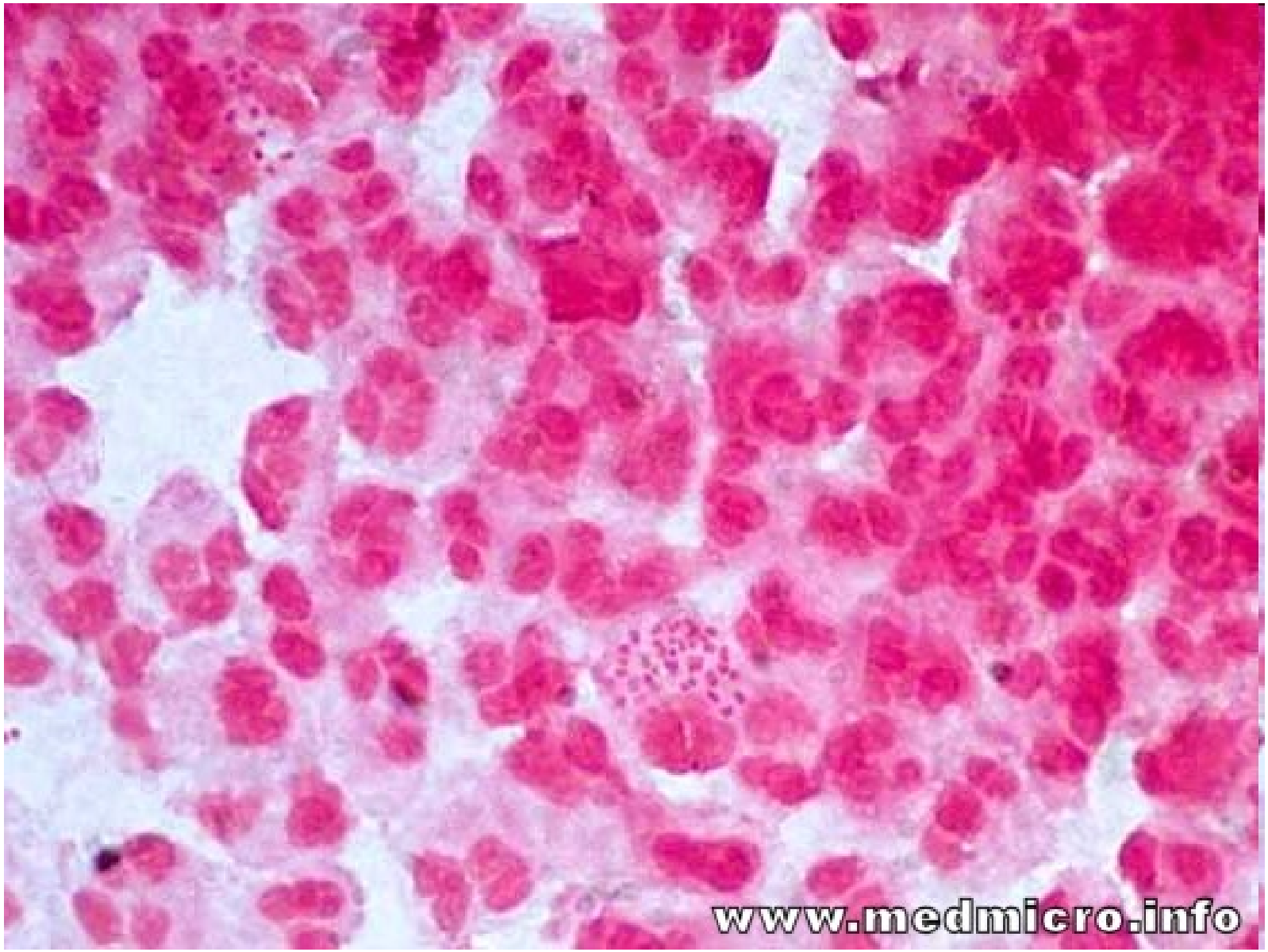
age	GBS	Haem. infl. b				
0-1 m.	50					
1-4 y.		70				
5-29						
30-59						
≥60						



Etiology of acute meningitis – III

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 – IV

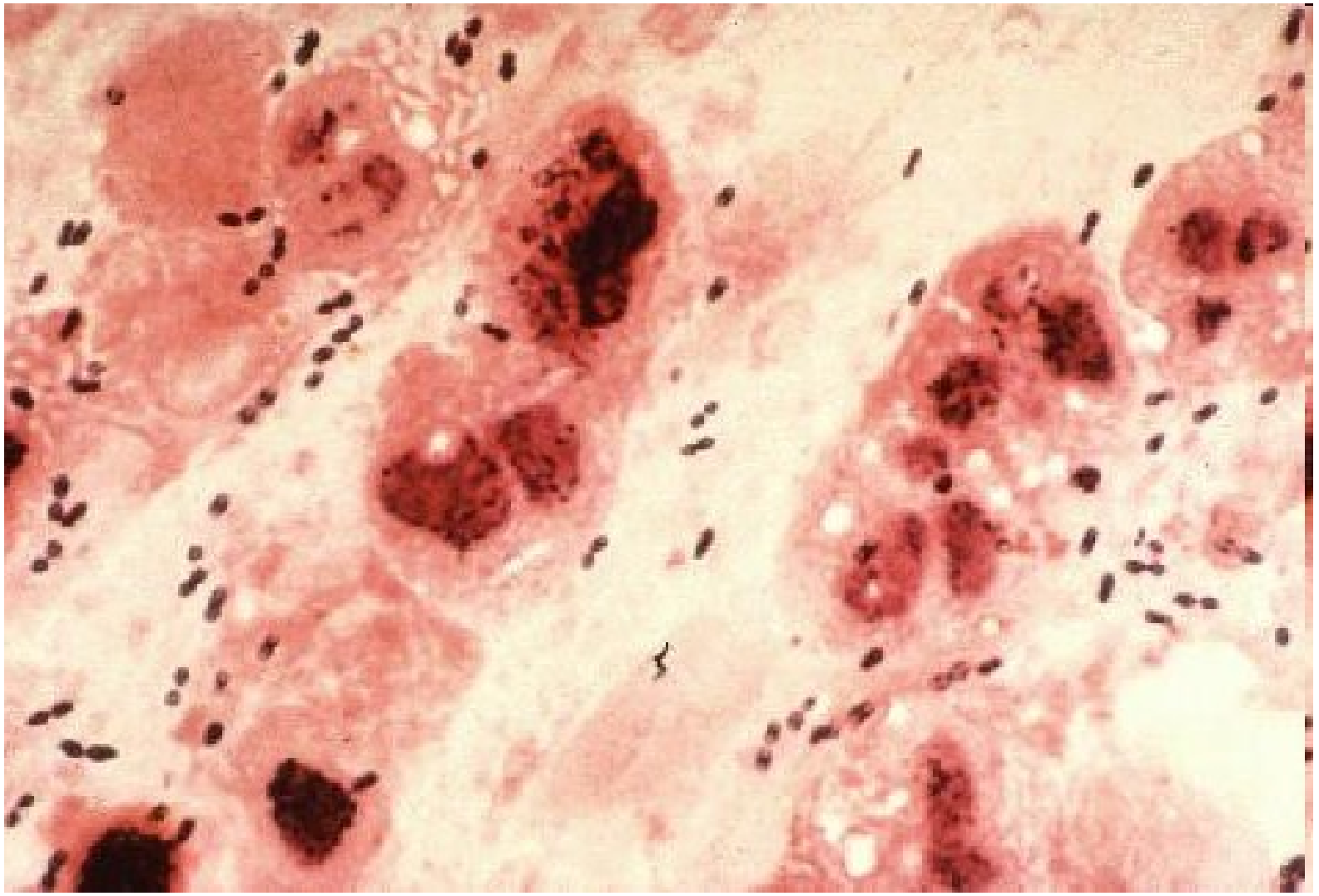
Etiology of purulent meningitis by the age in %

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

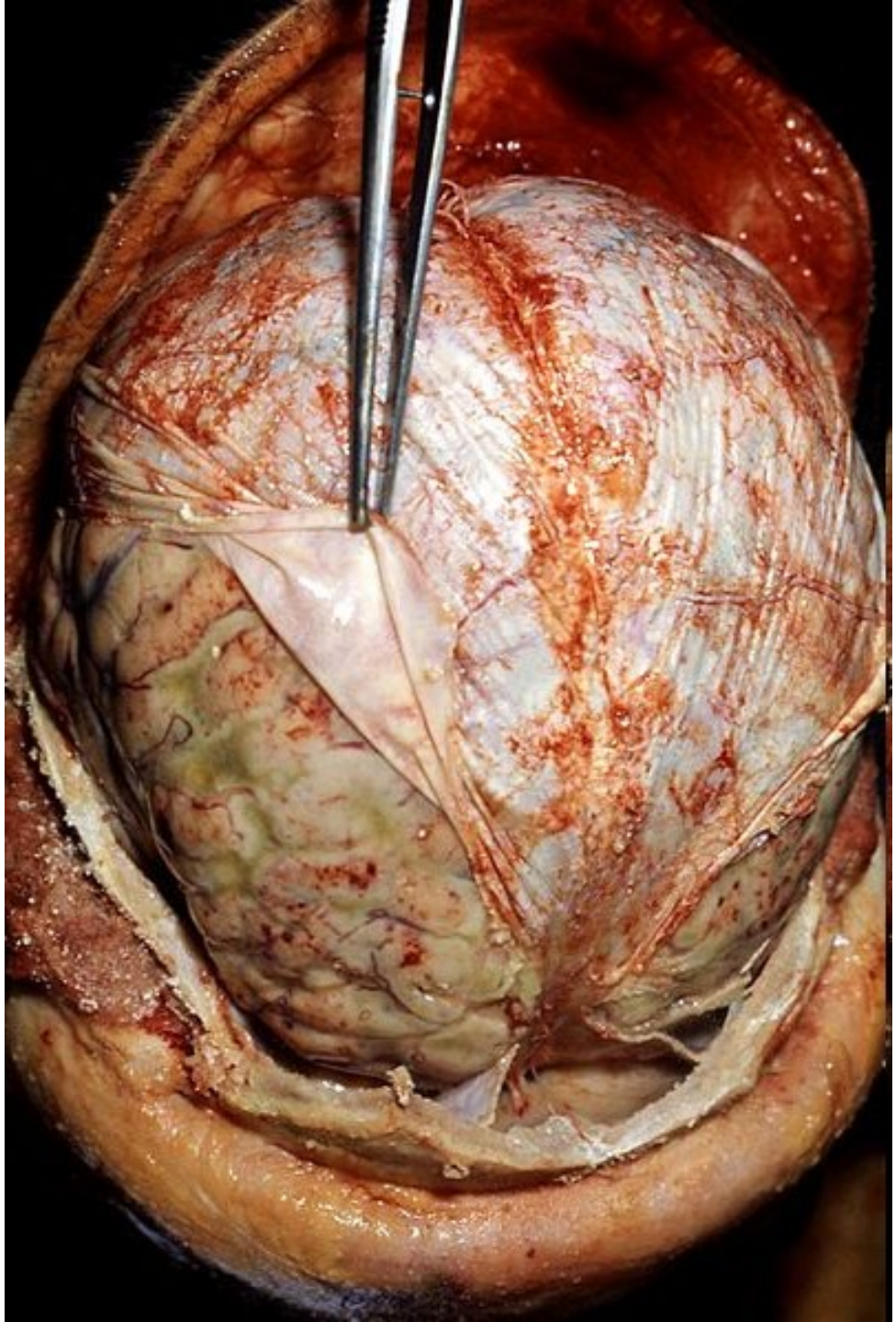
Etiology of acute meningitis – V

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

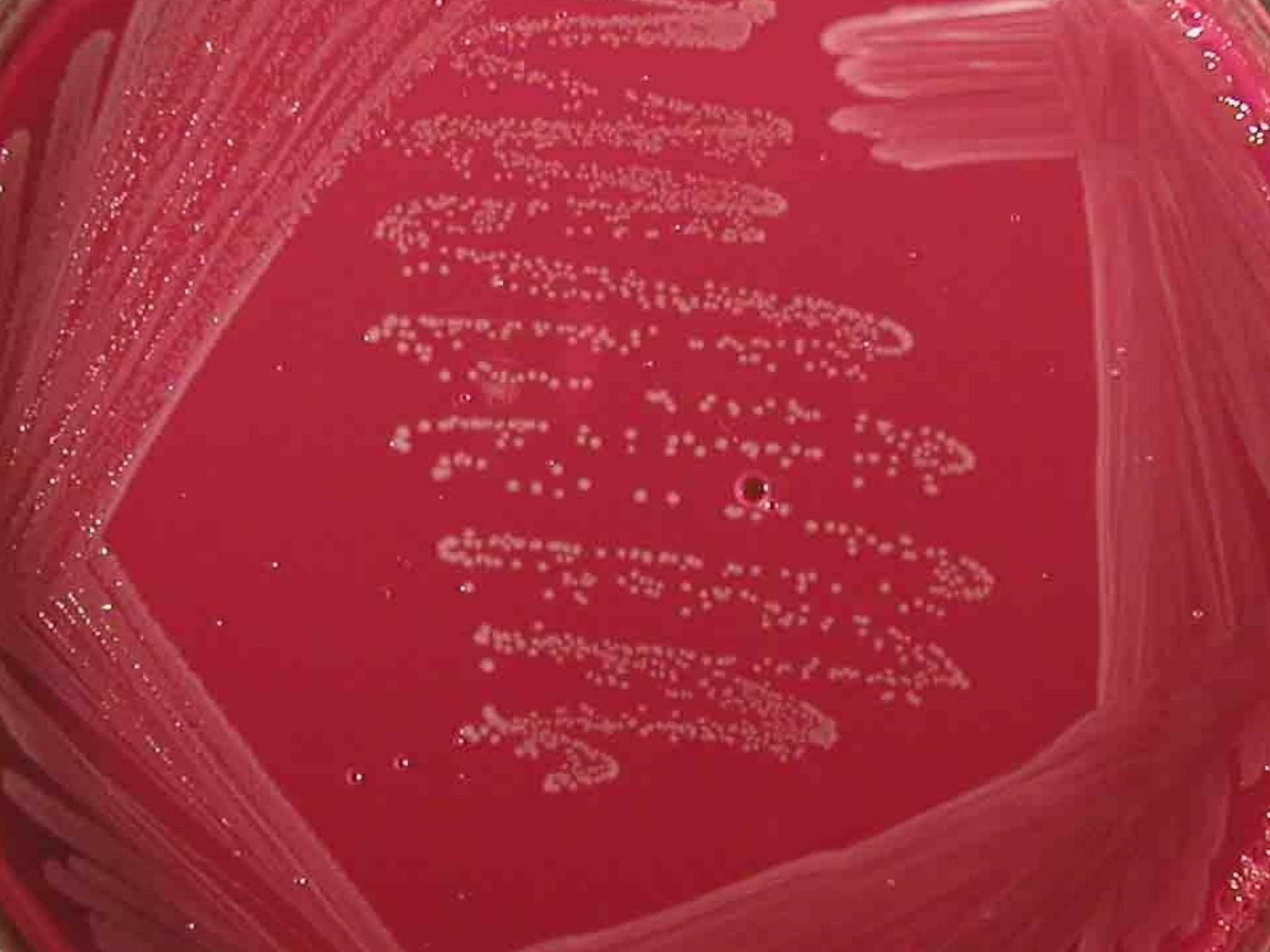


http://images.google.cz

Etiology of acute meningitis – VI

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



Lethality and sequelae of purulent meningitis

....according to etiology

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

Aseptic (viral) meningitis

mumps virus (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, M. tuberculosis

Etiology of chronic meningitis

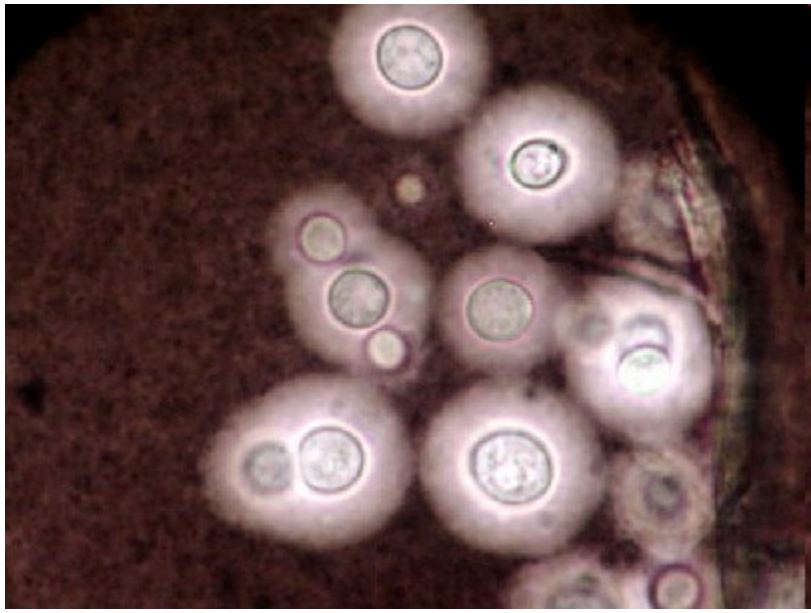
Bacteria: ***Mycobacterium tuberculosis***

(meningitis basilaris)

Moulds and yeasts:

aspergilli

Cryptococcus neoformans



http://www.icu.cn

Etiology of encephalitis

Encephalitis – only acute, of viral origin:

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

Mumps parotitis with cervical and presternal edema and erythema

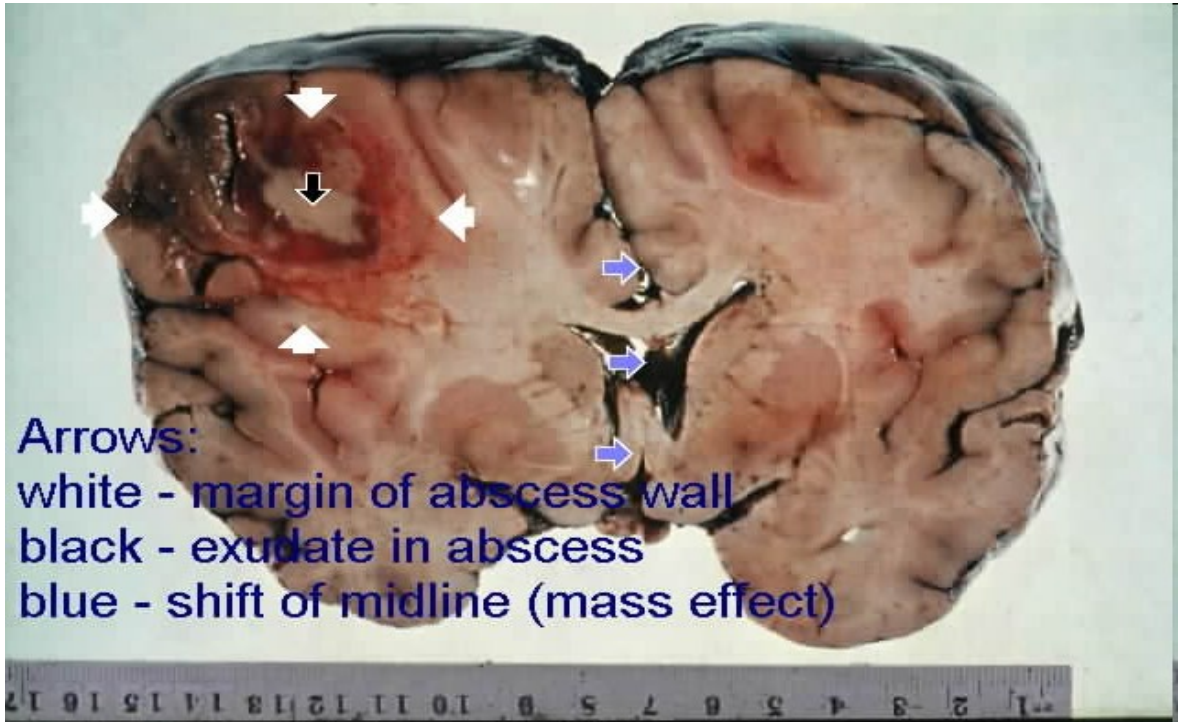
Cystic lesions resulting from accumulation of organisms in perivascular spaces

aapredbook.aappublications.org

Etiology of acute brain abscess

.....always bacterial:

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



Etiology of chronic brain abscess

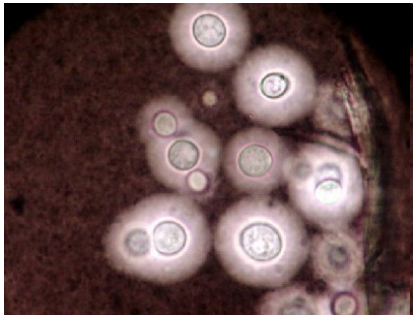
Bacteria:

Mycobacterium tuberculosis

Nocardia asteroides

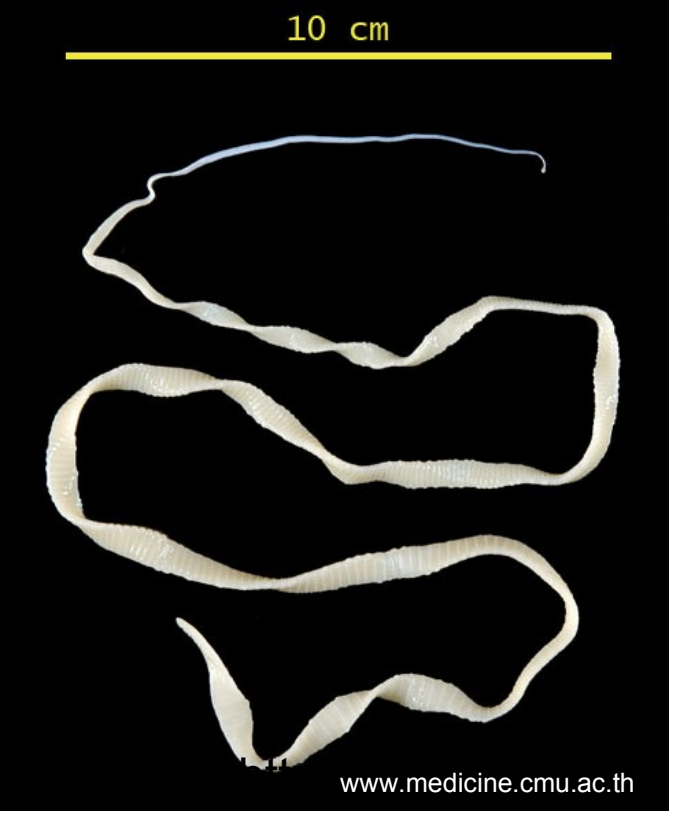
Mycotic organisms:

***Cryptococcus neoformans* (yeast)**



Parasites:

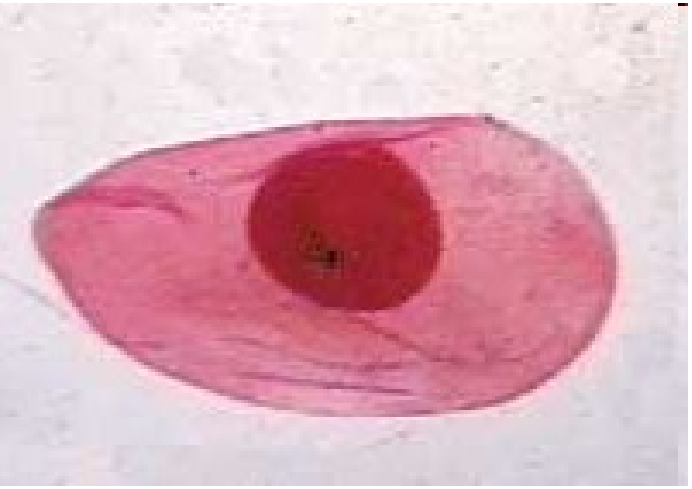
***Cysticercus cellulosae* (tissue form of pork tapeworm *Taenia solium*)**



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

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