

**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



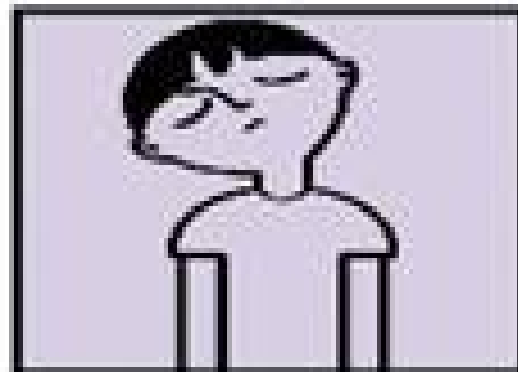
Stiff neck



Dislike of  
bright lights



Fever/vomiting



Drowsy and less  
responsive/  
vacant



Rash (develops  
anywhere on  
body)



# 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

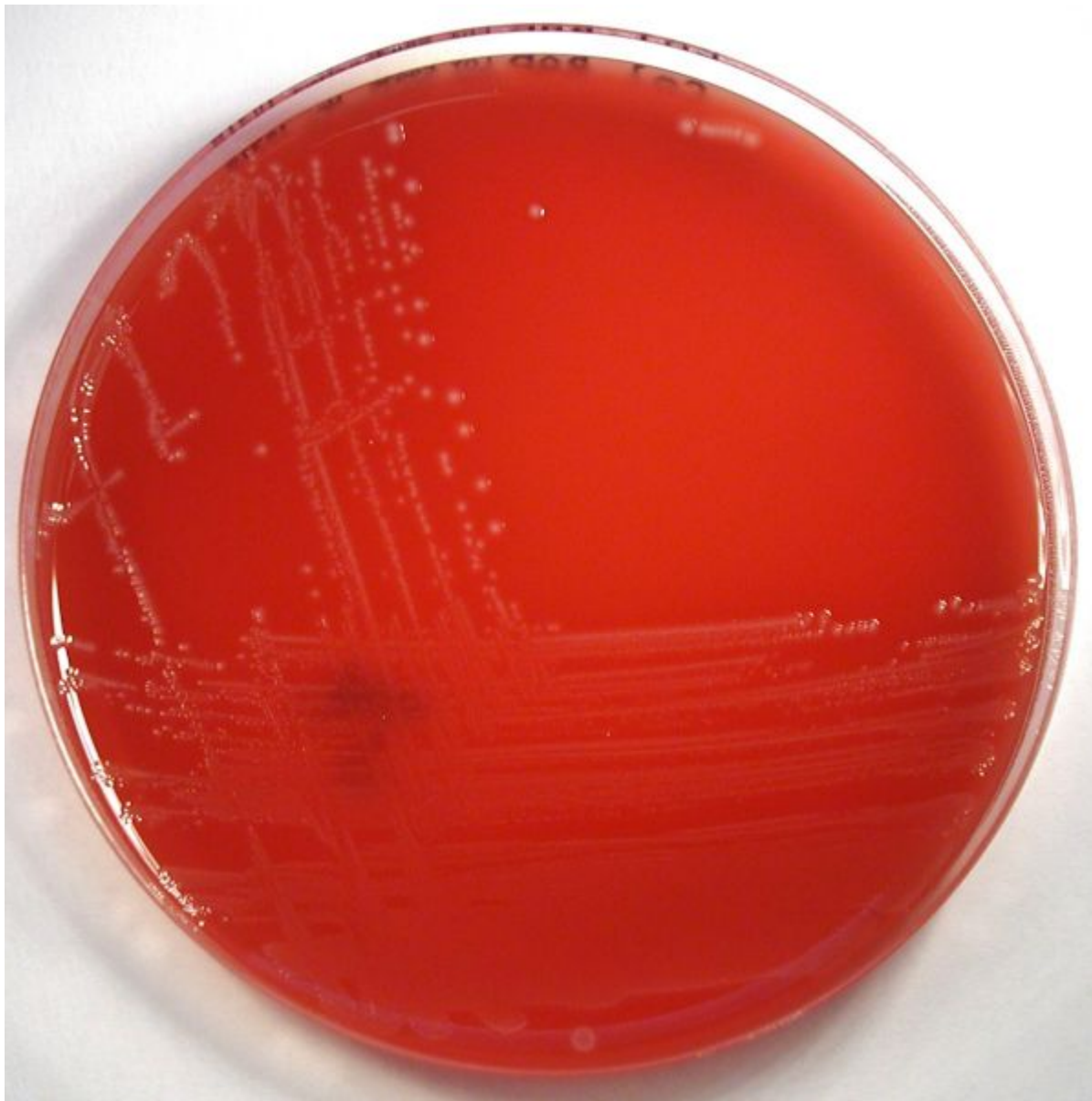
# Cytology and biochemistry of CSF

marker	norm	purulent meningitis	aseptic meningitis
cells	0-6/ $\mu$ 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 – I

## Etiology of purulent meningitis by the age in %

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

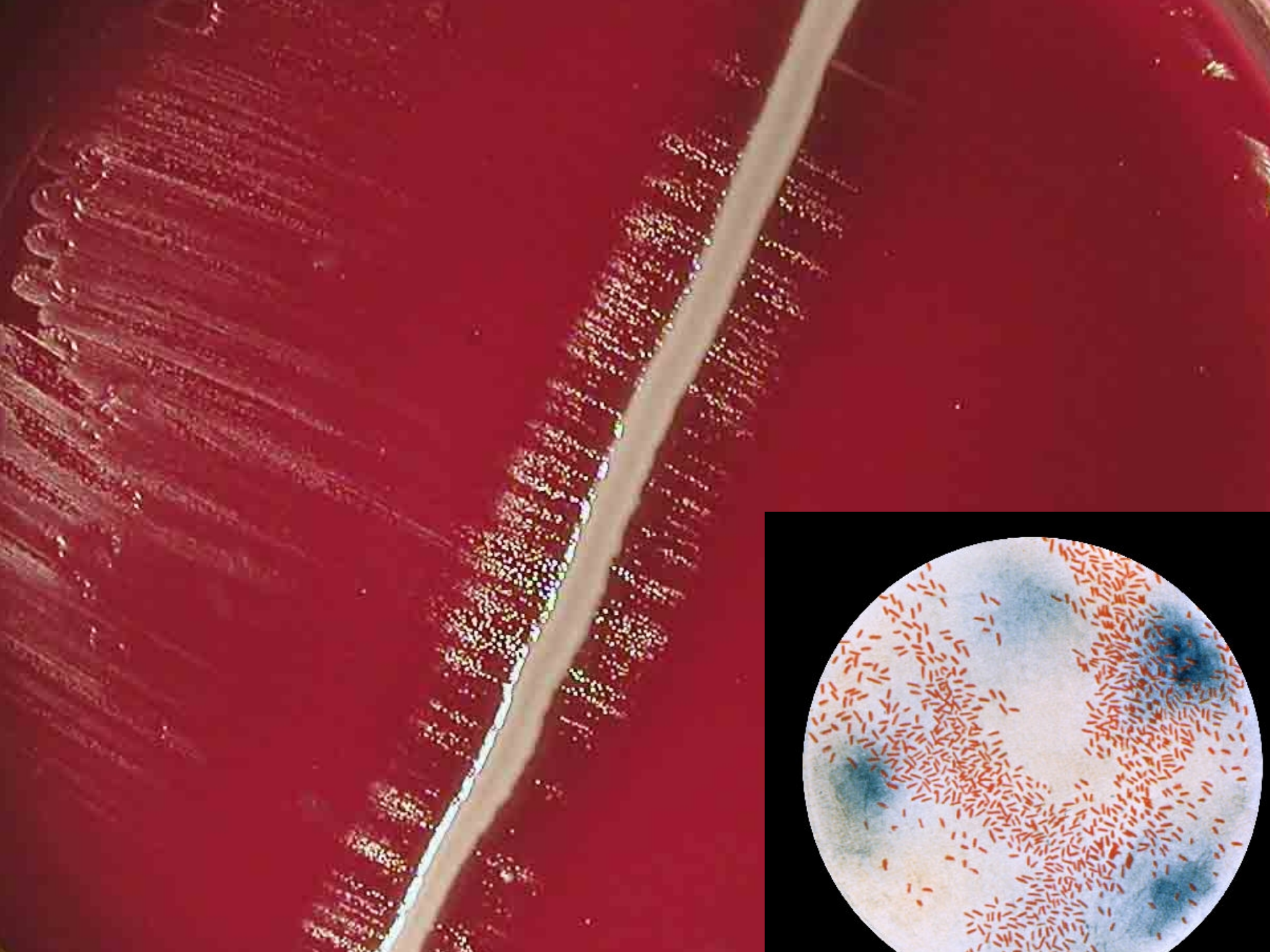


[www.bakteriologieatlas.de](http://www.bakteriologieatlas.de)

# 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						

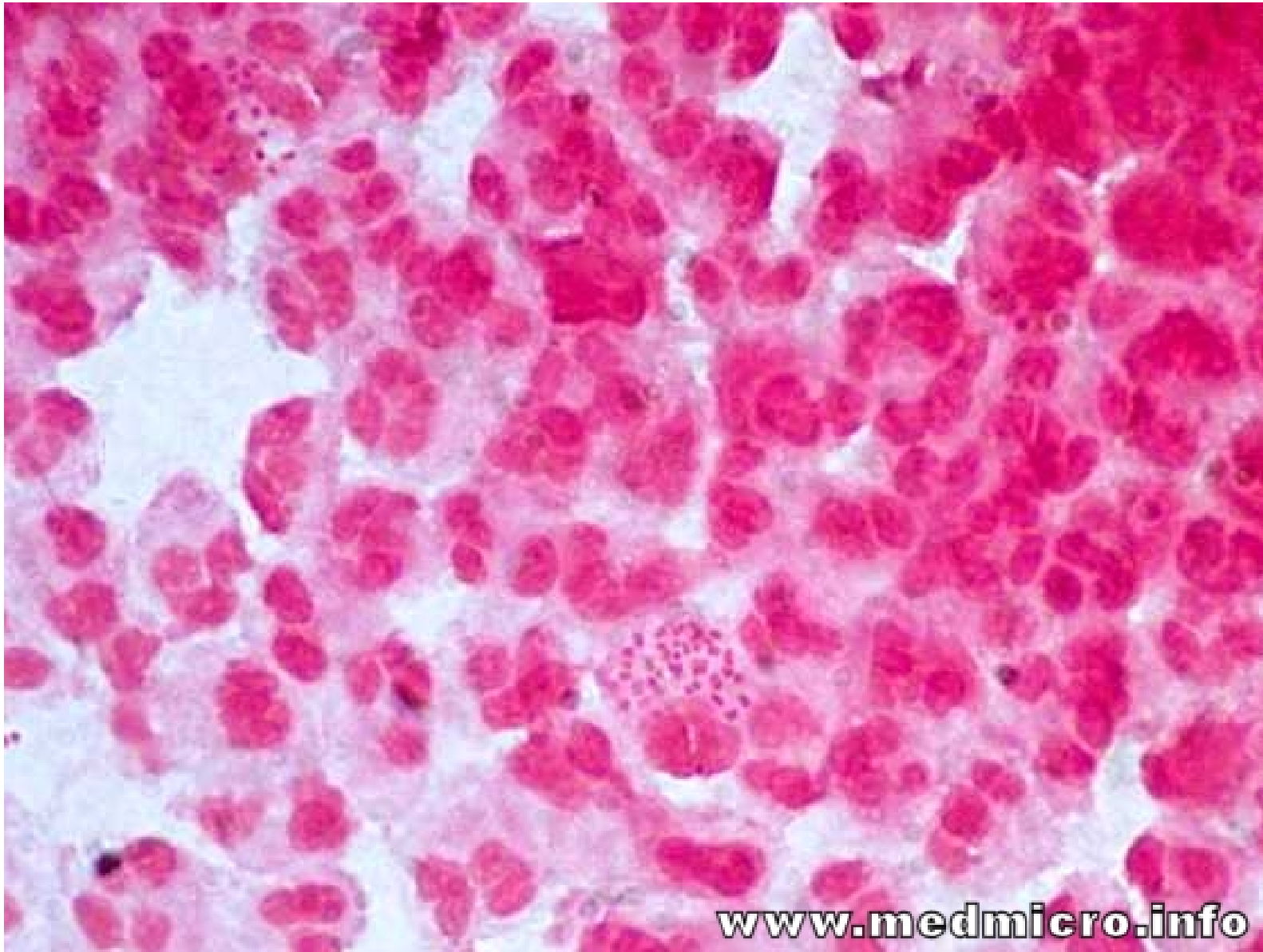


# Etiology of acute meningitis – III

## 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						









# Etiology of acute meningitis – IV

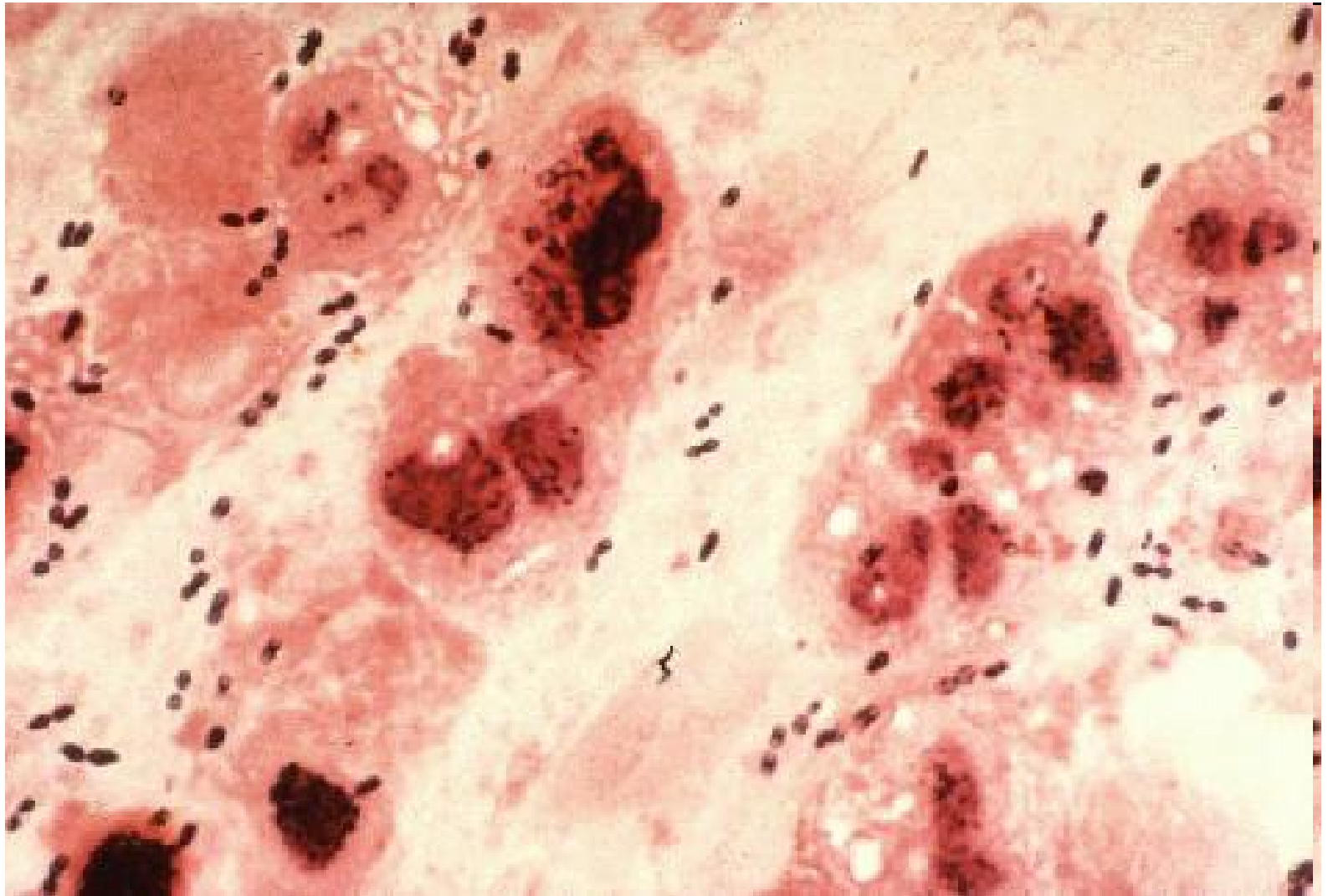
## Etiology of purulent meningitis by the age in %

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

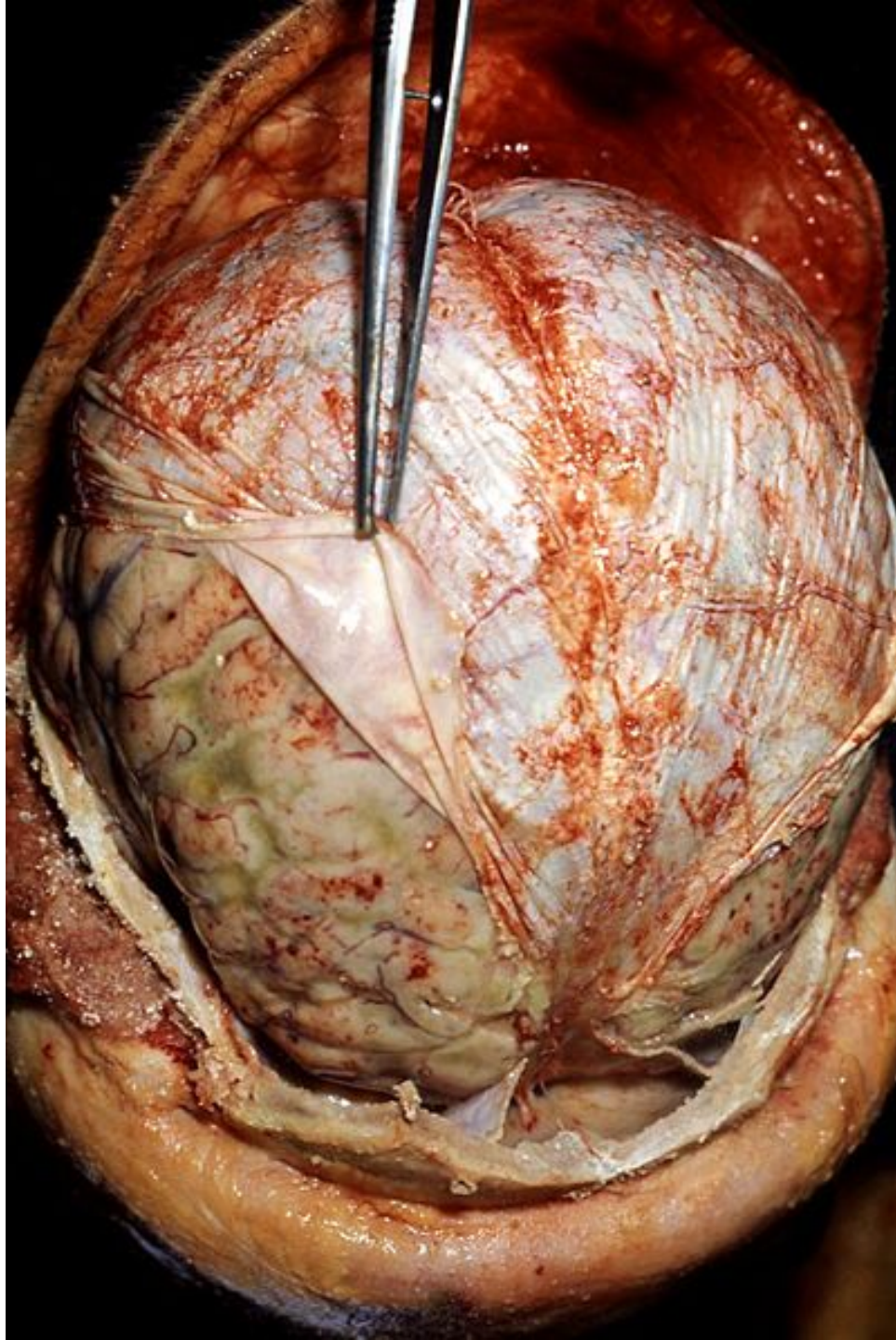
# Etiology of acute meningitis – V

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		



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



# 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	





# Lethality and sequelae of purulent meningitis

## ....according to etiology

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



# **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*



# 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

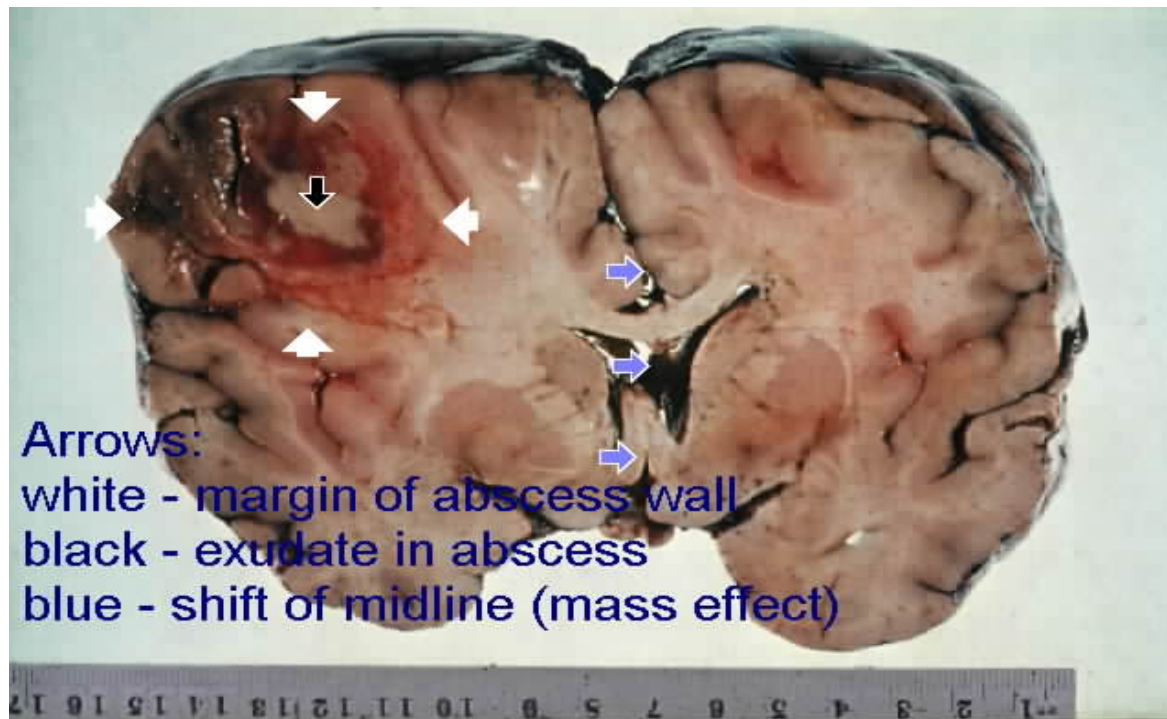


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# Etiology of acute brain abscess

.....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*)



10 cm



www.medicine.cmu.ac.th



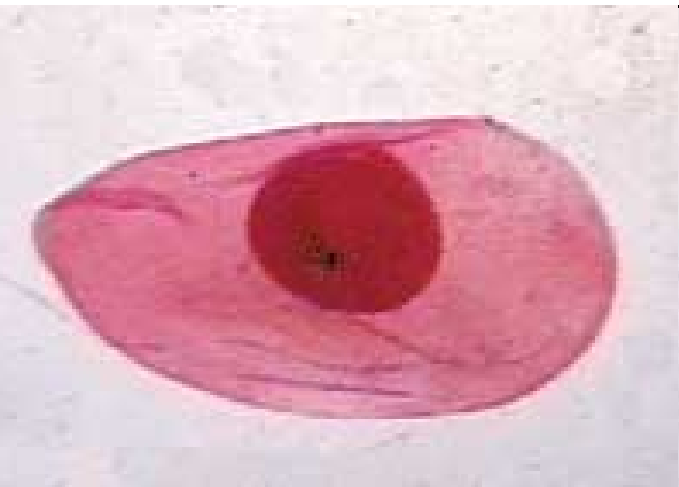
**Top: *Taenia solium* cysticerci** in the brain of a nine-year-old girl who died during cerebrospinal fluid extraction to diagnose her headaches.

**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.)



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

