

**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



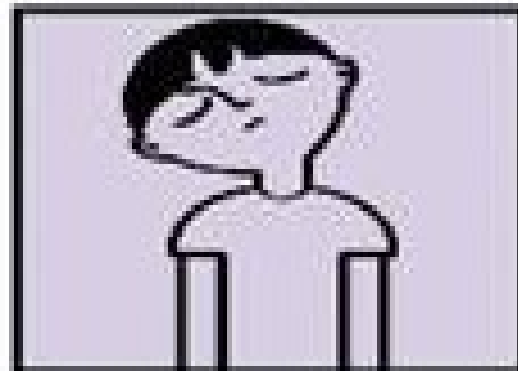
Stiff neck



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

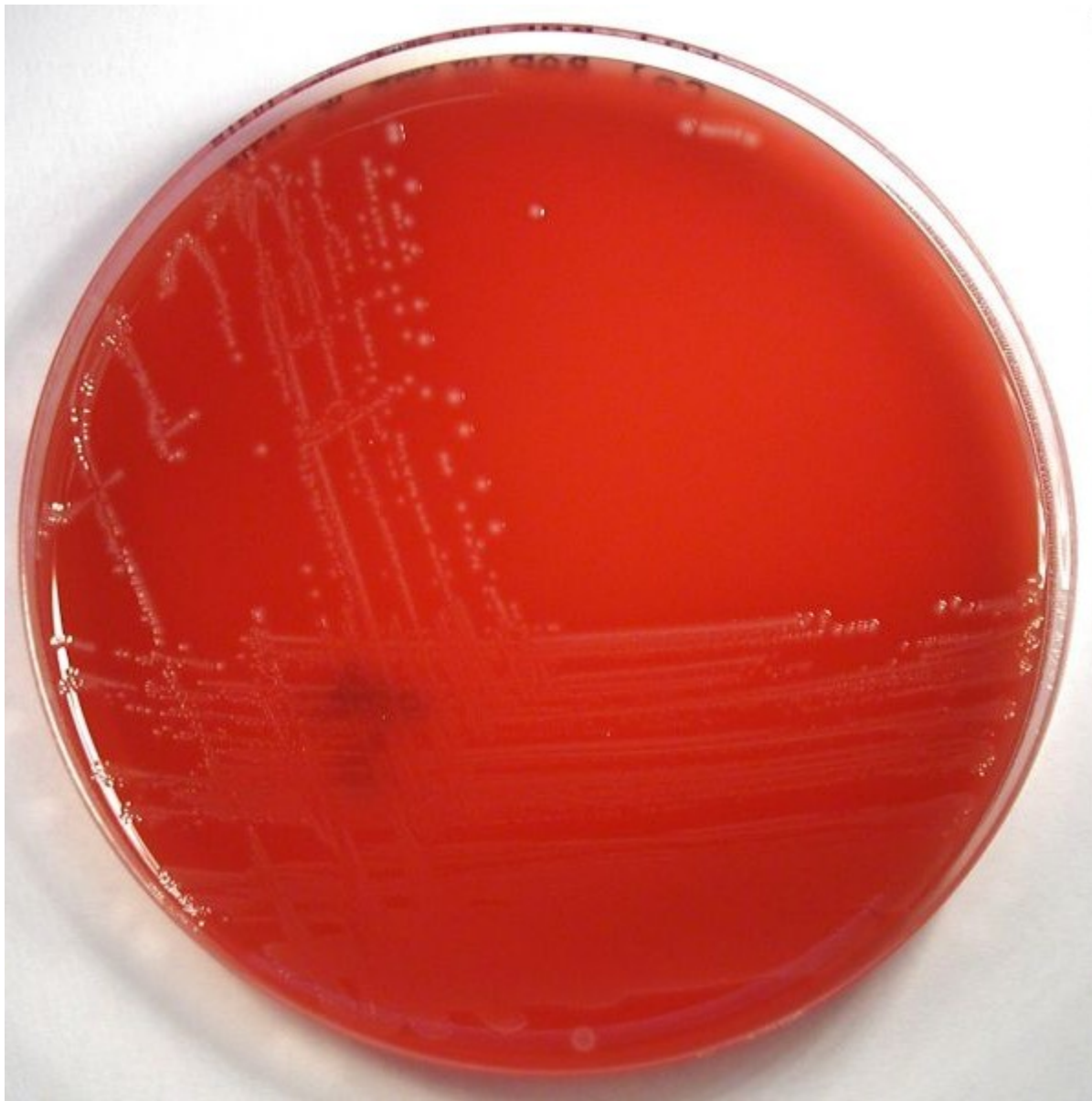
# Cytology and biochemistry of CSF

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						



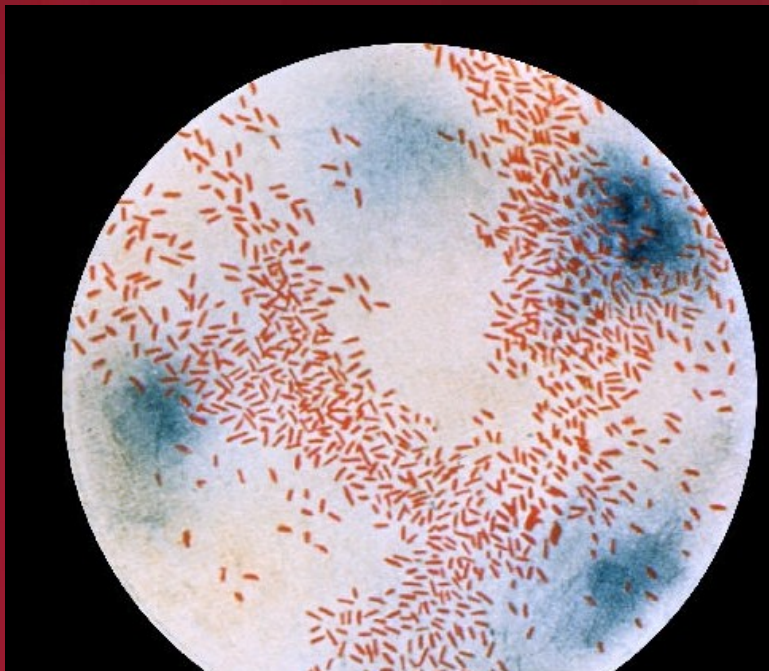
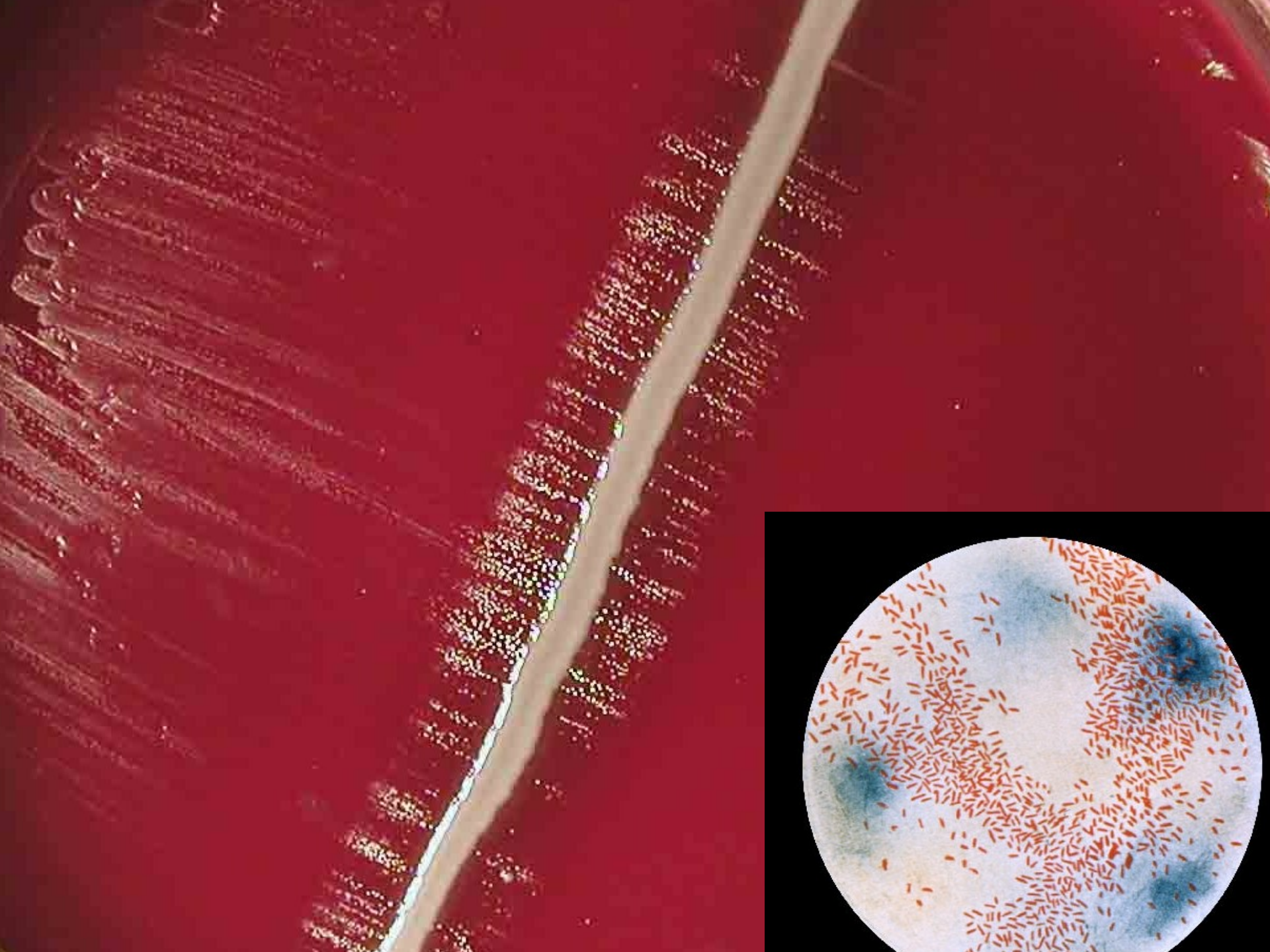
[www.bakteriologieatlas.de](http://www.bakteriologieatlas.de)



# Etiology of acute meningitis – II

Etiology of purulent meningitis by the age in %

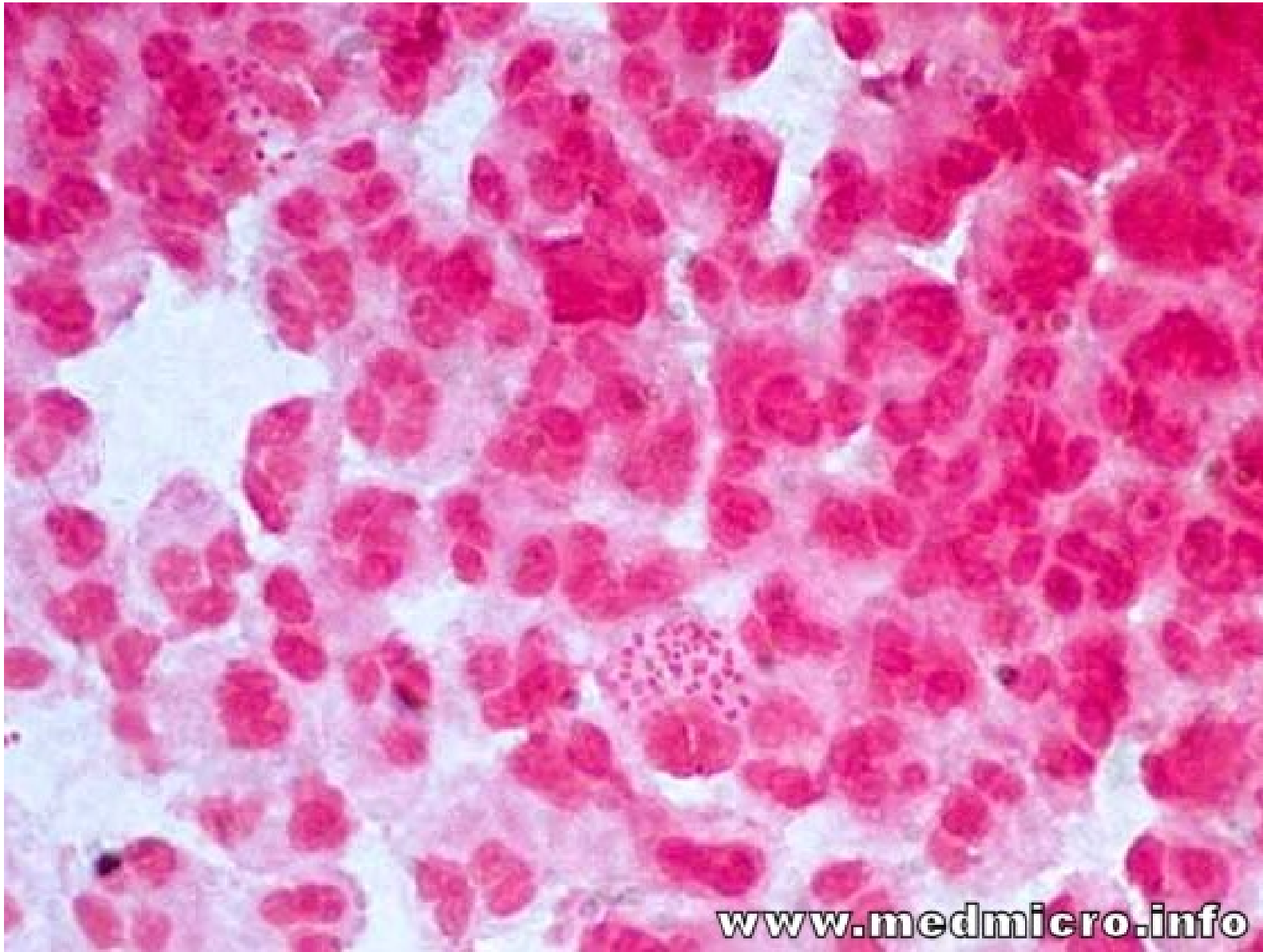
age	GBS	Haem. infl. b				
0-1 m.	50					
1-4 y.		70				
5-29						
30-59						
≥60						



# 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

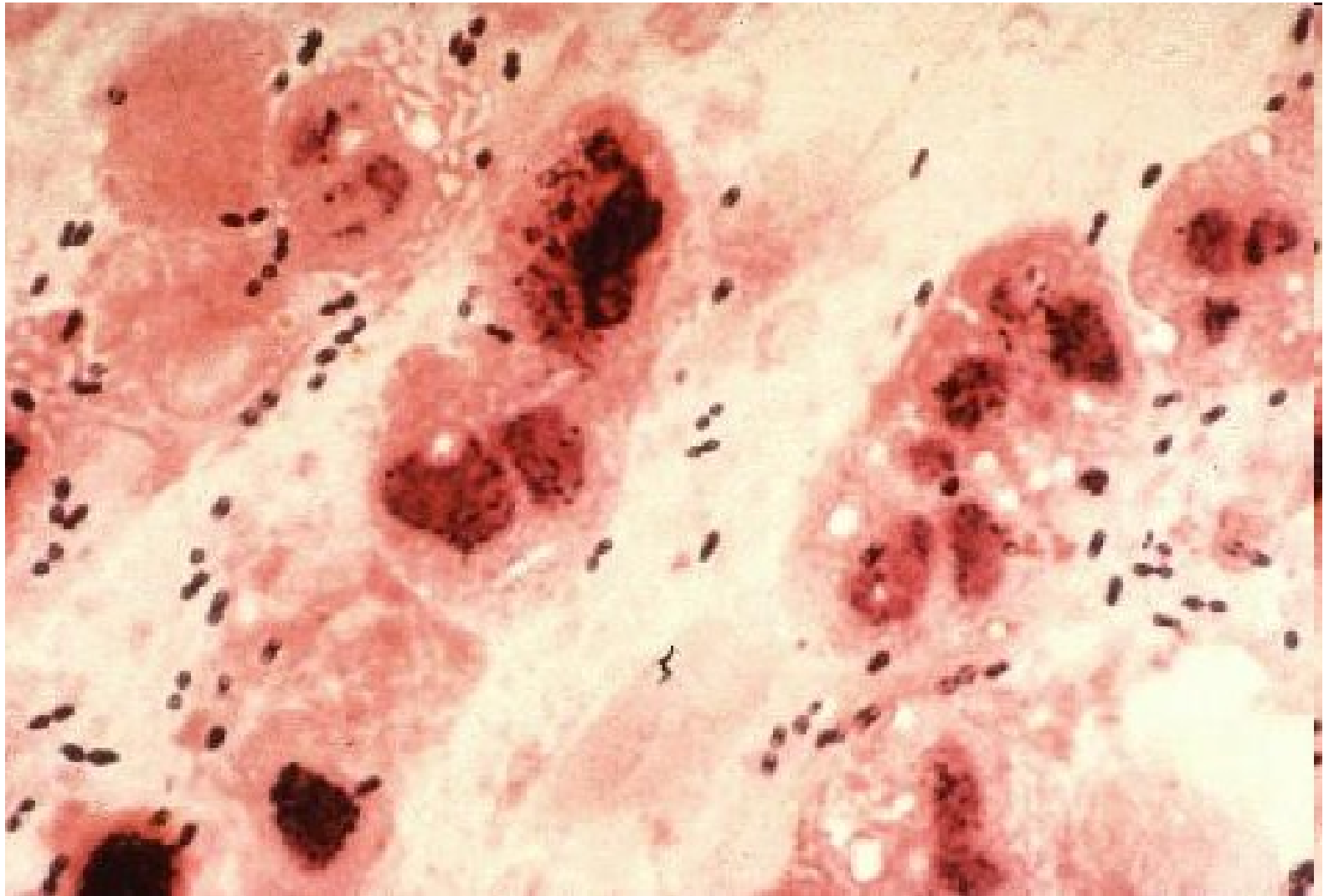
## Etiology of purulent meningitis by the age in %

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

# Etiology of acute meningitis – V

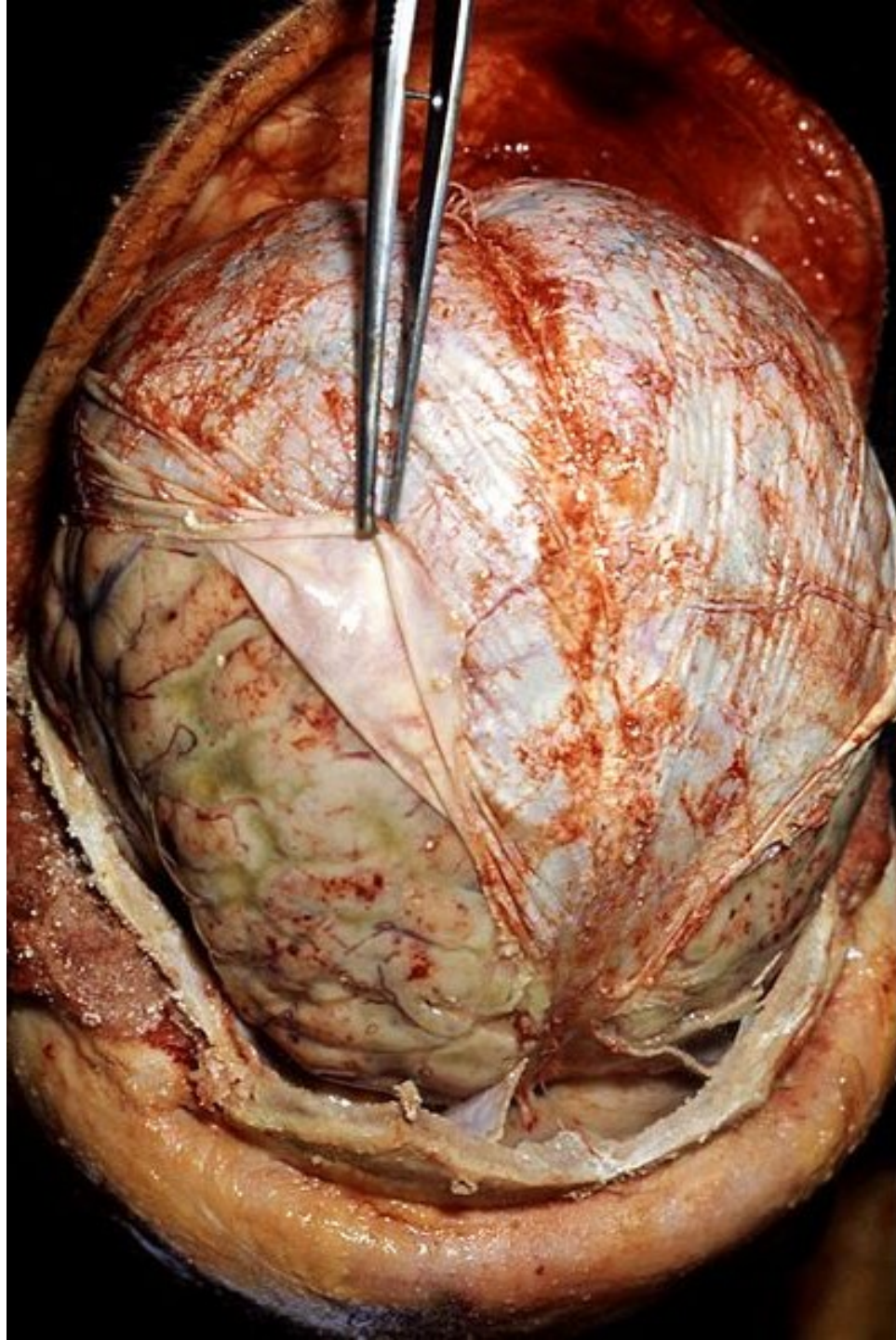
Etiology of purulent meningitis by the age in %

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>

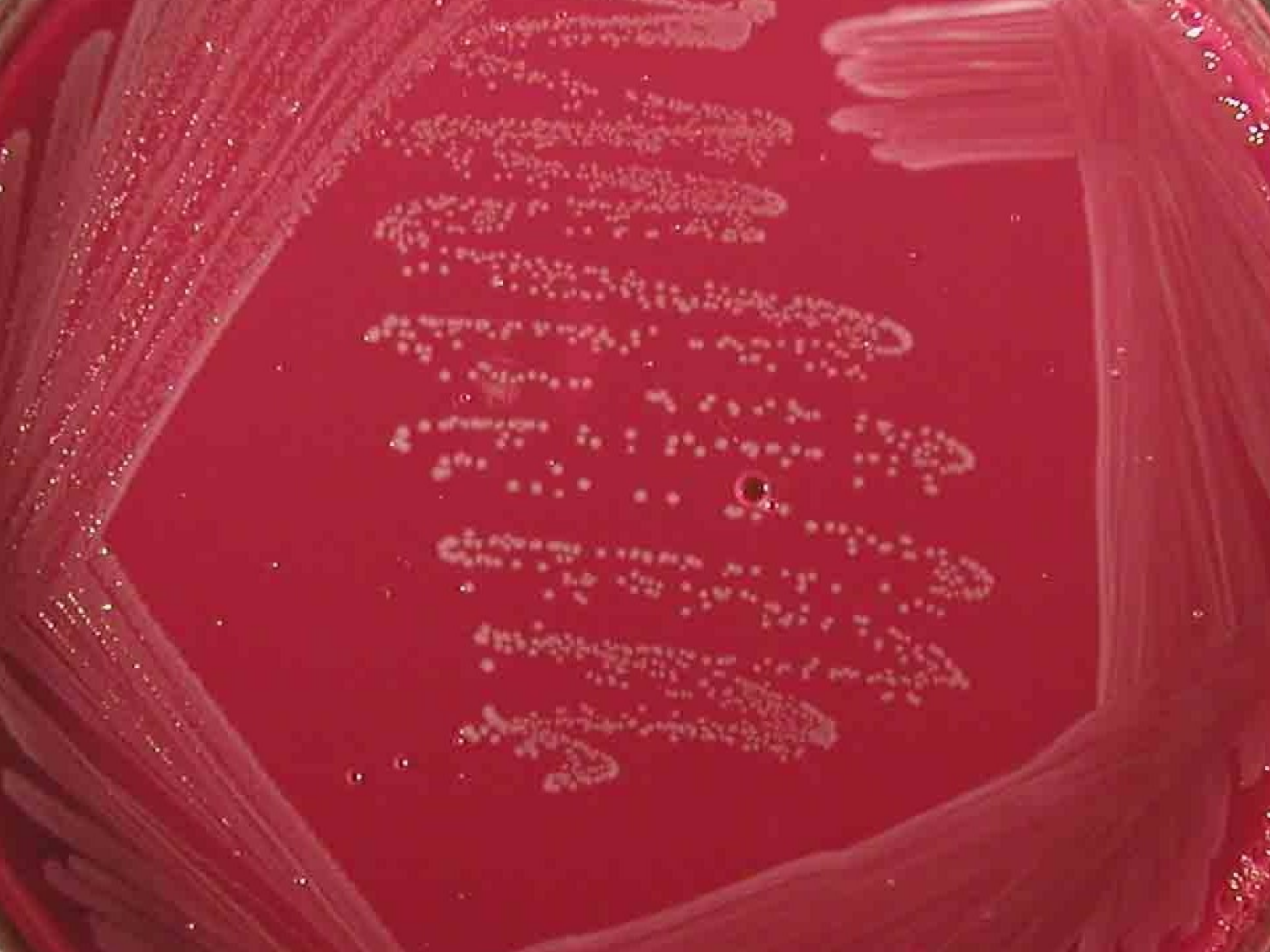




# Etiology of acute meningitis – VI

## 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

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



©Omnis Agamemolis MD



# 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



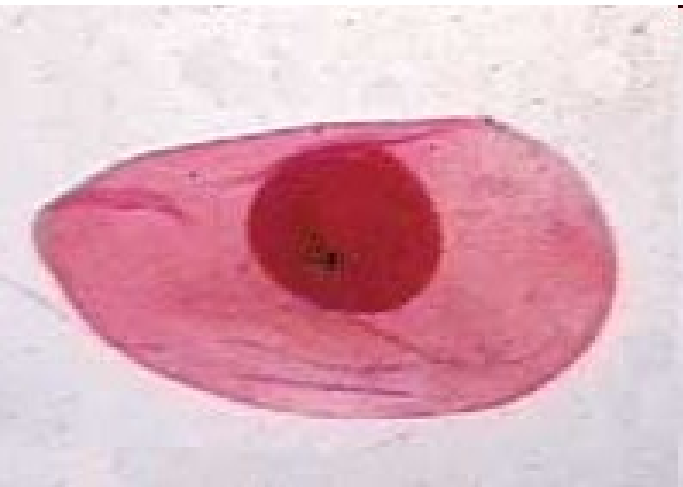
**Top: *Taenia solium cysticerci* in the brain of a nine-year-old girl who died during cerebrospinal fluid extraction to diagnose her headaches.**

**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)

