

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

**Miroslav Votava**

**Agents of urinary tract  
infections**

**The 6th lecture for 3rd-year students of dentistry  
7th December, 2010**

# Importance of central nervous system infections – revision

- **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 %

# Etiology of acute meningitis – revision 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 – revision II

## Cytology and biochemistry of CSF

marker	norm	<u>purulent</u> meningitis	<u>aseptic</u> 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 – revision III

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	

# Etiology of acute meningitis – revision IV

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 – revision V

## Importance of purulent meningitis according to etiology

(lethality and sequelae)

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

# Etiology of acute meningitis – revision VI

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 – revision

**TBEV (tick-borne enc. v.)** **other arboviruses**

**enteroviruses: polio**

**LCMV**

**coxsackie**

**/morbilli v./**

**echo**

**/EBV/**

**mumps v.**

**/polyomaviruses JC & BK/**

**HSV, VZV, CMV**

**/HIV/**

**rabies v.**

**/prions/**

# Arboviruses in Central Europe – revision I

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

# Arboviruses in Central Europe – revision 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 – revision

- Bacteria:

*Mycobacterium tuberculosis*  
(meningitis basilaris)

- Moulds and yeasts:

aspergilli

*Cryptococcus neoformans*

# **Etiology of encephalitis – revision**

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

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

# Etiology of acute brain abscess – revision

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**

# **Etiology of chronic brain abscess – revision**

## **bacteria:**

***Mycobacterium tuberculosis***

***Nocardia asteroides***

## **mycotic organisms:**

***Cryptococcus neoformans* (yeast)**

## **parasites:**

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

...

# Urinary tract infections (UTIs)

**Frequency of UTIs:**

**The 2nd most common infections (after respiratory ones)**

**In adults: the most common infections in a general practitioner's office**

**Afflicting mainly females (because of shorter urethra)**



# Examples of UTIs

**The most common UTI: cystitis**

**develops ascendently**

**caused by intestinal microflora**

**main symptoms: dysuria (difficult urination with sharp and burning pain)**

**pollakisuria (urgent need to urinate accompanied by urination of a small amount of urine only)**

**Other UTIs: mainly pyelonephritis (more serious)**

**origin: ascendent or hematogenous**

**urethritis – will be dealt with as STD**

# Etiology of UTIs

Proportional representation of microbes **differs in**

- **non-complicated UTIs**
- infections accompanying **structural abnormalities** (prostatic hypertrophy, urinary stones, strictures, pregnancy, congenital defects, permanent catheters)
- infections accompanying **functional disorders** (vesicoureteral reflux, neurological disorders, diabetes mellitus)

# Etiology of non-complicated UTIs

circa 80 % *Escherichia coli*

circa 10 % enterococci (*Enterococcus faecalis*)

circa 5 % *Proteus mirabilis*

rest: other enterobacteriae (*Klebsiella pneumoniae*,  
*Kl. oxytoca*, *Ent. cloacae*, *C. freundii* etc.)

*Streptococcus agalactiae*

coagulase neg. staphylococci (*S. epidermidis*,  
*S. saprophyticus*, *S. haemolyticus* etc.)

yeasts (mainly *Candida albicans*)

# Etiology of complicated UTIs

**circa 80 %:**

*Escherichia coli*

*Klebsiella pneumoniae*

*Proteus mirabilis*

*Pseudomonas aeruginosa*

**enterococci**

**the rest:**

**other enterobacteriae**

**acinetobacters**

**other G-neg. non-fermenting rods**

**candidae**

# ***Lege artis* taking a urine sample**

- 1. Only after a thorough cleaning of genital incl. external orificium of urethra by means of soap and water**
- 2. Take the middle stream of urine only**
- 3. Use a sterile vessel**
- 4. Pour urine into a sterile tube & stopper it promptly**
- 5. If not possible to process it within 2 hours, place the specimen into 4 °C for 18 hours at most**

# Semi-quantitative examination of the urine sample – I

We are interested

- not only in the kind of microbe present in the urine sample, but especially
- in the amount of the microbe

Why are we interested in the number of microbes in 1 ml of urine?

Because

- high numbers only stand for the UTI
- low numbers mean usually contamination acquired during urination

# Semi-quantitative examination of the urine sample – II

Therefore, the **urine is inoculated** on culture media by means of **calibrated loop**, usually taking **1  $\mu$ l** of urine

In this case

1 colony means  $10^3$  CFU/ml

10 colonies mean  $10^4$  CFU/ml

100 colonies mean  $10^5$  CFU/ml

(CFU = colony-forming unit = 1 bacterial/yeast cell)

# Significant concentrations of bacteria in urine

Type of specimen, symptoms	Type of microbe	Significant number (CFU/ml)
Middle stream, symptoms present	Primary urine pathogen	$10^3$
	Dubious urine pathogen	$10^5$
Middle stream, no symptoms	Any	$10^5$
Suprapubic puncture	Any	$10^1$



# Primary urine pathogens

***Escherichia coli*** & most of other enterobacteriae  
enterococci (mostly *Enterococcus faecalis*)

***Streptococcus agalactiae***

**staphylococci** (mostly coagulase negative: *S. epidermidis*, *S. saprophyticus*, *S. haemolyticus* etc.)

**yeasts** (in the main *Candida albicans*)

***Pseudomonas aeruginosa*** & some other Gram-negative non-fermenting rods

...

# Homework 6

Who is the author of this painting and what is its name?



# Answer and questions

The solution of the homework and possible questions please mail (on 6.30 a.m. at the latest) to the address

[mvotava@med.muni.cz](mailto:mvotava@med.muni.cz)

Thank you for your attention