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Agents of neuroinfections

The 5th lecture for 3rd-year students of dentistry
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Bacterial agents of diarrhea and dysentery – revision I

Escherichia coli

Most *E. coli* strains are component (approx. 1 %) of normal intestinal flora

- important
- essential
- beneficial
- non-pathogenic in the intestine

Only some *E. coli* strains are pathogenic even in the intestine

Bacterial agents of diarrhea and dysentery – revision II

Escherichia coli strains causing diarrheal disease:

- ETEC (enterotoxic *E. coli*): traveller s diarrhea
- EPEC (enteropathogenic *E. coli*): O55, O111; small infants
- EIEC (enteroinvasive *E. coli*): similar to shigellae
- EHEC (enterohaemorrhagic *E. coli*): O157:H7; hemorrhagic colitis & hemolytic-uremic syndrome

Bacterial agents of diarrhea and dysentery – revision III

Salmonella

Taxonomical remarks:

There are >4.000 salmonella serotypes

Their official names of them are very inconvenient

Instead we can use more useful names:

1. ***Salmonella* Enteritidis**
2. ***Salmonella* Typhi**

Bacterial agents of diarrhea and dysentery – revision IV

Two types of salmonella infections:

1) **Systemic infections (enteric fever): *S.* Typhi, *S.* Paratyphi A – C**
2) **Gastroenteritis (salmonellosis): remaining >4.000 serotypes**

Pathogenesis of both starts with the invasion of intestinal epithelia

In 1) invasion continues and infection becomes generalized → little or no diarrhea, but pronounced fever & other general symptoms

In 2) infection is localized to ileocaecal region → diarrhea, nausea & vomiting, abdominal pain, temperature may be elevated

Bacterial agents of diarrhea and dysentery – revision V

Diagnosis & treatment of salmonella infections:

1) **Enteric fever (reservoir: human beings only):**

   Detection of salmonellae in blood, urine and stool (on special media), later detection of antibodies (Widal reaction), in suspected carriers examination of duodenal fluid

   Treatment: antibiotics (chloramphenicol, fluorochinolones, ampicillin, cotrimoxazol)

2) **Gastroenteritis (reservoir: poultry & animals):**

   Examination of stool only

   Treatment: symptomatic only, no antibiotics

Bacterial agents of diarrhea and dysentery – revision VI

Campylobacter jejuni

As common as salmonella (or even more); invades jejunal epithelium ; reservoir: poultry

Cultured on a special medium, in an atmosphere of reduced oxygen, at 42 C

Shigella sonnei, S.flexneri, S.boydii, S.dysenteriae

Very low infectious dose → epidemic outbreaks

Transmitted only among human beings

Invasion of cells of colon and rectum

The disease is called bacterial dysentery

Bacterial agents of diarrhea and dysentery – revision VII

Yersinia enterocolitica

gastroenteritis, in children also mesenterial lymphadenitis (mimicking acute appendicitis)

vector: contaminated food

the microbe multiplies in refrigerator even at 4 C

Vibrio cholerae

Cholera toxin activates adenylate cyclase → hypersecretion of water & electrolytes → death by dehydration and electrolyte abnormalities

V. cholerae flourishes in water & causes epidemics

Vibrio parahaemolyticus: from raw fish & shell-fish

Diarrhea during antibiotic therapy – revision

- Common after tetracyclines; from excessively multiplied *Staphylococcus aureus, Pseudomonas aeruginosa* or *Candida albicans* (the example of diarrhea of mycotic origin)
- After lincomycin or clindamycin (but even after other ATB) → dangerous pseudomembranous colitis caused by *Clostridium difficile*
  - Patients contaminate the hospital environment with resistant spores
  - Colitis can be treated by metronidazol

Viral agents of diarrhea – revision

Generally: small, acid- and bile-resistant non-enveloped viruses

Rotaviruses (*Reoviridae* family)

serious diarrhea of young children, epidemics in winter

Noroviruses and sapoviruses (formerly agents Norwalk and Sapporo, *Caliciviridae* family)

epidemics in children and adults, too

Astroviruses (star-shaped virions)

Adenoviruses type 40 and 41

Small, round gastroenteritis viruses

Parasitic agents of diarrhea – revision

In previously healthy individuals:

- *Entamoeba histolytica*: amoebic dysentery
- *Giardia lamblia*: giardiasis
- *Cryptosporidium parvum*: cryptosporidiosis
- *Cyclospora cayetanensis*

In AIDS also:

- *Isospora belli* (coccidium)
- *Enterocytozoon bieneusi* (microsporidium)
- *Strongyloides stercoralis* hyperinfection (helminth)

Other intestinal parasites (helminths, no diarrhoea) – revision

Small intestine:

- *Ascaris lumbricoides* (human roundworm)
- *Ancylostoma duodenale* (Old World hookworm)
- *Necator americanus* (New World hookworm)
- *Strongyloides stercoralis* (threadworm)
- *Fasciolopsis buski* (giant intestinal fluke)
- *Taenia saginata* (beef tapeworm)
- *Taenia solium* (pork tapeworm)
- *Hymenolepis nana* (dwarf tapeworm)
- *Diphyllobothrium latum* (fish tapeworm)

Large intestine:

- *Enterobius vermicularis* (pinworm)
- *Trichuris trichiura* (whipworm)

Food poisoning – revision

1. Intoxication due to a toxin preformed in the food
   - *Staphylococcus aureus*: heat-stable enterotoxin
   - *Clostridium perfringens*: heat-labile enterotoxin
   - *Bacillus cereus*: heat-stable enterotoxin and vomiting toxin (mostly in rice)
   - *Clostridium botulinum*: heat-labile neurotoxin
2. Intoxication due to invasive microorganisms
   - *Salmonella* gastroenteritis
   - ETEC and EHEC
   - *Listeria monocytogenes*

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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 %

Pathogenesis of CNS infections

Penetration of the agent 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)**

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						

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						

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	

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

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 – I

Genus or family : arbovirus	Disease	Antibodies only
Flavivirus: TBEV	+	
WNV (West Nile v.)	+	
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)

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 v.**
- **HSV**
- **enteroviruses**
- **mumps v.**

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**

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*)**

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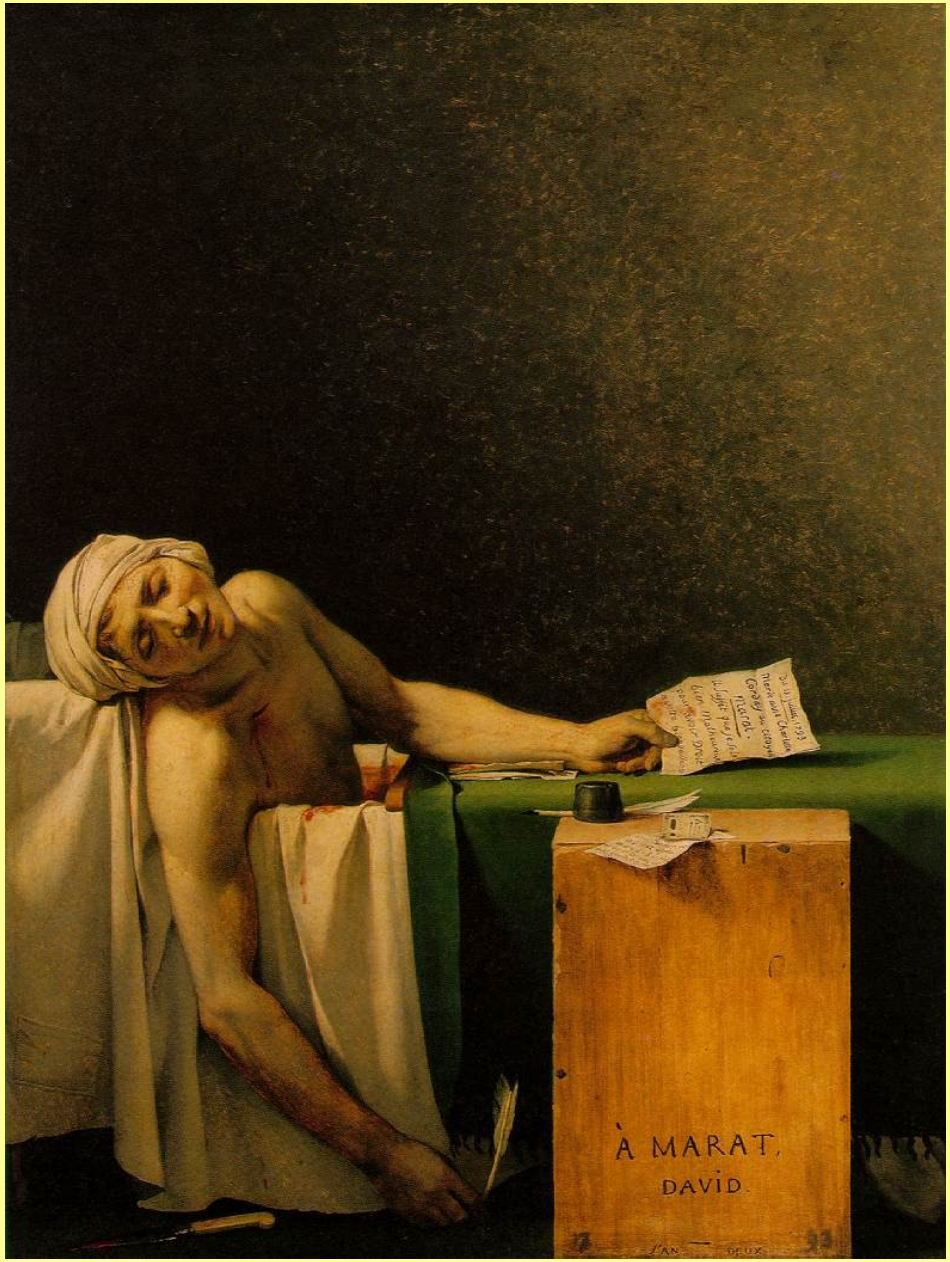
Homework 5

Please specify everything that connects this picture with the medicine



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

Thank you for your attention