

Agents of digestive system infections (I. & II. completed in 1 lecture)



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Digestive system

- in the colon is approx. 10^{12} bacteria/g
- normal intestinal flora: 99 % anaerobes
(*Bacteroides*, *Fusobacterium*, *Clostridium*,
Peptostreptococcus), only 1 %
Enterobacteriaceae (mainly *E. coli*) &
enterococci

Mouth cavity I



Normal flora:

- **viridans** (α -haemolytic) **streptococci** (e.g. *Streptococcus salivarius*)
- oral **neisseriae** (e.g. *Neisseria subflava*)
- **haemophili** of very low pathogenicity (e.g. *Haemophilus parainfluenzae*)

Dental plaque is adherent microbial layer at the tooth surface consisting of living and dead bacteria and their products together with components from the saliva. Dental plaque = **biofilm** - cannot be washed off, only mechanically removed



Mouth cavity II



Dental caries: chronic infection caused by normal oral flora → localized destruction of tooth tissue

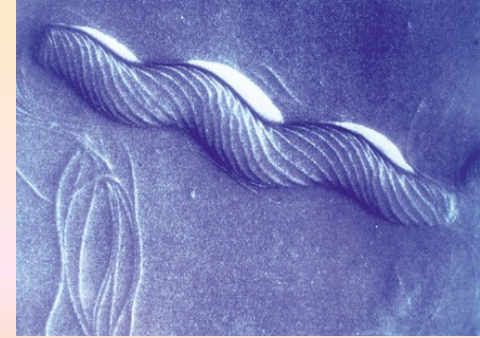
Etiology: mouth microbes (mostly *Strept. mutans*) making acids from sucrose in food

Thrush (in Latin **soor**): *Candida albicans* - occurs mostly in newborns

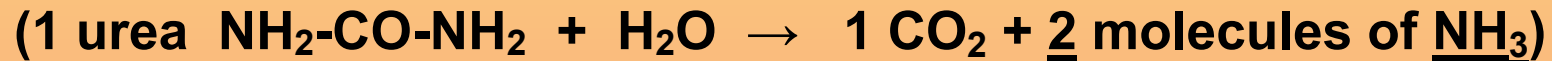
Herpetic stomatitis: primary infection with HSV 1

Ludwig s angina: polymicrobial anaerobic infection of sublingual and submandibular spaces (*Porphyromonas*, *Prevotella* etc.)

Stomach



The microbes are killed by means of HCl except *Helicobacter pylori*. It produces an urease and hydrolyzes urea, it increases pH around itself



H. pylori causes chronic gastritis, peptic ulcer

Oesophagus

Oesophagitis usually in immunocompromised persons (AIDS, after a chemotherapy) due to: *Candida albicans*, Cytomegalovirus (CMV)

Biliary tree & the liver I

Acute cholecystitis (colic, jaundice, fever):
obstruction due to gallstones

Etiology: intestinal bacteria (*E. coli* etc.)

Complication: ascending cholangitis

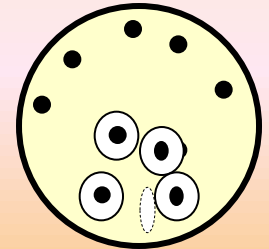
Chronic cholecystitis: the most dangerous agent is
Salmonella Typhi (carriers of typhoid fever)

Granulomatous hepatitis: Q fever, tbc, brucellosis

Biliary tree & the liver II

Parasitic infections of the liver:

Amoebiasis (*Entamoeba histolytica*: liver abscess)



Entamoeba

Malaria (the 1st, clinically silent part of the life cycle of malaric plasmodia)

Leishmaniasis (*Leishmania donovani*: kala-azar, *L. infantum*)



Leishmania

Schistosomiasis (eggs of *Schistosoma japonicum*, less often *S. mansoni*)

Infections which start in the digestive tract

Enteric fever (typhoid fever and paratyphoid fever): *Salmonella Typhi*, *Salmonella Paratyphi A*, *B* and *C*

Listeriosis: *Listeria monocytogenes*
(dangerous for the fetus)

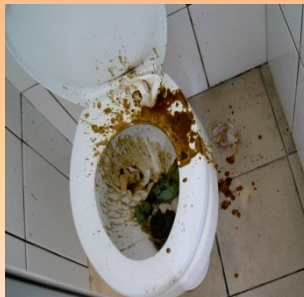
Peritonitis (after appendicitis or an injury):
colonic flora (*Bacteroides fragilis* + other anaerobes + mixture of facultative anaerobes)

Viral hepatitis: HAV, HEV

Small and large intestine

Diarrhoea: increase amount of stool water – common intestinal response to many agents

Dysentery: acute inflammation of the colon → abdominal pain & small-volume stools with blood, pus and mucus



Etiology of diarrhoea

Infectious etiology:

- **Bacterial (the most frequent)**
- **Viral**
- **Parasitic**
- **Mycotic**

Non-infectious etiology:

- **Food poisoning**

Bacterial agents of diarrhoea and dysentery

Escherichia coli - important component (approx. 1 %) of normal intestinal flora, non-pathogenic in the intestine. Only some strains are pathogenic even in the intestine:

Strains causing diarrhoea:

- **ETEC** (enterotoxigenic *E. coli*): children in developing countries, traveller's diarrhoea; 2 enterotoxins (heat-labile and heat-stable)
- **EPEC** (enteropathogenic *E. coli*): O55, O111; small infants; disruption of microvillus structure
- **EIEC** (enteroinvasive *E. coli*): similar to shigellae → dysentery-like disease; invasion of colonic cells
- **EHEC** (enterohaemorrhagic *E. coli*): **O157:H7**; 2 cytotoxic shigatoxins, destruction of microvilli; **hemorrhagic colitis** & **hemolytic-uremic syndrome** (HUS); in 2011 strain O104:H4

Bacterial agents of diarrhoea and dysentery – II

Salmonella

Taxonomical remarks: There are >4.000 salmonella serotypes

Official names of them are very inconvenient:

1. The most frequent salmonella: *Salmonella enterica* subspecies *enterica* serotype *enteritidis*
2. The most important salmonella: *Salmonella enterica* subspecies *enterica* serotype *typhi*

Instead of them we can use more useful names:

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

Bacterial agents of diarrhoea and dysentery – III

2 types of salmonella infections:

- 1) Systemic infections (enteric fever = typhoid fever): S. Typhi, S. Paratyphi A – C

Pathogenesis starts with the invasion of intestinal epithelia.

Invasion continues and infection becomes generalized → little or no diarrhoea, but pronounced fever & other general symptoms

- 2) Gastroenteritis (= salmonellosis): remaining >4.000 serotypes

Pathogenesis starts with the invasion of intestinal epithelia.

Infection is localized to ileocaecal region → diarrhoea, nausea & vomiting, abdominal pain, temperature may be elevated

Bacterial agents of diarrhoea and dysentery – IV

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

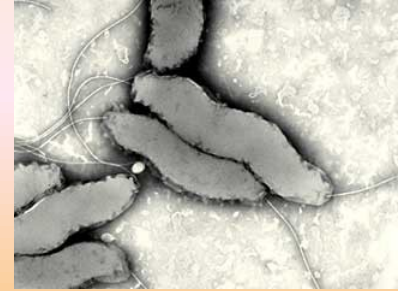
Treatment: **antibiotics** (chloramphenicol, fluoroquinolones, ampicillin, cotrimoxazol)

2) Gastroenteritis (reservoir: poultry & animals):

Examination of **stool** only

Treatment: symptomatic only, **no antibiotics**

Bacterial agents of diarrhoea and dysentery – V



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, it is transmitted only among human beings. Invasion of cells of colon and rectum

The disease is called bacterial dysentery

Bacterial agents of diarrhoea and dysentery – VI

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

Diarrhoea due to antibiotic therapy

Common after tetracyclines; from multiplied *Staphylococcus aureus*, *Pseudomonas aeruginosa* or *Candida albicans* (diarrhoea of mycotic origin)

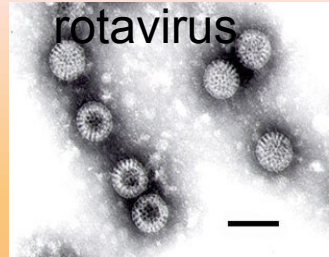
After lincomycin/clindamycin (+ other ATB) → dangerous **pseudomembranous colitis** caused by *Clostridium difficile*

Patients contaminate the hospital environment with resistant spores

Treatment: metronidazol, vankomycin

Viral agents of diarrhoea

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



Rotaviruses (*Reoviridae* family)

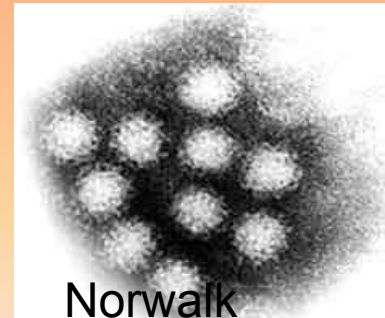
serious diarrhoea of young children, epidemics in winter

Noroviruses and **sapoviruses** (formerly agents Norwalk and Sapporo, *Caliciviridae* family)
epidemics in children and adults

Astroviruses (star-shaped virions)

Adenoviruses type 40 and 41

Small, round gastroenteritis viruses



Parasitic agents of diarrhoea

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 not causing diarrhoea (helminths)

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)



Enterobius - eggs

Food poisoning



Intoxication due to a toxin preformed in the food:

Bacillus cereus: heat-stable enterotoxin and vomiting toxin (mostly in rice). Heat-labile diarrhoea toxin (cold sauce)

Clostridium perfringens: heat-labile enterotoxin

Clostridium botulinum: heat-labile neurotoxin

