THE GENUS *VIBRIO*, *CAMPYLOBACTER* AND ASSOCIATED BACTERIA (*AEROMONAS*, *HELICOBACTER*, *PLESIOMONAS*)

General Characteristics of *Vibrio*, *Aeromonas* and *Plesiomonas*

- Gram-negative
- Facultative anaerobes
- Fermentative bacilli
- Polar flagella
- Oxidase positive

➢ **Formerly classified together as *Vibrionaceae***
- **Primarily found in water sources**
- **Cause gastrointestinal disease**

- ***Vibrio, Campylobacter, Aeromonas, Plesiomonas* and *Helicobacter* species are gramnegative rods, that are all widely distributed in nature.**
  - ï *Vibrio* sp. are found in marine and surface waters. Some of them can cause a disease in man as well as in marine vertebrates and invertebrates. *Vibrio cholerae* produces an enterotoxin that cause cholera, a profuse watery diarrhea that can rapidly lead to dehydration and death.
  - ï *Aeromonas* sp. is found predominantly in fresh water and in cold-blooded animals.
  - ï *Plesiomonas* sp. exists in both cold- and warm-blooded animals, including many domesticated animals.
  - ï *Campylobacter* sp. is a common cause of enteritis in humans. Less commonly, *Aeromonas* sp. and rarely, *Plesiomonas* sp. have been associated with diarrheal disease in humans.
  - ï *Helicobacter pylori* has been associated with gastritis and ulcer disease.

The VIBROS

- Among common pathogenic vibrio species belong:
  - ï *V. cholerae*, *V. parahaemolyticus*, *V. vulnificus*, *V. alginolyticus*, *V. mimicus*.
- The genus can be divided:
  - ï into non-halophilic vibrios, including *V. cholerae*, that are able to grow in media without added salt,
  - ï and halophilic species which do not grow in these media, they require higher contents of salt.

The VIBROS

- **Morphology:**
  - ï gramnegative rods, non-spore forming, motile (polar flagellum)
- *Vibrio cholerae* serotypes

Genus *Vibrio*	*Vibrio cholerae*	*V. cholerae*	serotype O1	biotypes	classical
					El Tor
				serosub-groups	Ogawa
					Inaba
					Hikojima
			non O1	non-agglutinating vibrios	
	other species	*V.parahaemolyticus*	food associated diarrheal disease		
		V. vulnificus	wound infection, sepsis		
		V. alginolyticus	otitis externa, wound infection		

The VIBROS pathogenity

- *V. cholerae* serotype O1 causes cholera in humans, while other vibrios may cause sepsis, enteritis and other infections.
  - ï *V. cholerae* serotype O1: epidemic and pandemic cholera
  - ï *V. cholerae* serotype non O1: choleralike diarrhea, mild diarrhea, rarely extraintestinal infection
  - ï *V. parahaemolyticus*: gastroenteritis, possibly extraintestinal infection
  - ï other (*V. mimicus*, *V. vulnificus*....): ear, wound, soft tissue and other extraintestinal infections, all uncommon

Vibrio cholerae

- Gramnegative, slim, curved rods about 2 to 4 μm long.
- Cell may be linked end to end, forming "S" shapes and spirals.
- They are non-spore forming and do not form a capsule.
- Cholera vibrios are motile with a single polar flagellum. Their motility is extremely rapid.

- **The bacterium *Vibrio cholerae***
  - ï Humans are one of the reservoirs of this pathogen.
  - ï It is also often found in the aquatic environment and is part of the normal flora of brackish water.
  - ï It is often associated with algal blooms (plankton), which are influenced by the water temperature.

- **Cholera in the world**
  - ï Annually 5-7 million cases, 100,000 deaths worldwide.

Vibrio cholerae

- *V. cholerae* can grow aerobically or anaerobically on a variety of simple media.
- Vibrios grow at a very high pH (8.5 to 9.5) and are rapidly killed by acid conditions.
- In alkaline peptone water they produce a turbidity and surface membrane in six hours of incubation.
- *V. cholerae* grows in convex, smooth, round colonies on nutrient or blood agar.
- Vibrios grow well on thiosulfate-citrate-bile-sucrose (TCBS) agar on which they form yellow colonies.
- Vibrios are oxidase-positive, which differentiates them from enteric gramnegative bacteria grown on blood agar.
- *V. cholerae* strains produce catalase. Vibrios form acids without gas from a many sugars.

Vibrio cholerae is divided into two biotypes:

- Cholera biotype:
  - ï causes severe forms of cholera with a high mortality,
  - ï does not hemolyse on blood agar,
  - ï does not agglutinate chicken, sheep or human erythrocytes,
  - ï it is susceptible to polymyxin B.
- El tor biotype:
  - ï all the properties has just opposited as given above.

Vibrio cholerae
antigenic structure

- Many cholera vibrios share a single heat-labile flagellar H antigen. Antibodies to the H antigen are probably not involved in the protection of susceptible host organisms.

- *V. cholerae* has cell wall lipopolysaccharides that confer serological specifity as somatic O antigens. There are more than 140 antigens.

Vibrio cholerae antigenic structure

- *V. cholerae* strains causing classical epidemic cholera belong into the O1 group. They are classified as *V. cholerae* O1.

- Strains of other serogroups are classified as *V. cholerae* non O1 or non-agglutinated vibrios s.c. NAG vibrios (they do not agglutinate in anti-O1 serum) or non-cholera vibrios s.c. NCV. Many of these vibrios may cause diarrhea in humans as s.c. cholera-like disease or gastroenteritis of travellers.

Vibrio cholerae antigenic structure

- The *V. cholerae* serogroup O1 antigen has determinants A, B, C that make possible further subdivison into three serologic subtypes:
  - A,B (s.c. Ogawa)
  - A,C (s.c. Inaba)
  - A,B,C (s.c. Hikojima)

Vibrio cholerae toxicity

- Endotoxin:
  - it has only a negligible significance as a virulence factor.
- Enterotoxin:
  - it is a main factor of pathogenity,
  - it is heat-labile protein which can be changed by formol into a toxoid,
  - synthesis of cholera toxin is controlled by chromosomal gene. Its molecule is a complex of multiple polypeptide chains organized into a toxic unit A, consisting of A1 and A2 subunits, and unit B.

Vibrio cholerae toxicity

- The B unit mediates tight binding to a cell wall ganglioside receptor G_{M1} of enterocytes in the small intestine. It means that ganglioside G_{M1} serves as the mucosal receptor for subunit B, which promotes entry of subunit A into cell.

- Activation of subunit A1 yields increased levels of intracellular cyclic AMP (adenosine monophosphate) and results in prolonged hypersecretion of water and electrolytes. There is increased sodium-dependend chloride secretion, and absorption of sodium and chloride is inhibited. Diarrhea occurs - as much as 20 - 30 L/day - with resulting dehydratation, shock, acidosis and death.

Vibrio cholerae toxicity

- *V. cholerae* is pathogenic only for humans. Cholera is not an invasive infection. The microorganism do not reach the blood stream but remain within the intestinal tract.
- Although cholera toxin is the most important virulence factor, the motility and the production of mucinase and other proteolytic enzymes contribute to the ability of *V. cholerae* to colonize.
- The microorganism can colonize the entire intestinal tract from the jejunum to the colon and can multiply to high numbers. An alkaline environment is ideal for bacterial growth.

Vibrio cholerae

- **Incubation:**
  - ï several hours to 5 days (usually 2-3 days)

- **Symptoms:**
  - ï diarrhea and other (vomiting, pain in the abdominal region, hypotermia, hypotension, anuria, metabolic acidosis and others)

Vibrio cholerae therapy

- In the treatment of cholera absolute priority must be given to the replacement of fluid and electrolytes.

- Antimicrobial therapy shortens the duration of diarrhea and reduces the period of excretion of *V. cholerae* in the stools of cholera patients.
  - ï tetracyclines have been used most frequently (tetracycline for 3 days), although chloramphenicol, fluoroquinolones, cotrimoxazole and others have also been effective.

Vibrio cholerae

- **Transmission:**
  - ï Epidemic cholera is spread primarly by contaminated water and food, most commonly during the warm months of the year. Cholera vibrios can be transmitted by direct contact with patients and carrriers.
- **Morbidity:**
  - ï In epidemics 1-5%.
- **Mortality:**
  - ï About 50% in classical *V. cholerae*,
  - ï only 1% in *V. cholerae* El tor.

- **The genus *AEROMONAS***
  - ï *Aeromonas hydrophila* is the most important species from this genus causing disease in humans.
  - ï The strains have been associated with diarrhea.

- **The genus *PLESIOMONAS***
  - ï *Plesiomonas* sp. is most common in tropical and subtropial areas.
  - ï *Plesiomonas shigeloides* can cause diarrhea.

Characteristics and epidemiology of *Aeromonas* spp.

- Gram-negative facultatively anaerobic bacillus
- Motile species have single polar flagellum (nonmotile species apparently not associated with human disease)
- 16 phenospecies: Most significant human pathogens *A. hydrophila*, *A. caviae*, *A. veronii* biovar *sobria*
- Ubiquitous in fresh and brackish water
- Acquired by ingestion of or exposure to contaminated water or food

Characteristics of *Plesiomonas* spp.

- Oxidase positive
- Multiple polar flagella (lophotrichous)
- Single species: *Plesiomonas shigelloides*
- Isolated from aquatic environment (fresh or estuarine)
- Acquired by ingestion of or exposure to contaminated water or seafood or by exposure to amphibians or reptiles
- Self-limited gastroenteritis: secretory, colitis or chronic forms
- Variety of uncommon extra-intestinal infections

The genus *CAMPYLOBACTER*

- *Campylobacter jejuni* has emerged as a common human pathogen, causing mainly enteritis and occasionally systemic invasion.
- The medically important *Campylobacter* species:
  - ï *C. jejuni*
    - diarrhea (common)
  - ï *C. fetus* subspecies *fetus*
    - septicemia in debilitated and immunocompromised patients
  - ï *C. coli*, *C. laridis*
    - diarrhea
  - ï *C. cinaedi*, *C. fennelliae*
    - infections in homosexual man

The genus *CAMPYLOBACTER* therapy

- Rehydration
- Most patients do not require antibotics
  - ï exceptions: high fewer, bloody stool, prolonged illness (more than 1 week), pregnancy, HIV and other immunosuppressed states
- Erytromycin 2x500 mg p.os
- Ciprofloxacin 2x500 mg p.os

The genus *HELICOBACTER*

- *Helicobacter pylori* is associated with antral gastritis and apears to be important in the pathogenesis of ulcer disease.
- It is motile and a strong producer of urease.
- It is present on the gastric mucosa of less than 20% of persons under age 30, but increases in prevalence to 40-60% of persons age 60.
- In developing countries, the prevalence of infection may be 80% or higher in adults.

The genus *HELICOBACTER*

- Therapy:
  - ï Combination of two of the following three antibiotics (amoxicillin, clarithromycin, metronidazole, tetracycline) plus omeprazole.
  - ï Resistence of *H. pylori* to antibiotics in the Czech Republic:

Antibiotic	**Resistance (in %)**
amoxicillin	0
clarithromycin	4
tetracycline	4
ciprofloxacin	0
metronidazole	42

The genus *HELICOBACTER* therapy

- Therapy:
  - ï amoxicillin + clarithromycin + omeprazol
  - ï metronidazol + clarithromycin + omeprazol
  - ï metronidazol + tetracycline + omeprazol