

Anaerobic bacteria

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Anaerobes

- Anaerobic bacteria are common as etiologic agents in variety of clinical syndromes (aspiration pneumonia, abscesses, intra-abdominal infections)
- Anaerobic bacteria are predominant part of human microbiota – opportunistic pathogens of indigenous infections
- Clostridia – cause of exogenous infectious

Anaerobes – clinical syndromes

- Blood-stream infections
- Infections of head and neck
- Thoracic infections
- Intra-abdominal infections
- Enteric diseases
- Obstetric-gynecological infections
- Skin and soft tissue infections
- Prosthetic joint infections
- Gut anaerobes play role in neurologic disorders (autism, depression)

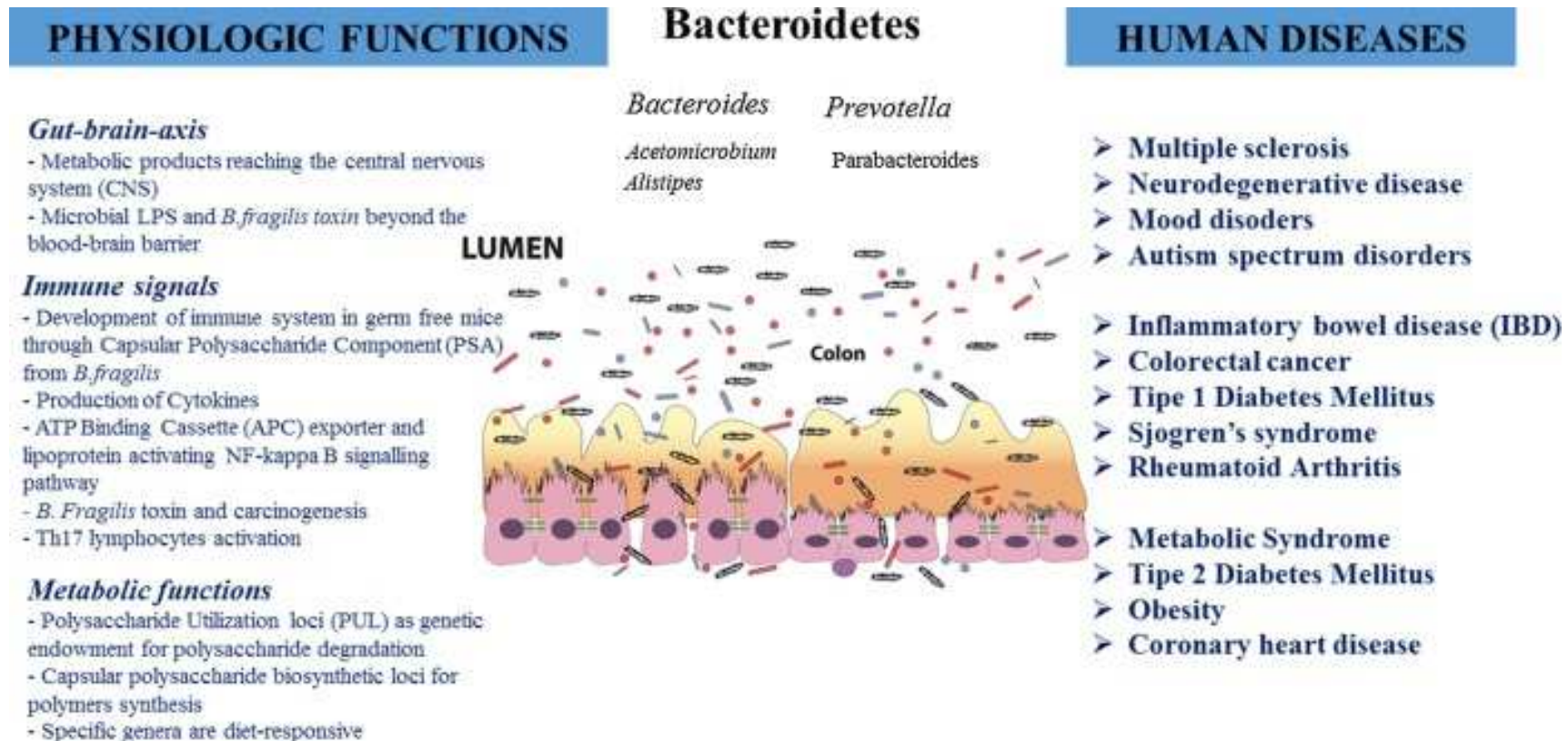
Anaerobic bacteria in gut

- The gut microbiota, composed of thousands of different microbial species and more than 15000 kinds of bacteria for a weight equal to 1 kg
- The presence of the microbiota varies within the gastrointestinal tract, mostly present in the colon, represented by the *Firmicutes* and *Bacteroidetes* phyla
- The functions performed by the flora:
 - the establishment of the intestinal barrier, stimulating epithelial regeneration through the production of short chain fatty acids (SCFAs), leading to mucus production
 - Involvement in the maturation of the immune system: it stimulates innate immunity in the early years of life, and acquired immunity
 - the synthesis and metabolism of certain nutrients, hormones and vitamins.

Anaerobic bacteria in gut

- In physiological conditions, the continuous stimulation of the immune system by the gut microbiota leads to a state of “low-grade physiological inflammation” – an effective mechanism of defence against pathogens
- the flora exerts its protective role competitively, metabolizing those nutrients needed for pathogens survival, and producing molecules that inhibit the growth of such microbes
- Recent data show the strong correlation between dysbiosis and conditions such as obesity, allergies, autoimmune disorders, irritable bowel syndrome (IBS), inflammatory bowel disease (IBD), and psychiatric disorders
- gut microbiota has the fundamental role in the alteration of immune, neural, and endocrine pathways, the so-called “**gut-brain axis**”

Physiological/pathological functions of Bacteroidetes



Identification of anaerobic bacteria

- Specimens are usually obtained by aspiration of fluid or pus (needle), tissue samples should be taken during surgery
- Blood samples – anaerobic bottle (standard protocol)
- Specimens must be transported in containers that exclude air
- Gram stain of original specimens – critical step in timely clinical management
 - Necrotizing fasciitis, myonecrosis, clostridial gas gangrene, bacterial vaginosis

Identification of anaerobic bacteria

- Anaerobic blood agar + broth
- Cultivation on anaerobic atmosphere (jars, anaerobic chambers)
- Examination of plates – after 48 hours of cultivation – in case of clostridial infections after overnight incubation
- Identification using MALDI-TOF MS
- Susceptibility testing is difficult (MIC by BDM for *Bacteriodes fragilis* group, E-test)

Anaerobes of clinical importance

Cellular morphology	Gram reaction	Spores	organism	species
Rods or coccobacilli	+	+	Clostridium	C. tetani, perfringens, botulinum, difficile
		-	Actinomyces Propionibacterium, Bifidobacterium, Lactobacillus, Mobiluncus	A. israelii P. acnes
	-	-	Bacteroides, Porphyromonas, Prevotella, Fusobacterium	B. fragilis
Cocci	+	-	Peptostreptococcus, Finegoldia, Parvimonas	Pep. anaerobius
	-	-	Veilonella	

Gram-positive anaerobic cocci (GPAC)

Anaerococcus, Peptostreptococcus, Finegoldia, Parvimonas

- Obligately anaerobic, non-spore forming cocci or coccobacillary cells
- GPAC are part of commensal microbiota of mouth, upper respiratory tract and GIT, female genitourinary system, and skin
- **Opportunistic pathogens** – severity of disease ranging from mild skin abscesses to life threatening infections (brain abscess, bacteremia, endocarditis, necrotizing pneumonia, lung abscess, bone and joint infection, septic abortion)
- Skin and soft tissue infections – streptococcal myonecrosis, necrotizing fasciitis, cellulitis
- Oral and dental infections (brain abscess)

Gram-negative anaerobic cocci (GNAC)

Veilonella

- Small percentage of the human anaerobic cocci
- GNAC are part of oral, respiratory, intestinal, and genitourinary tract
- Veilonella – highest concentration in saliva and tongue surface
- Typically part of mixed culture in infections
- Rarely cause of endocarditis, meningitis, osteomyelitis

Gram-positive anaerobic rods

- **Phylum *Actinobacteria*** (Actinomyces, Mobiluncus, Propionibacterium, Bifidobacterium)
- **Phylum *Firmicutes*** (Lactobacillus, Eubacterium)
- Part of mucocutaneous surfaces of human body
- Part of healthy microbiome, infections result from bite wounds
- Infections are usually polymicrobial (oral, intraabdominal)

Actinomycosis

Actinomycosis – granulomatous disease

- Actinomyces – low virulence
- Presence of sulfur granula in pus
- Categorised as **orocervicofacial** (50% of all cases), **thoracic**, and **abdominopelvic** forms
 - Orocervicofacial – poor oral hygiene is the risk factor
 - Thoracic form – aspiration
 - Abdominal infection – result of bowel perforation
 - Pelvic infection – intrauterine contraceptive devices

Lactobacillus

- Beneficial members of human microbiota, infrequently human opportunistic pathogens in patients with underlying conditions (malignancy, organ transplant, diabetes)
- Probiotic strains
- Bacteremia and endocarditis (*L. rhamnosus*)
- Chorioamnionitis
- Bacterial vaginosis (depletion of *Lactobacillus*, increased bacterial diversity and vaginal pH)

Gram-negative anaerobic rods

Non-spore forming rods

- Inhabit mucosal surfaces of oral cavity (Fusobacterium, Prevotella) and GIT (Bacteroides) from an early infancy
- Phylum ***Fusobacteria*** (Fusobacterium, Leptotrichia)
- Phylum ***Bacteroidetes*** (Bacteroides, Porphyromonas, Prevotella)
- Genus ***Bacteroides*** – saccharolytic, bile-resistant, non-pigmented species of gut
- ***B. fragilis*** group (more than 50 species)

Gram-positive anaerobic rods

clinical significance

- Polymicrobial infections associated with mucosal surfaces of their residence (endogenous infections)
- Breached integrity of colonised mucosa (trauma, surgery, underlying disease)
- Anaerobic bacteremia (colon cancer, GIT surgery)
- Oral infections – risk of endocarditis or mediastinitis
- Biofilm associated infections (periodontitis, bacterial vaginosis)
- Exogenous infections – animal/human bites

Type of infections

- Mouth
 - abscesses, endodontic, periodontal infections
- Lower respiratory tract
- Abdomen/intestine
 - abscesses, appendicitis, peritonitis
- Urogenital tract
 - abscesses, bact. vaginosis, intra-amniotic infections
- Skin/soft tissue infections
- Bone/joint infections
 - osteomyelitis
- Cardiovascular
 - bacteremia, endocarditis, pericarditis

B. fragilis group

- Bile-resistant
- most common in clinical specimens (GIT)
- more virulent and resistant to ATB (metalobetalactamase – resistance to carbapenems)



ATB therapy

Gram positive anaerobic bacteria

- **penicilin**

Gram negative anaerobic bacteria

- **metronidazole**, carbapenems, ampicilin/sulbactam, piperacilin/tazobactam, chloramphenicol
- Less active – clindamycin, moxifloxacin