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Agents of congenital and neonatal infections

The 13th lecture for 3rd-year students of dentistry
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Bacteremia versus sepsis I – revision

Bacteremia = mere presence of bacteria in blood

But: Bacteria = starting mechanism of sepsis

Interaction of microbial products with macrophages releases a lot of cytokines

→ systemic inflammatory response syndrome (SIRS)

= elevated temperature

accelerated pulse and breathing

leukocytosis

Bacteremia versus sepsis II – revision

Sepsis = suspect or proved infection + systemic inflammatory response syndrome

Severe sepsis = sepsis + organ dysfunction (hypotension, hypoxemia, oliguria, metabolic acidosis, thrombocytopenia, confusion)

Septic shock = severe sepsis + hypotension despite adequate supply of fluids

Characterization of sepsis – revision

Clinic:

- fever or hypothermia ↑↓ T
- tachycardia ↑ P
- tachypnoe ↑ D
- lowered blood pressure ↓ BP
- confusion

Pathologic physiology:

- higher heart output
- lower peripheral vascular resistance

Laboratory:

- leukocytes ↑↓ Leu
- serum bicarbonate ↓ HCO_3^-
- bacteremia may not be already demonstrable

Types of bacteremia I – revision

***Intermitent* bacteremia – *in localized* infections:**

pneumonia (pneumococci)

meningitis (meningococci)

pyelonephritis (*Escherichia coli*)

osteomyelitis (*Staphylococcus aureus*)

septic arthritis (*S. aureus*, gonococci)

cholecystitis (enteric bacteria, enterococci)

peritonitis (mixed anaerobic and facultatively anaerobic flora)

wound infections (*S. aureus, S. pyogenes*)

bedsores (mixed skin and intestinal flora)

Types of bacteremia II – revision

***Continual* bacteremia – *in general* infections:**

typhoid fever (*Salmonella* Typhi)

brucellosis (*Brucella melitensis*)

plague (*Yersinia pestis*)

Types of bacteremia III – revision

Bacteremia in bloodstream infections

thrombophlebitis (***S. aureus, S. pyogenes***)

acute endocarditis (***S. aureus, S. pyogenes, S. pneumoniae, Neisseria gonorrhoeae***)

subacute bacterial endocarditis = sepsis lenta (α-hemolytic streptococci, enterococci, HACEK group =
Haemophilus aphrophilus
Actinobacillus actinomycetemcomitans
Cardiobacterium hominis
Eikenella corrodens
Kingella kingae)

„culture-negative“ endocarditis (bartonellae, coxiellae, legionellae)

Types of bacteremia IV & V – revision

Bacteremia in some malignities:

colonic carcinoma (*Streptococcus bovis*)

leukemia (*aeromonads, Bacillus cereus, Bacillus subtilis, Clostridium septicum*)

Bacteremia in intravenous drug users:

skin flora (staphylococci, corynebacteria)

mouth flora (neisseriae, eikenellae, even nasopharyngeal pathogens)

bacteria from the environment (clostridia, bacilli)

Types of bacteremia VI – revision

Bacteremia in iatrogenic infections:

tooth extraction (α-streptococci, prevotellae)

bronchoscopy (nasopharyngeal flora including pathogens)

bladder catheterization (*Escherichia coli*)

infusions (skin flora, G– non-fermenting rods)

vascular catheters (coagulase-negative staphylococci, yeasts)

invasive devices and implants (coag.-negative staphylococci, micrococci, corynebacteria, nocardiae)

febrile neutropenia (antibiotic-resistant staphs, enterococci, G– rods, yeasts, moulds)

Clinical types of sepsis – revision

- wound-originated sepsis
- urosepsis
- abdominal sepsis
- fulminant sepsis
- nosocomial (hospital-acquired) sepsis

Wound-originated sepsis – revision

Staphylococcus aureus

Streptococcus pyogenes

beta-hemolytic streptococci groups G, F, C

***Pseudomonas aeruginosa* (burns)**

Clostridium septicum

Urosepsis – revision

Escherichia coli

Proteus mirabilis

other enteric bacteria

Abdominal sepsis – revision

Polymicrobial etiology

anaerobes: ***Bacteroides fragilis***

Peptostreptococcus micros

Peptostr. anaerobius

&

facultative anaerobes: ***Escherichia coli***

Proteus mirabilis

Fulminant sepsis – revision

Neisseria meningitidis

Streptococcus pyogenes

Yersinia pestis

Nosocomial sepsis – revision

Staphylococci, coagulase-negative (intravenous catheter-associated sepsis, infections of plastic devices *in situ*, febrile neutropenia)

Staphylococcus aureus (infected surgical wounds)

***E. coli* + other enterobacteria** (catheter-associated infections of the urinary tract)

Gram-negative non-fermenting rods (contaminated infusion fluids)

yeasts (catheter-associated sepsis, febrile neutropenia)

many other microbes (compare with the agents of iatrogenic bacteremia)

Treatment of sepsis – revision

At intensive care units (ICU) only

- **Control of infection**
  - antibiotics – initially broad spectrum ones, then oriented on the isolated microbe
  - removal of all infected tissues or devices)
- **Support of breathing and hemodynamics**
  - artificial ventilation
  - oxygen
  - fluids
  - vasopressors etc.

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Congenital and neonatal infections, definitions

- **Congenital infections =**
  = intrauterine infections =
  = prenatal infections

- **Neonatal infections**
  - **perinatal infections (closely before and during the delivery)**
  - **postnatal infections (up to 4 weeks of life)**

- **Congenital and neonatal infections are caused by agents unusual in older children**

A little bit of immunology

Fetus = an immunological paradox

Fetus and mother = two immune systems

To be able to get on well, both must be modulated

„Fetal immunodeficiency“

1. **Inability to produce cytokines**
2. **Defects in intracellular killing**
3. **Immature production of antibodies**

The protection of the fetus

- Placenta and amnion
- Maternal IgG (halftime = 20 days)
  - actively transported through the placenta
  - IgG against capsular polysaccharides are active only up to circa 3 months after delivery
  - IgG against viruses are effective even up to 12-15 months
- Colostral IgA

Prenatal infections – I

Notes to the following Table:

- Crosses in the column Trimester mark the frequency of the transfer of an agent into the fetus, not the gravity of the affliction

Gravity of the affliction tends to be the highest during the infection in the 1st trimester, when it may cause abortion

Prenatal infections – II

Agent	Trimester			Congenital defects	Postnatal persistence
	1.	2.	3.		
Treponema pallidum	-	+	+	+	+
List. monocytogenes	-	-	+	-	-
Rubella virus	++	+	-	+	+
CMV	+	+	+	+	+
Parvovirus B19		+		-	-
VZV	+	-	+		+
HSV	+	+	+	-	+
HIV	·	·	·	-	+
Toxoplasma gondii		+	++	+	+

Diagnostics of prenatal infection

Examination of mother

– immensely important in syphilis (obligatory in most countries) and in toxoplasmosis

Examination of the newborn

– above all the detection of its IgM (IgM antibodies cannot be of maternal origin – they don't go through the placenta)

– sometimes the direct detection (e.g. CMV in urine)

Treatment & prevention of prenatal infection

Treatment (of the mother):

- **PNC** in syphilis
- **spiramycin** in toxoplasmosis

Prevention:

- **healthy mother** (examined for syphilis, possibly for toxoplasmosis)

Infections proceeding more severely in pregnancy

Malaria – because of lower cellular immunity

Virus hepatitis – especially VHE

Influenza – during pandemics

Poliomyelitis – more frequent paralysis

Urinary tract infections – pressure on the ureter, atonia of urinary bladder

Candidosis – vulvovaginitis

Listeriosis – beware of cheese

Agents activating themselves during pregnancy

Polyomaviruses JC & BK – in kidneys

CMV – cervix and mammary gland

HSV-2 – in cervical area mostly

EBV – higher excretion from oropharynx

Perinatal infections

„Immunologic immaturity and naivety of the newborn“

- Inability to produce antibodies against polysaccharides
- Low level of complement and few NK cells
- Small supply of neutrophils
- Insufficient function of neutrophils
- Low level of IgA (particularly in premature infants)
- Low mucosal immunity
- (Satisfactory cellular immunity)

Agents transmissible during delivery

- ***Agents originating in <u>vagina, cervix and rectum</u>:***

GBS – sepsis and meningitis (early and late one)
***Chl. trachomatis* D – K – inclusion conjunctivitis**
***E. coli* & other enteric rods – sepsis and meningitis**
***Neisseria gonorrhoeae* – purulent conjunctivitis**
***Listeria monocytogenes* – meningitis and sepsis**
***Haemophilus influenzae* – meningitis and sepsis**
***Mycoplasma hominis* – pneumonia?**
***Candida albicans* – soor (thrush)**
HSV-2 – generalized herpes

- ***Agents originating in <u>blood</u>:***

HBV, HIV

Agents transmissible postnatally

- ***From the mother:***

group B streptococci – sepsis and meningitis
***Staphylococcus aureus* – pyodermia, even sepsis**
***Mycobacterium tuberculosis* – tuberculosis**
CMV – ?
HIV – AIDS

- ***From the surrounding environment:***

enterobacteriae incl. salmonellae – diarrhoea and sepsis
***Pseudomonas aeruginosa* – serious diarrhoea**
***Staphylococcus aureus* – pyodermia, even sepsis**
respiratory syncytial virus (RSV) – bronchiolitis

Diagnostics of perinatal and postnatal infections

The most rapid methods are essential

– therefore direct detection only

Microscopy – invaluable in CSF (Cocci or rods? G+ or G– ? In clumps, chains, or in pairs?)

Detection of antigens – CSF again: GBS, HIB, pneumococci, meningococci (group B ~ *E. coli* K1)

PCR – not yet standardized

Prevention of perinatal and postnatal infections

Screening of the mother (examination of vaginal and rectal swab for GBS)

Prevention of premature labour (because of immune immaturity of the newborn)

Leading the delivery lege artis (examination per rectum, induction of labour after the rupture of membranes etc.)

Cleanness and tidiness in delivery room and at the newborn ward

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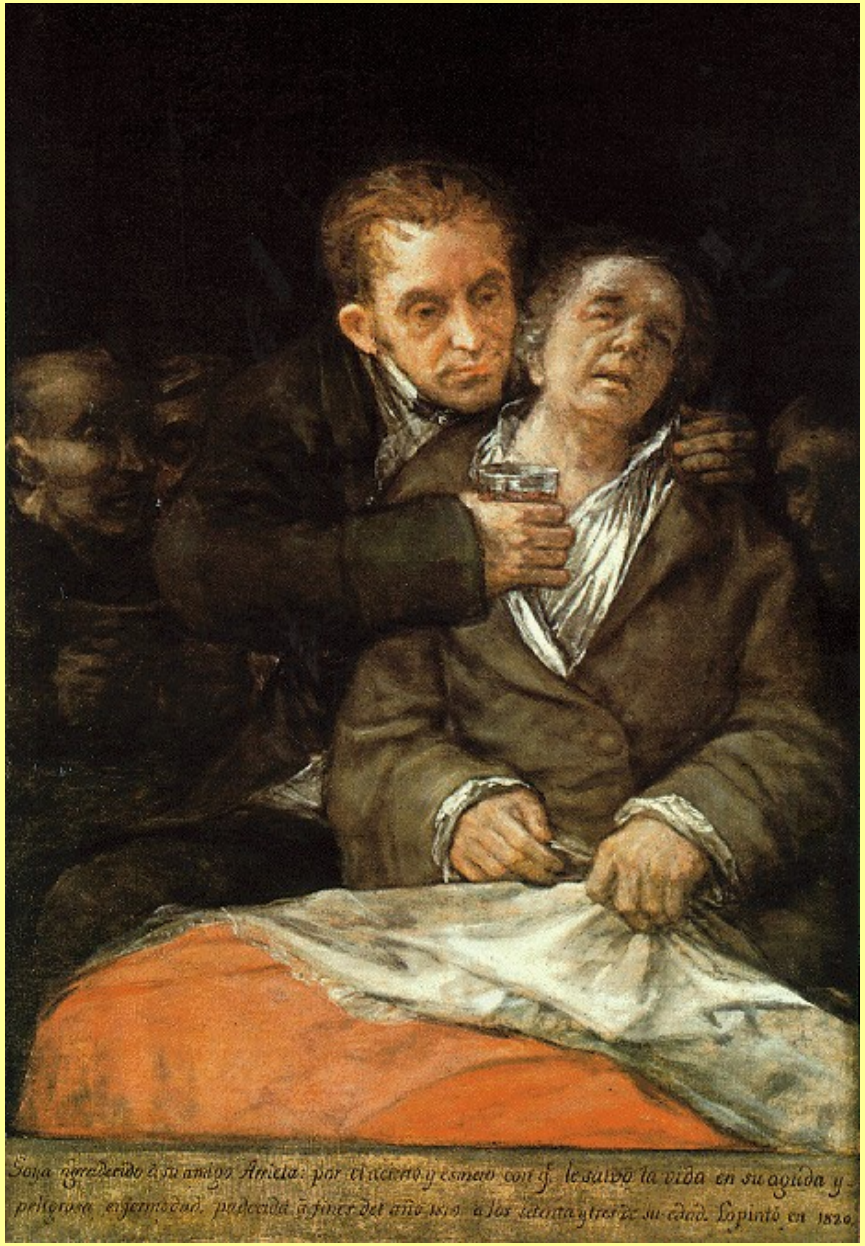
Homework 10

Francisco José de Goya y Lucientes (1746–1828): Goya Attended by Dr. Arietta



Homework 10

Successful homework 10 solvers:

Sorry, no answers have been received

Homework 11

Jakub Schikaneder (1855-1924):
By the Girl´s Bed (The Death is Coming; 1910)

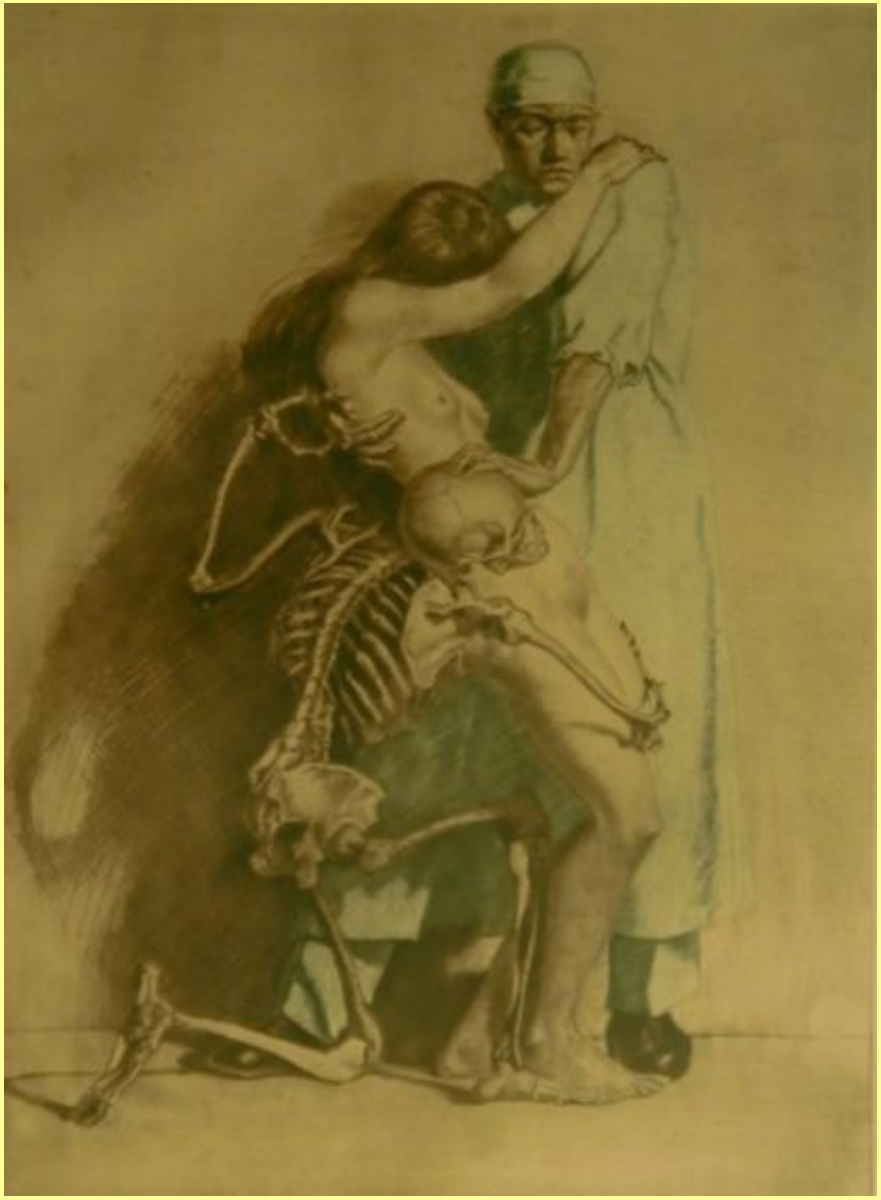
Homework 11

Successful homework 11 solvers:

Sorry, no answers have been received

Homework 12

Ivo Saliger (1894–1987):
The Physician Struggling with the Death for a Young Girl (1920)



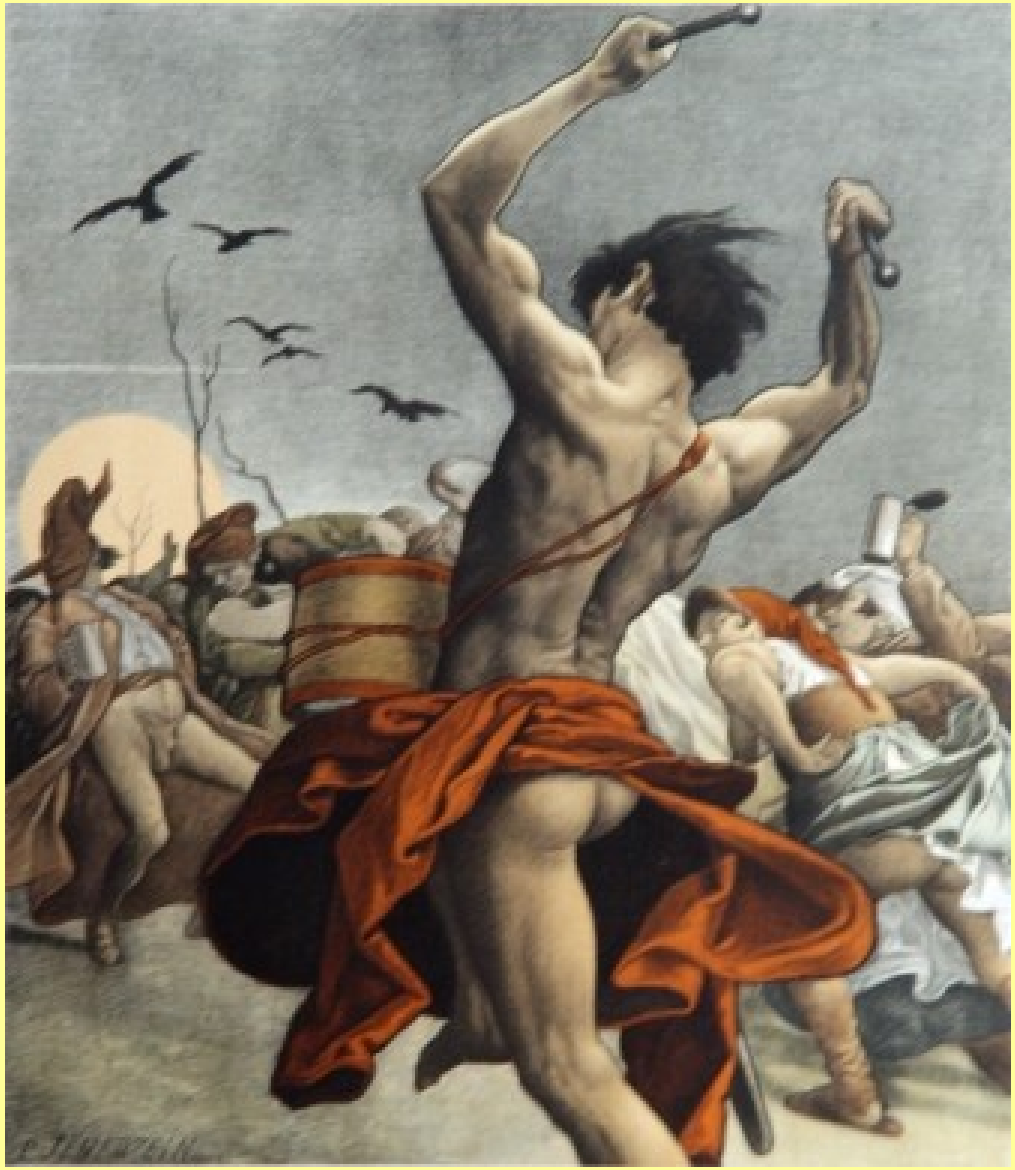
Homework 12

Successful homework 12 solvers:

Sorry, no answers have been received

Homework 13

The gouache of a Czech artist is a part of the cycle named after an infectious disease – which one?



Answer and questions

The solution of the homework and possible questions please mail (on Monday Dec. 12th at 6.30. at the latest) to the address

mvotava@med.muni.cz

Thank you for your attention