

## Sepsis and Infective Endocarditis

Michal Holub

Department of Infectious Diseases  
First Faculty of Medicine  
Charles University in Prague and University Military Hospital

## Bacteremia and Sepsis

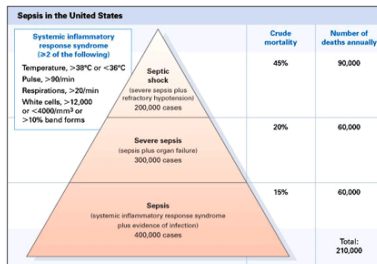
- bacteremia = presence of bacteria in the bloodstream
- sepsis = syndrome of systemic inflammatory response (SIRS) to infection
- sepsis = presence of focal bacterial infection in the body, from which bacteria are released, inducing systemic response

## Criteria of SIRS

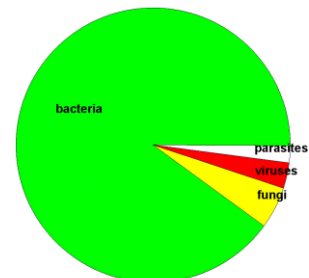
- temperature ( $^{\circ}\text{C}$ )  $>38$  or  $<36$
- heart rate (pulses/min.)  $>90$
- breathing rate (breaths/min.)  $>20$
- $\text{PaCO}_2$  (mm Hg)  $<32$
- leukocytes ( $\times 10^9/\text{l}$ )  $>12$  or  $<4$  or  $>10\%$  bands

## Epidemiology

- statistically sepsis is the main cause of death in ICU
- high incidence of sepsis - 900,000 cases annually (USA)
- sepsis is 7th cause of death (USA, E.U.)
- morbidity of sepsis is growing - aging of population, invasive therapy, immunosuppressive therapeutic procedures etc.



Wenzel RP. N Engl J Med 2002; 347:966.



## Pathogenesis

- infectious SIRS = reaction to bacteria or their signal molecules in blood circulation
- autoaggressive SIRS = inflammatory damage to organs
- syndrome of multiorgan dysfunction (MODS) or failure (MOFS)

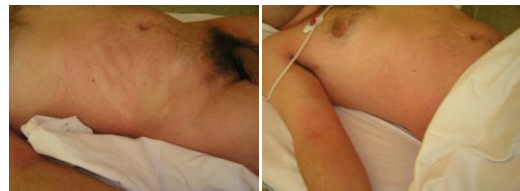
## Clinical stages

- sepsis
- severe sepsis (associated with MOFS)
- septic shock (circulatory failure)

## Clinical picture

- fever or hypothermia
- hypotension or tachycardia
- findings on the skin
- heart murmurs (endocarditis)
- alterations of mental status
- septic arthritis flebitides, erysipiel, early infections, etc.

## Toxic shock syndrome - TSS



## Sufusions in invasive meningococcal disease



## Diagnostics

- hemocultures (three pairs for aerobic and anaerobic cultivation)
- inflammatory markers
- laboratory and clinical marks of DIC
- findings of infectious foci (chest X ray, ENT examination, abdominal ultrasound, CT and others)
- neurological examination ⇒ lumbar puncture in case of alteration of consciousness and meningeal irritation

### Severe sepsis

- MODS/MOFS: ALI/ARDS, acute renal failure etc.
- circulatory failure - hypotension (syst. pressure <90 mm Hg)
- DIC - Gram-negative sepsis
- GIT failure, hepatic failure
- damage of CNS - septic encephalopathy

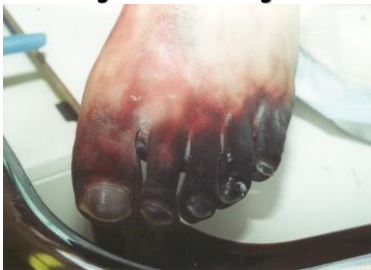
### Periferal vasoconstriction and hemorrhage



Acknowledgement: MUDr. M. Hejčí



### Gangrenes in meningococcal sepsis



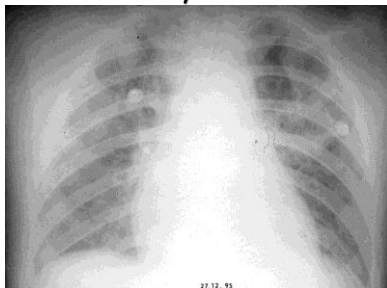
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### Gangrenes in meningococcal sepsis



### ARDS and myocarditis



27.12. 95

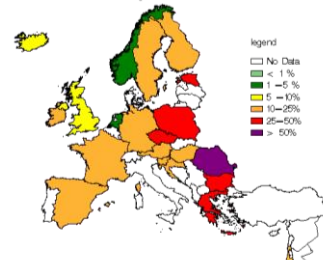
### Treatment of severe sepsis and septic shock

- fluid therapy, oxygenotherapy, circulatory support, insertion of catheters, mechanical ventilation and others
- antibiotics (!!!)
- source control - surgical evacuation of abscesses etc.
- corticosteroids, normoglycemia, normocalcemia etc.

### Nosocomial sepsis

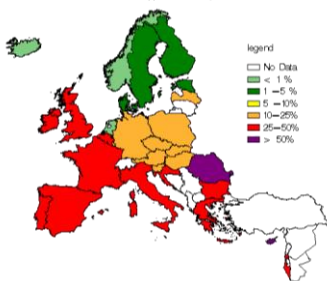


### Resistance of *P. aeruginosa* to carbapenems



Reprinted from EARSS Annual Report 2005, <http://www.earss.rivm.nl>

### MRSA in European countries



Reprinted from EARSS Annual Report 2005, <http://www.earss.rivm.nl>

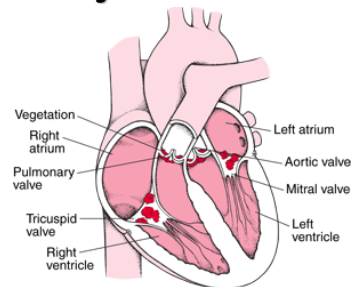
### Sepsis - the major cause of death in ICU

- 20-50% of patients in ICU suffer from nosocomial infection
- ventilatory pneumonia
- catheter-related sepsis
- urosepsis
- decubital sepsis

### Infective endocarditis

- life-threatening infectious disease
- presence of thrombus („vegetation“) on cardiac valve
- endocarditis on native valve
- endocarditis on valve implants

### Damage of valves



## Etiology

- ***Staphylococcus aureus*** - may infect pathologically changed and healthy valves
- **coagulase-negative staphylococci** (*S. epidermidis*, *S. haemolyticus*, *S. hominis*) - have affinity to artificial surfaces
- **viridans group streptococci** (*S. mitis*, *S. sanguis* a *S. mutans*) - in oral cavity and GIT
- **enterococci** - are common in GIT
- **Gram-negative bacteria and fungi**

## Etiology of native valve IE

- streptococci 55% (*S. viridans* [*sanguis*, *mutans*, *mitis*], *S. bovis*, *S. equinus*, *S. pyogenes* - group A)
- staphylococci 30% (*S. aureus*, *S. epidermidis*)
- enterococci 6% (*Enterococcus faecalis*, *E. faecium*)
- bacteria of the group HACEK (*Haemophilus* spp., *Actinobacillus actinomycetemcomitans*, *Cardiobacterium hominis*, *Eikenella* spp., *Kingella kingae*)

## Etiology in injection drug users

- *S. aureus* ~50%
- streptococci and enterococci ~20%
- *Candida* sp. ~6%
- Gram-negative bacteria ~6%

## Pathogenesis

*S. aureus* can attack intact valve

preexisting heart damage in 60-80% of patients



degenerative changes of valves (30-40%)  
post-rheumatic changes (<25%)  
inherited cardiac defects (6-25%)  
endothelial damage in catheterization (5-25%)

## Clinical picture

- sepsis with embolization into skin
- feverish condition in a patient with predisposing heart disease
- every feverish condition with isolation of viridating streptococci, *S. aureus*, enterococci and bacteria of the group HACEK from hemoculture
- migrating pneumonia
- unexplainable fever in intravenous drug users
- CVA picture associated with fever and increase of inflammatory parameters



## Diagnostics and therapy

echocardiography

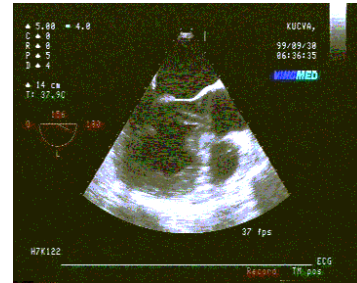
hemocultivation

staphylococci - oxacilin (12-18 g/day) + adjunctive antibiotic

streptococci and enterococci - penicillin (10-20 mil IU/day)  
+ adjunctive antibiotic

unknown etiology with subacute course - ampicillin/sulbactam  
+ gentamicine

unknown etiology with acute course - vancomycin + adjunctive  
antibiotic



\*specimen should be taken before fever spikes

\*specimen is taken to STARDARD bottles before administration of antibiotics

\*PLUS bottles can be used in patients treated with antibiotics

\*site of venipuncture must be properly disinfected

\*the amount of collected blood is usually 8-10 mL in adults

\*the amount of blood in children is usually 2-3 mL („Pedi“ bottle)

## Life-threatening complications

- valve damage
- congestive heart failure
- spread of infection to subvalvular tissue
- septic embolisation of organs
- aneurysm of blood vessels
- multiple organ failure

## Preventive measures and antibiotic prophylaxis for dental patients at risk for infection

### Dental procedures for which prophylaxis is reasonable

- manipulation of gingival tissue
- manipulation with periapical region of teeth
- perforation of the inflamed oral mucosa

### No prophylaxis

- anesthetic injections through non-infected tissue, dental radiographs, placement of orthodontic appliances, bleeding from trauma to lips or oral mucosa

**Table 1. CARDIAC CONDITIONS ASSOCIATED WITH THE HIGHEST RISK OF ADVERSE OUTCOME FROM ENDOCARDITIS FOR WHICH PROPHYLAXIS WITH DENTAL PROCEDURES IS REASONABLE**

- Prosthetic cardiac valve or prosthetic material used for cardiac valve repair
- Previous infective endocarditis
- Congenital heart disease (CHD)\*
  - Unrepaired cyanotic CHD, including palliative shunts and conduits
  - Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure†
  - Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization)
- Cardiac transplantation recipients who develop cardiac valvulopathy

\* Except for the conditions listed above, antibiotic prophylaxis is no longer recommended for any other form of CHD.  
† Prophylaxis is reasonable because endothelialization of prosthetic material occurs within 6 months after the procedure.  
Circulation. 2007;116:1745. Reprinted with permission ©2007, American Heart Association, Inc.‡

## Recommendation for patients with cardiac condition

- daily oral hygiene
- daily plaque removal
- daily flossing
- regular dental care

## Patients with compromised immunity

- secondary immunodeficiencies: HIV, neutropenia, cancer chemotherapy and hematopoietic stem cell or solid organ transplantation
- head and neck radiotherapy
- autoimmune diseases
- sickle cell anemia
- asplenicism
- diabetes and chronic steroid usage

**Table 3. REGIMENS FOR A DENTAL PROCEDURE**

Situation	Agent	Regimen: Single Dose 30 to 60 min Before Procedure	
		Adults	Children
Chd†	Ampicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin OR	2 g IM or IV	50 mg/kg IM or IV
	Cefazolin or ceftriaxone	1 g IM or IV	50 mg/kg IM or IV
Allergic to penicillin or ampicillin—oral	Cephalexin**	2 g	50 mg/kg
	OR	600 mg	20 mg/kg
	Clindamycin	500 mg	15 mg/kg
Allergic to penicillin or ampicillin and unable to take oral medication	Azithromycin or clarithromycin	500 mg	15 mg/kg
	Cefazolin or ceftriaxone†	1 g IM or IV	50 mg/kg IM or IV
	OR	600 mg IM or IV	20 mg/kg IM or IV
	Clindamycin	600 mg IM or IV	20 mg/kg IM or IV

IM indicates intramuscular; IV, intravenous.  
\* Or other first- or second-generation oral cephalosporin in equivalent adult or pediatric dosage.  
† Cephalosporins should not be used in an individual with a history of anaphylaxis, angioedema, or urticaria with penicillin or ampicillin.  
‡ Circulation. 2007;116:1747. Reprinted with permission © 2007, American Heart Association, Inc.‡

**PRŮKAZ NEMOCNĚHO OHROŽENĚNĚ  
INFEKČNÍ ENDOCARDITIDOU**

Pacient: \_\_\_\_\_  
 Rodné číslo: \_\_\_\_\_  
 Srdce (zdravělo):  
 **vystaž**  
 **ne** (chirurgický zákrok, léky po infekční endokarditidě)  
 **střední**  
 **ne** (léky dlouhodobě, onemocnění srdce, hypertenze, infarkt, ateroskleróza)  
 **ne** (ne)  
 **ne** (srdce, onemocnění, defekt septa, aort. aneurizma, aortitida, endokarditida, infarkt)  
 Výše MUDr.: \_\_\_\_\_  
 Adresa: \_\_\_\_\_  
 Telefon: \_\_\_\_\_

**PROFYLAXE PRO VYVOZCE V OBLASTI  
KARDIOVASCULÁRNÍ**

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## Postoperative antibiotic therapy

- procedures involve infected tissues
- procedures on a patient with compromised immunity

## Post-procedural symptoms of acute infection

- fever
- malaise
- weakness and lethargy