Sepsis course – III: Clinical signs of sepsis

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SZTE, AITI

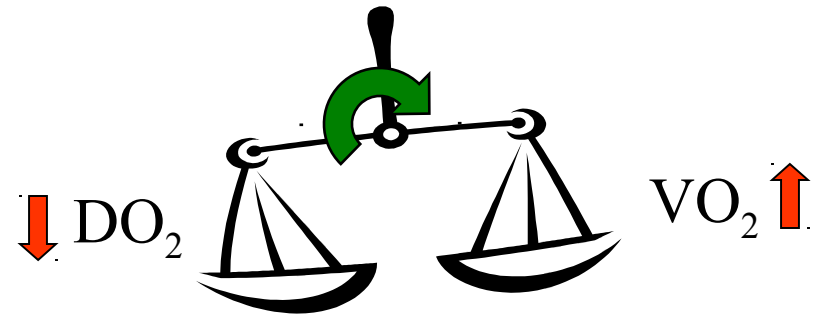
Case

- 65 year old man
- Malaise, fever for 2 days – A&E
- On assessment
  - Frail looking patient
  - Sleepy, but answers for questions
  - Sweaty, cold hands, peripheral cyanosis
  - Tachypnoe
  - P = 130/m, BP = 75/35 mmHg
  - SpO_2 = 85%, PaO_2= 62 mmHg
  - T: 39 C

Why do patients get into trouble?

The debt…

- $DO_2 = \underbrace{(SV \cdot P)}_{CO} \cdot \underbrace{(Hb \cdot 1.39 \cdot SaO_2 + 0.003 \cdot PaO_2)}_{CaO_2} \sim 1000 ml/m (SaO_2 = 100\%)$
- $VO_2 = CO \bullet (CaO_2 - CvO_2) \sim 250$ ml/m ($ScvO_2 \sim 70\text{-}75\%$)
- In critical illness:
- Sokk = $VO_2 > DO_2$



How can we assess it?

Vital organs

- Brain
- Heart/circulation
- Lungs/respiration
- Kidneys
- Liver/GIT
- Haematology

Vital organs - brain

- Consciousness: „Glasgow Coma Scale” (GCS)
  - Eyes: 1-4
  - Verbal response: 1-5
  - Motor response: 1-6
  - Evaluation:
    - 15 = awake, oriented (clear)
    - 3 = coma
    - Critical threshold: 6-8 (airway maintenance)
  - Quick assessment:
    - **A**dequate
    - **V**erbal response

    } OK

    - Resp. to **P**ain
    - **U**nresponsive

    } ET

Reasons

- A
- T
- O
- M
- I
- C

Reasons

- A – alcohol
- T
- O
- M
- I
- C

Reasons

- A – alcohol
- T – trauma
- O
- M
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Reasons

- A – alcohol
- T – trauma
- O – overdose
- M
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Reasons

- A – alcohol
- T – trauma
- O – overdose
- M – metabolic (BS, renal-, liver-failure)
- I
- C

Reasons

- A – alcohol
- T – trauma
- O – overdose
- M – metabolic (BS, renal-, liver-failure)
- I – infection (sepsis)
- C

Reasons

- A – alcohol
- T – trauma
- O – overdose
- M – metabolic (BS, renal-, liver-failure)
- I – infection (sepsis)
- C – CO (burn, smoke)

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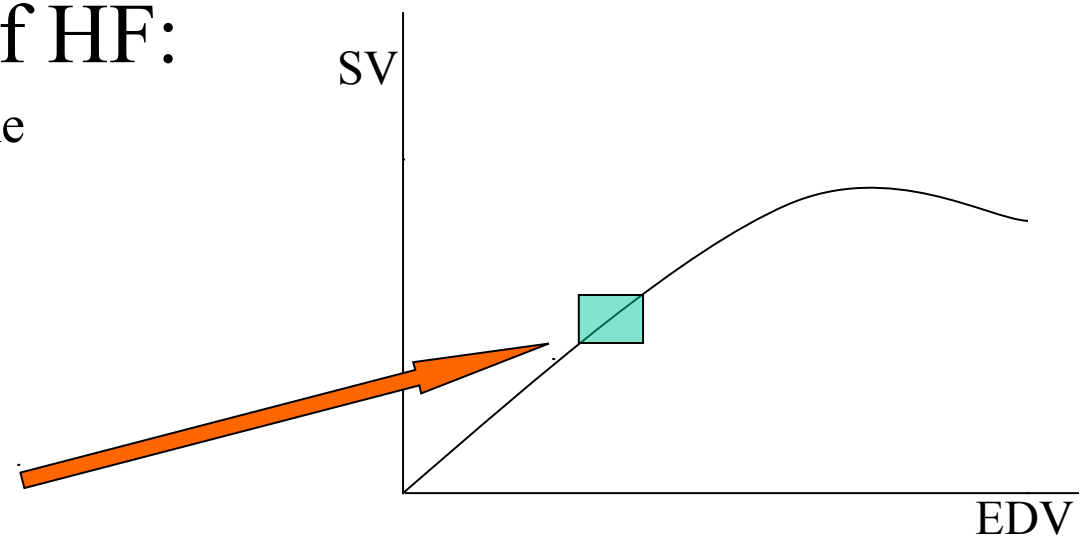
- AVPU
- GCS: 3-5-6=14

Vital organs - CVS

- Otto Frank, Ernest Starling – 1914: „Law of the heart”
  - „The mechanical energy set free in the passage from the resting to the active state is a function of the length of the fiber„
  - „Within physiological limits, the force of contraction is directly proportional to the initial length of the muscle fiber”
- Most common reasons of HF:
  - Reduced circulating volume
  - Reduced pump function

„Normal state”



Starling EH. The Linacre Lecture on the Law of the Heart. London; 1918
Starling EH. *J R Army Med Corps*. 1920; 34: 258-262

Vital organs - CVS

- Global measures
  - HR, MAP
  - $ScvO_2$ <70%, or >80%(?)
- Assessing perfusion
  - Capillary refill
  - Core-peripheral temperature difference
  - Urine production
- Metabolic signs
  - Metabolic acidosis (high lactate, low HCO_3)
- „Sepsis-syndrome" definition (part):
  - Tachycardia (>90/perc)
  - Hypotension (systolic < 90Hgmm)

Bone RC, et al. *N Engl J Med* 1987; 317: 654

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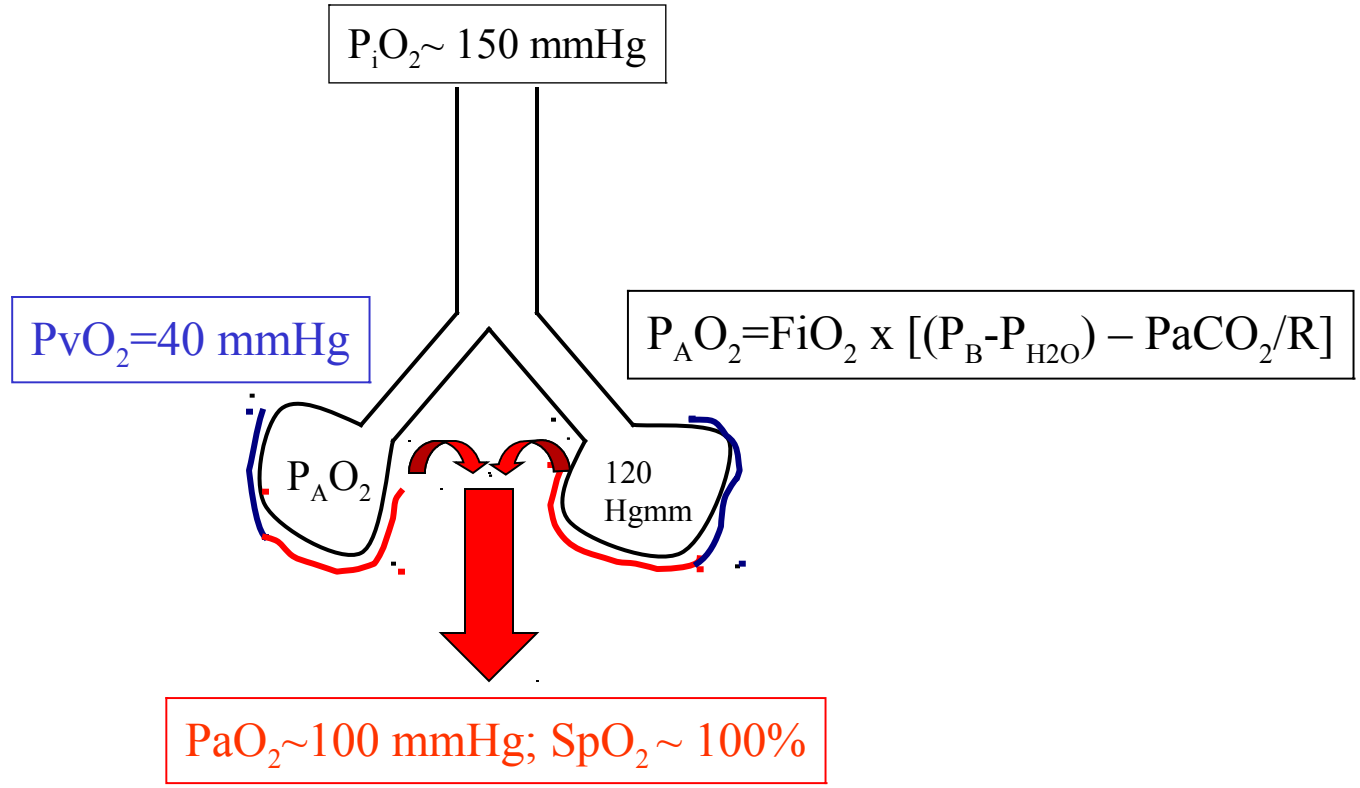
- Centralised circ.
- Tachycardia
- Syst < 90 mmHg

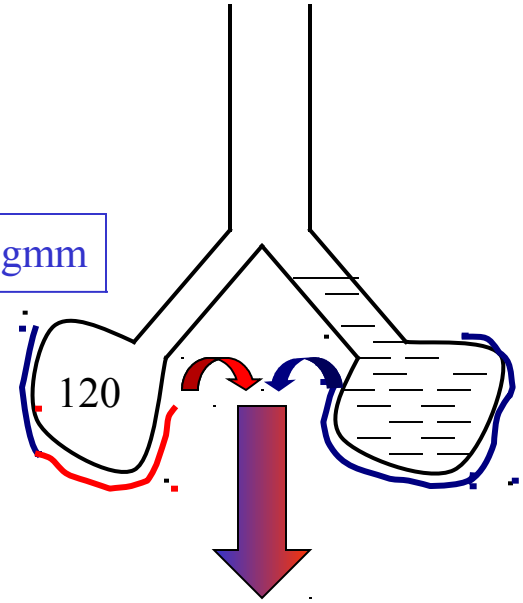
Vital organs - lungs

- Oxygenation
  - PaO_2/FiO_2
  - PaO_2~100 mmHg
  - F(raction of) i(nspired) O_2 = 0.21 (21%)
  - PaO_2/FiO_2= 100/0.21 = 476 mmHg
- Ventilation
  - $PaCO_2$ ~ 40 mmHg
  - Hypoventilation = high $PaCO_2$
  - Hyperventilation = low $PaCO_2$

Alveolar oxygenation



Venous admixture



$PaO_2 = (120+40)/2 = 80$ mmHg; $SpO_2 \sim 94$ %

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- Hypoxia

Vital organs - kidneys

- Hourly diuresis
  - ~ 1 ml/kg/hour
  - <0.5: oliguria
  - <0.2: anuria
- Function
  - BUN, creatinine
  - K^+
  - HCO_3
  - Acidosis = low HCO_3 (hyperkalaemia)
  - Alkalosis = high HCO_3 (hypokalaemia)

Reasons of ARF

- Mostly secondary in sepsis
- Mainly pre-renal
  - Hypovolaemia
  - Hypoperfusion
  - Hypoxia

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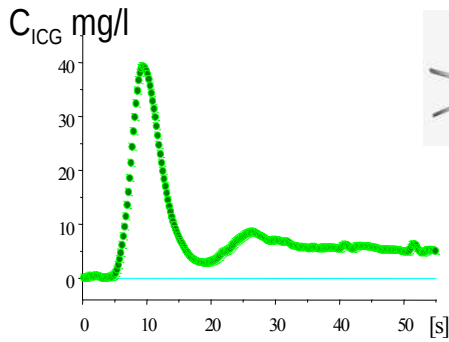
- Hypoperfusion
- Hypoxia

Vital organs – liver/GIT

- Liver function
  - For „physicians”: AST, GPT, ALP, LDH, γGT
  - For „intensivists”: Bi, Prothr, albumin

Reisman Y, et al. *Hepatogastroenterology* 1997; 44: 982-989

- Indicyanine green (ICG) – clearence:



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- Hypoperfusion
- Hypoxia

Vital organs - haematology

- Bone marrow
  - Hb (Htc)
  - Platelets

Objektive signs of organ dysfunction

	0	1	2	3	4
CNS (GCS)	15	13-14	10-12	7-9	≤6
CVS (P, inotr., lactate)	≤120	120-140	>140	Inotr.	seLactate>5
Resp (PaO_2/FiO_2) >300	226-300	151-225	76-150	≤75	
Ren (seCreat)	≤100	101-200	201-350	351-500	>500
Liver (seBi)	≤ 20	21-60	61-120	121-240	>240
Hemat (TCT)	>120	81-120	51-80	21-50	≤20

Cook R et al. *Crit Care Med* 2001; 29: 2046

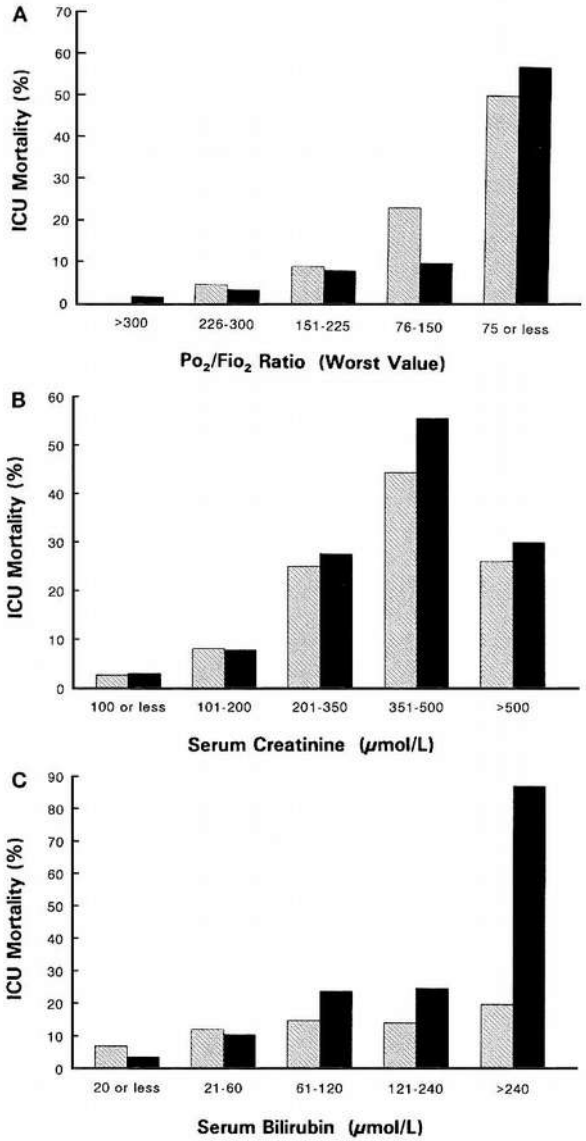
- Most frequently found early signs:
  - Arterial hypoxemia: 60%
  - Arterial hypotension: 57%
  - Metabolic acidosis: 47%

Bogár L. *Infektológia* 2007; 14: 1-6

  - Atrial fibrillation: >10%
  - Altered level of consciousness: >10%

Low DE, et al. *J Gastrointest Surg* 2007; 11: 1395

Organ dysfunction dynamics and outcome



- SOFA score dinamics and outcome:
  - 0-1. day
  - CVS (p=0.0010)
  - Creat (p=0.0001)
  - PaO_2/FiO_2 (p=0.0469)
- Se creat increase and mortality
  - ~100µmol/24h p<0.05

Levy MM et al. *Crit Care Med* 2005; 33: 2194

Marshall JC et al. *Crit Care Med* 1995; 23: 1638

Severe sepsis and septic shock

ACCP/SCCM. *Crit Care Med* 1992; 20: 864

- Sepsis
  - SIRS + infection
- Severe sepsis
  - Sepsis + organ dysfunction (hypoperfusion, hypotension)
- Septic shock
  - After adequate fluid resuscitation:
  - Hypotension
  - Vasopressor (noradrenaline, dopamin) requirement
  - Organ, tissue hypoperfusion

ICU

After resuscitation

- CNS: GCS=3-5-6 (14)
- CVS: (500 ml koll) P = 130/m, BP = 75/35 mmHg
- Resp: (O_2 mask) SpO_2 = 92%, PaO_2=68 mmHg
- Renal: 20ml/h
- Liver: Normal
- Hemat: WBC = 13 000 G/l

Conclusion

- Resuscitation
  - O_2, fluid, monitoring
  - Blood tests, CXR
- CXR: pneumonia l.d.
- Dg: severe sepsis?
- Transfer to ICU
- To be cont….

Motto

Diagnsis can wait, but cells can’t!