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MODS (Multiple Organ Dysfunction Syndrome)

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Learning Outcomes

- Student will able to define and recognize Multiple Organ Dysfunction Syndrome (MODS)
- Student will know aetiology and mechanisms of MODS
- Student will know basic principles regarding management of patient with MODS

Definition of MODS

- Acute dysfunction of two or more organs with potential reversibility.
  - = mainly functional injury (reversible) not structural!
- Very frequent syndrome in critically ill patients
- MODS is not specific disease (nosological entity) but MODS is syndrome common for multiple aetiological factors
- Severity of MODS is due to high mortality which is positively correlated to the number of failing organs

Aetiology of MODS

- All critical care patients are in the risk of progression their disease to the MODS
- The most frequent cause of MODS is **sepsis**
- Non-infection aetiology:
  - Trauma
  - Burns
  - Major surgery
  - Shocks (all types)
  - Pancreatitis
  - GIT bleeding
  - Post-CPR syndrome

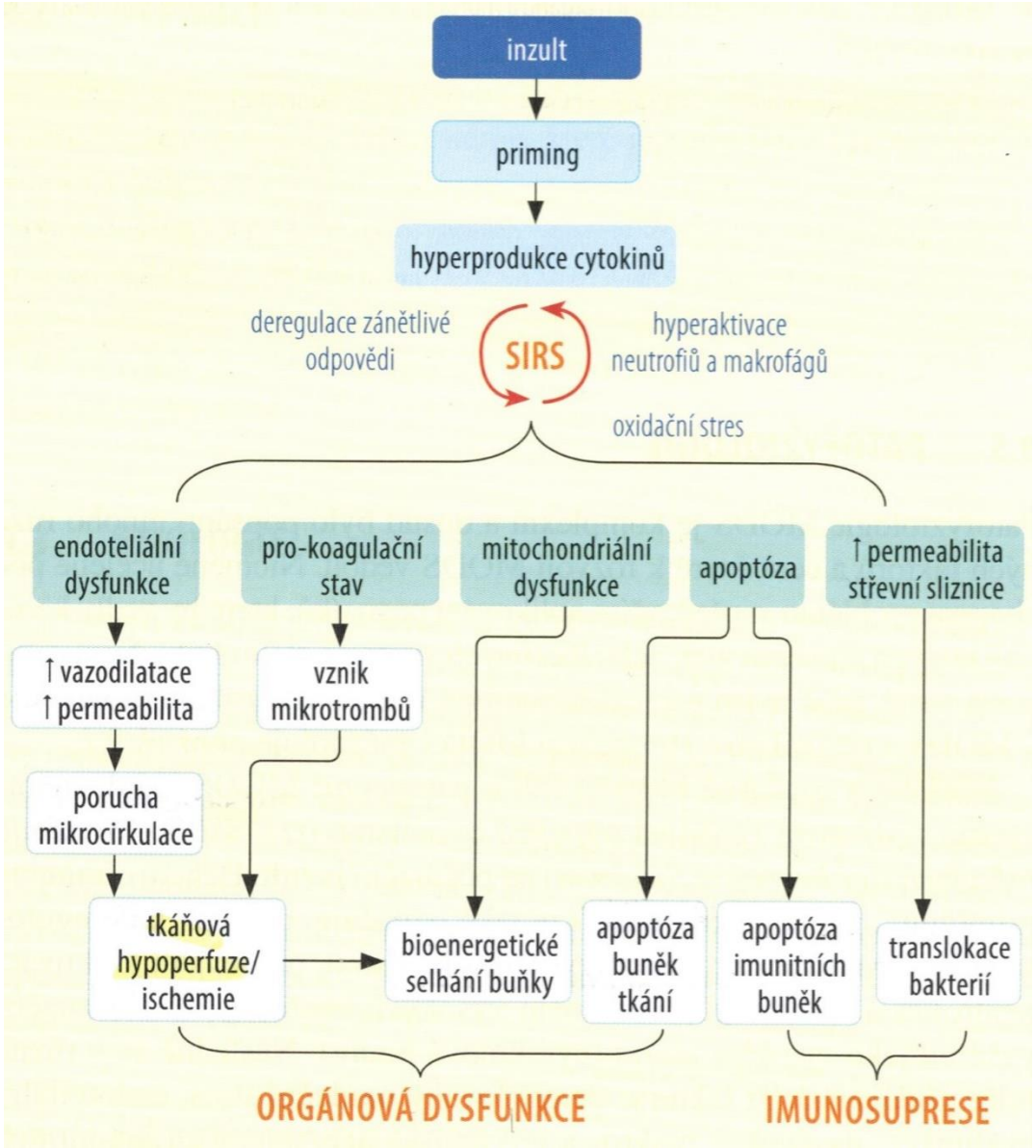
Pathophysiology of MODS

- Pathophysiology is very complex
- Many factors supporting development of MODS
- Risk factors for MODS:
  - Age
  - Nutrition
  - Physiological reserves
  - Immunity
- Major role: dysregulated Systemic inflammatory response syndrome **- SIRS** (activation of inflammatory pathways)
  - Activation of neutrophils and macrophages, high levels of cytokines
- The result is functional injury to the organs

Pathophysiology of MODS - SIRS

- Complex of non-specific reaction aiming to localise and eliminate the primary insult = activation of inflammation in primary non-affected tissues results in their injury
- **Oxidative stress**: overproduction of reactive forms of 0_2 -> direct injury plus signal molecules enhancing inflammatory response
- **Endothelial dysfunction:** enhanced permeability plus activation of coagulation
- **Dysfunction of macrocirkulation** (shock) + **microcirculation**: *micro thrombi, endothelial dysfunction, shunting, dysfunction of vasodilatation*
- **Dysfunction of GIT**: permeability, translocation of bacteria -> stimulation of inflammatory response

Pathophysiology of MODS



Zdroj tabulka: J.Maláska a kol., Intenzivní Medicína v praxi; Maxdorf, 2020

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Presentation, diagnostics and scoring systems

- Clinical presentation is closely connected to the dysfunction of each system.
- Assessing function/dysfunction of each organ is part of scoring system: **SOFA**:
  - CNS
  - Respiration
  - Circulation
  - Kidney
  - Liver
  - Haemocoagulation
- Daily assessment of SOFA for evaluation MODS dynamics

CNS dysfunction

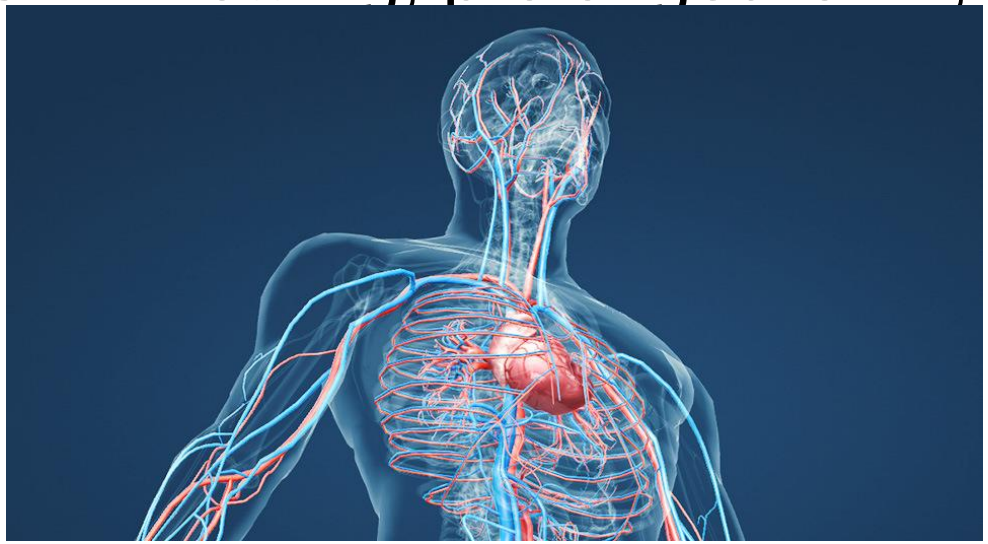
- Direct injury of haematoencephalic barrier, translocation of cytokines and inflammatory cells
- Change of consciousness - **delirium** (frequently early sign of MODS), late quantitative changes H
- Assessment tool - GCS

Lung Dysfunction

- Extravasation of fluids in the intersticium or alveoli due to the inflammatory changes
- ARDS (P/F ratio < 300 mm Hg)
- X-ray/ CT - bilateral infiltration

Dysfunction of circulation

- Development of SHOCK- distributive shock (cardiogenic shock due to the cardiomyopathy)
- Dysfunction of macrocirculation: hypotension plus need for vasopressors
- Dysfunction of microcirculation: skin mottling, prolonged CRT, lactate elevation



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Dysfunction of kidney

- Development of AKI (Acute Kidney Injury)
  = functional changes in the tubules and microcirculation of kidney

- Low UO (Urine output)
- Elevation of creatinine and BUN

Dysfunction of liver

- Signs: elevation of bilirubin, liver enzymes (100x
- Dysfunction of synthetic function – diminished coagulation
- Dysfunction of regulatory function hypoglycaemia

Dysfunction of haemocoagulation

- Signs: DIC, low platelets and dysfunction of coagulation
- Patients with dysfunction of liver and haemocoagulation ha
  the highest risk of mortality

– *Other organ dysfunctions that are not part of SOFA score*

Dysfunction of GIT

– Symptoms: paralytic ileus, stress ulcer, GIT bleeding

Dysfunction of muscles

– Symptoms: neuropathy, myopathy

Management of MODS

- Basic principle is early and agressive treatment of underlying cause
- After control of underlying cause there is only support of each organ
- Oran support replace normal organ function and saves times for functional recovery of each organ =
- Apart of organ support there is *general supportive care* in the ICU:
  - Prevention of nosocomial infections
  - Prevention of TED
  - Nutrition
  - Rehabilitation

Management of MODS

Failing organ	Organ support
Lung	Artificial ventilation, ECMO
Circulation	Fluid, vasopressors
Kidney	Renal replacement therapy
Liver	Nutrition
Haemocoagulation	Substitution, prevention of TED
CNS	Sedation
GIT	Stress ulcer prophylaxis
Muscles	Nutrition, rehabilitation

Table: J.Maláska a kol., Intenzivní Medicína v praxi; Maxdorf, 2020
Picture: www.bbraun.cz

Clinical Vignette – Day 1

- Man, 76 age, admitted to internal ICU for general deteoriation and emesis.
- Diagnosis of sepsis was identified due to infected retroperitoneal haematoma on the left side
- Initially with coagulopathy. After blood therapy and coagulation management the surgery was performed: perirenal abscess and nephrectomy was performed
- Due to circulatory instability admitted to the multidisciplinary ICU
- Sepsis is typical cause for MODS, SOFA on admission 10
- Admission:
  - A+B: artificial ventilation, intubation
  - C: Afib, HR 150, NOR 0,54 ug/kg/min, lactate. 2,2
  - D: sedated
  - R: UO 30 ml/h, creat 346 Umol/l
  - L: bili 56 umol/l

Clinical Vignette – Day 3

- Infusion of crystalloids and cardioversion with amiodarone
- Stop of sedation and patient is on spontaneous mode of ventilation
- After SBT patient was successfully extubated
- Progressive stabilisation, SOFA 12 .. 10:
  - A+B: spontaneous ventilation,
  - C: Afib, HR 100, NOR 0,13 ug/kg/min, lactate. 0,8
  - D: GCS 15
  - R: UO 20 ml/h, creat 353Umol/l
  - L: bili 19 umol/l

Clinical Vignette – Day 4

- 4.den worsening of consciousness with respiratory insufficiency and need for reintubation
- CT of the brain without pathology
- Due to progression of AKI there was a need for two session of IHD
- MODS induced by **sepsis** was potentiated by repeated surgery

- After initial improvement of MODS, SOFA is now 11:
  - A+B: PSV, light oxygenation dysfunction
  - C: Afib, HR 80, NOR 0,04 ug/kg/min, lactate. 0,9
  - D: Delirium
  - R: 2x IHD
  - L: bilirubin normal

Clinical Vignette – Day 7

- Tracheostomy is performed
- EEG without seizures, signs of slightly disturbed signal and thereafter slowly improvement of consciousness
- Transfer to surgical ICU
- With early and effective **control of primary cause** with **adequate organ support** and good physiological reserves states could improve and organ functions slowly normalize
- SOFA 11 -> 7:
  - A+B: tracheostomy, spontaneous ventilation, no oxygenation dysfunction
  - C: Afib, HR 100, NOR 0,04’8 ug/kg/min, lactate. 0,9
  - D: GCS 15, cooperated
  - R: U 20,5, creat 201, Lasix
  - L: bilirubin normal

Take home message

- MODS is syndrome due to progression of different disease and insults with severe prognosis
- Basic management of MODS is early identification of underlying cause and effective control
- Organ support doesn‘t “heal“ but temporarily replace specific organ function and takes time for reparation of organ function

SOURCES

- J.Maláska a kol., Intenzivní Medicína v praxi; Maxdorf, 2020

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