

MUNI
MED

Shock - treatment

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Learning outcomes

- Student will learn how to treat different types of shock

Treatment in general

1. Initial resuscitation

2. Causal treatment

- Goal is to restore organ perfusion, O₂ supply

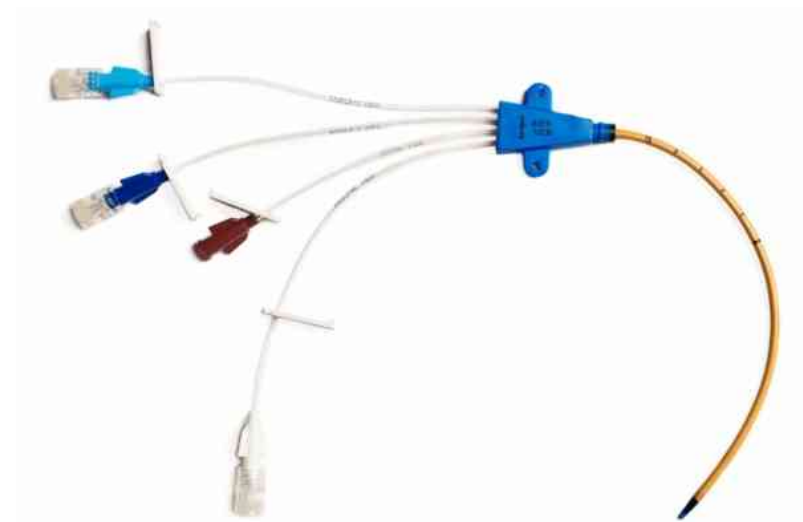
MUNI MED Hypovolemic shock

Hypovolemia, bleeding

Venous access

- 2-3 thick peripheral cannulas
- Central venous access is secondary (good for catecholamine, not so much for fluids)

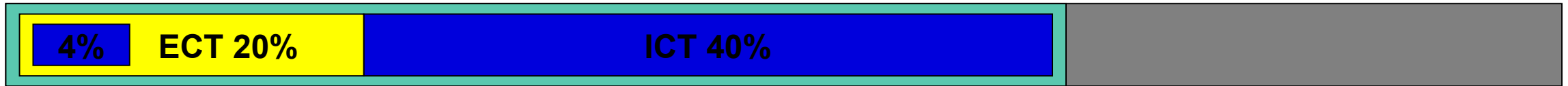
$$\frac{\Delta V}{\Delta t} (Q) = \Delta P \cdot \frac{\pi}{8} \cdot \frac{1}{\eta} \cdot \frac{R^4}{L}$$



<https://www.bactiguard.com/products/intensive-care/bip-cvc/>

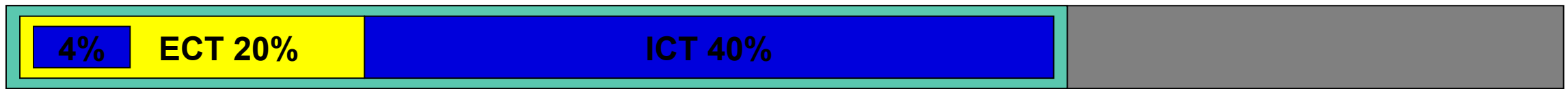
Witch fluid to use?

- distribution ICT/ECT ---- Ions Na^+ and K^+
- distribution plasma/ECT ---- oncotic pressure



Glucose

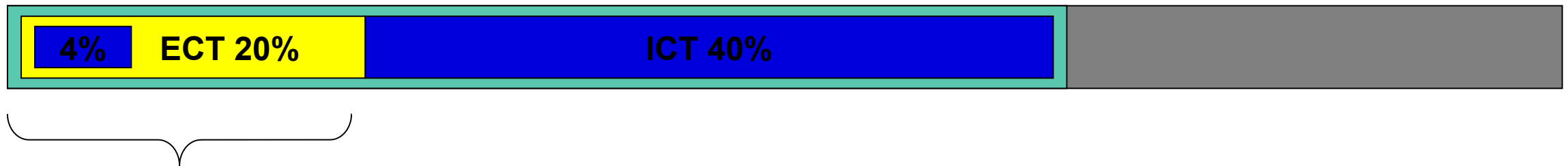
- Inadequate
- Absolute water deficit
- Hyponatremia correction



Distribution volume

Crystalloids

- Balanced/Normal saline
- Fast leak into the ECT compartment
- Substitution has to be 4x higher than the deficit (questioned ...) → **swellings**



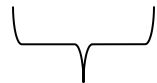
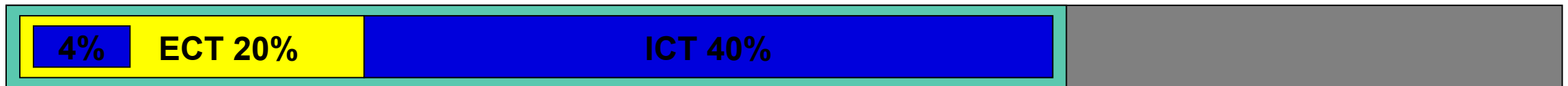
Distribution volume

Context sensitive interval

- Fluid volume effect depends on a clinical situation in which the fluid is administered
- Volume effect of crystalloids is bigger if administered in hypovolemia (low hydrostatic pressure)
- Importance of glycocalyx

Coloids

- Do not leave the intravascular compartment
- Equal the deficit
- Adverse reactions, contraindication – sepsis – renal damage
- Good for acute blood loss



Distribution volume

Intenzivní medicína – cvičení (VLAM9X1c)

Blood products

- Only for blood loss corrections
- 5% albumin – natural colloid
 - +/- expensive
 - hemodynamic optimization

Bleeding treatment

- Stop the bleeding
- Give i.v. fluids + catecholamines
- Give erythrocytes: type 0- (immediately available), after +/- 30 minutes type matched
- Fresh frozen plasma 1:1 with erythrocytes
- Target Hb 70-90 g/l
- Thrombocytes 50 – 100 tis/ul
- Fibrinogen 1,5 g/l
- Calcium (citrate in ERY and FFP)
- Prevent hypothermia, hypotension and acidosis

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Cardiogenic shock

Acute coronary syndrome, arrhythmias, myocarditis

ACS - treatment

- Oxygen to maintain O₂ saturation 92-94%
- Analgosedation - morphine
- ASA 325 mg
- heparin 5000 IU i.v. / enoxaparin 1 mg/kg s.c./i.v.
- ADP blockers (usually after PCI)
- Beta blockers - metoprolol i.v. (tachycardia)
- Diuretics – in case of pulmonary edema

Heart failure - treatment

- **Oxygen** – increase O₂ supply to get O₂ saturation about 92-94%
- **NIV, invasive ventilation** – oxygenation, decreases preload/afterload
- **Diuretics/fluids** – decrease preload, in later phase optimization of preload (fluid challenge/PLR)
- **Catecholamine** – norepinephrine for blood pressure, dobutamin (milrinon, levosimendan) for inotropy
- **Vasodilatancia** – nitrates, coronary artery, but also systemic vasculature (increased blood pooling - preload lowering; arterial – afterload lowering)
- **Morphine** – improves dyspnea

Avoid

- **Tachycardia** – short diastolic phase, increased work load (however, sometimes only chance how to increase CO)
- **Severe hypotension, hypovolemia, vasodilatation** – low coronary artery perfusion pressure (Ao pressure – EDP LV)
- **Increased afterload** – increase of wall tension, work

MUNI 3 Obstructive shock MED

Pulmonary embolism, tamponade, tension pneumothorax

1. High risk PE (shock, hypotension)

- CT angio or ECHO, if CT unavailable/impermissible for the patient
- CT/ECHO positive - trombolysis

Thrombolysis

- **Thrombolysis** – optimally within 48 hrs
alteplasis (0,9 mg/kg)—10 mg bolus iv. + 90 mg cont. iv. for 2 hrs
- Also RV dysfunction, TNT, NTproBNP
- + heparin - UFH 80 IU/kg bolus + 18 IU/kg/hr

Thrombolysis contraindications

Absolute Contraindications for Thrombolytic Treatment

- Recent intracranial hemorrhage (ICH)
- Structural cerebral vascular lesion
- Intracranial neoplasm
- Ischemic stroke within three months
- Possible aortic dissection
- Active bleeding or bleeding diathesis (excluding menses)
- Significant head injury or facial trauma within three months
- Recent Intracranial or spinal surgery
- Severe uncontrolled hypertension
- For streptokinase, previous treatment within six months

Fugate JE, Rabinstein AA. Absolute and Relative Contraindications to IV rt-PA for Acute Ischemic Stroke. Neurohospitalist. 2015 Jul;5(3):110-21

2. Low risk PE (without shock/hypotension)

- High clinical suspicion – CT angio
- Low clinical suspicion – DD

- Negative DD nearly completely exclude PE

Low risk PE

UF heparin – bolus 80IU/kg + 18IU/kg/hr—aPTT 1,5-2,5 times norm

- At least 6-10 days, than warfarin/OACS

LMWH- as effective as UFH, s.c. every 12 hrs

- At least 6-10 days, than warfarin/OACS
- Cave – renal dysfunction, antiXa (0,6-1,0 U/ml) 3 hrs after administration

Others

- Tension pneumothorax – decompression, chest drainage
- Pericardial tamponade - pericardiocentesis

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4 Distributive shock

Septic shock

Antibiotics

- As soon as possible (within one hour)
- Initially broad spectrum, de-escalation as soon as the microbial agent is identified
- 7-10 day duration is usually enough
- Longer if source is not under control, clinical response is slow, STAU infection, PSAE infection, immunodeficiency
- Daily evaluation, PCT

Source control

- As soon as possible

Fluid resuscitation

- Fluid challenges
- Start crystalloids 30ml/kg (if hypotension, high Lac)
- Solution of albumin
- No synthetic colloids

Catecholamines

- **Norepinephrine** is the first choice
- Additional **vasopressin** – to fortify NE / to lower NE dose (pulmonary hypertension, tachyarrhythmias)
- **Dobutamin** – signs of hypoperfusion despite adequate fluid resuscitation
- **Dopamin** – no beneficial effect on renal function

Corticosteroids

- If hemodynamic instability despite fluids and catecholamines
- 200mg HCT/day – continuous infusion or qid

Take home message

- Treatment of shock involves initial resuscitation of hemodynamics and causal treatment

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