Sepsis course – IV: Organ support in sepsis

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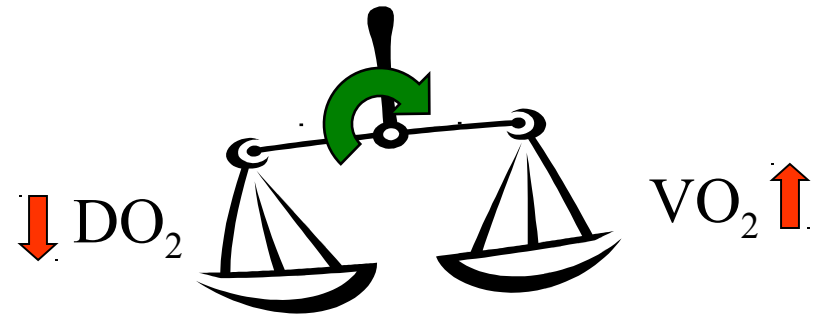
Case

- 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…

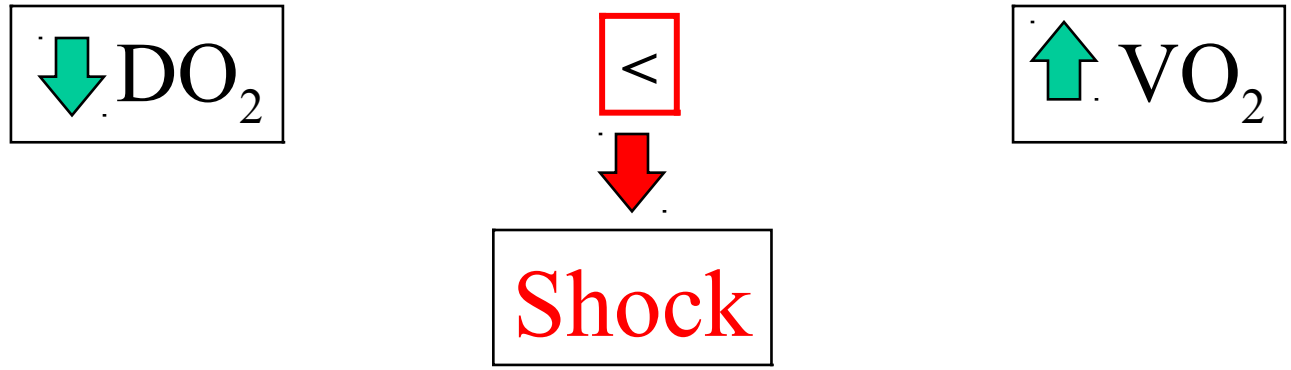
- $DO_2 = \underbrace{(SV \cdot P)}_{CO} \cdot \underbrace{(Hb \cdot 1.39 \cdot SaO_2 + 0.003 \cdot PaO_2)}_{CaO_2} \sim 1000 ml/p \ (SaO_2 = 100\%)$
- $VO_2 = CO \bullet (CaO_2 - CvO_2) \sim 250 \ ml/p \ (ScvO_2 \sim 70\text{-}75\%)$
- In critical illness:
- Sokk = $VO_2 > DO_2$



Reasons of shock

- Hypovolaemia
- Hypoxaemia
- Heart failure

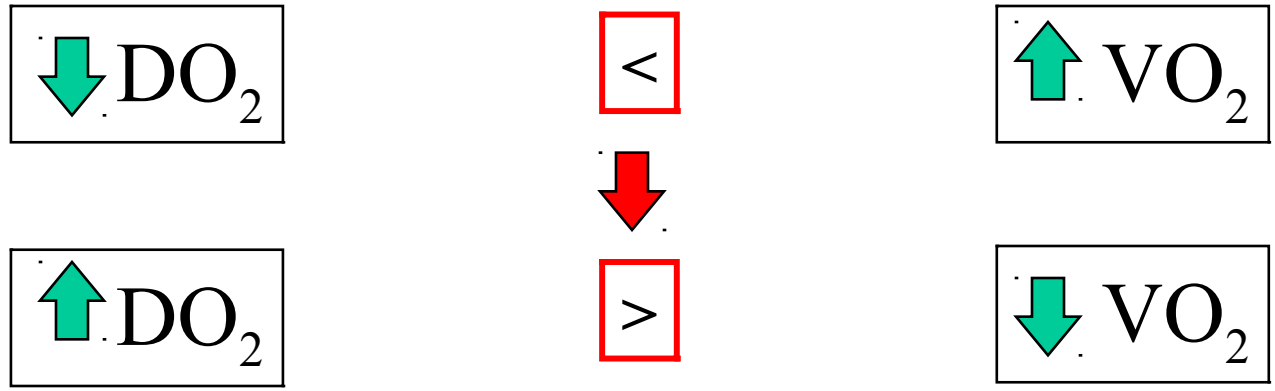
- Pain
- Stress
- Tachypnoe



Aim of resuscitation

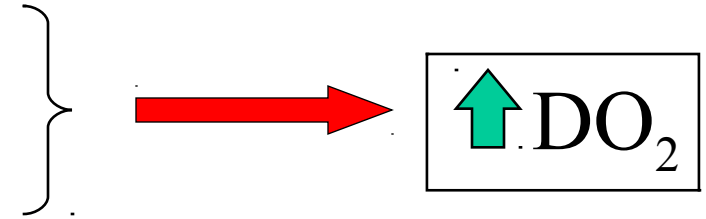
- Hypovolaemia
- Hypoxaemia
- Heart failure

- Pain
- Stress
- Tachypnoe



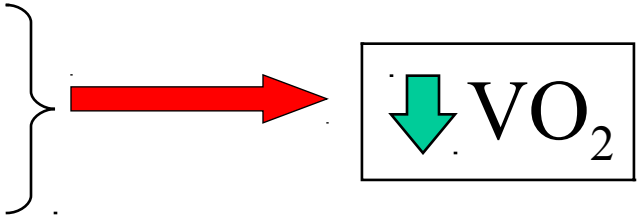
Interventions

- Oxygen
- Venous access



- Monitoring (SpO_2, NIBP, EKG)

- Pain relief
- Warming



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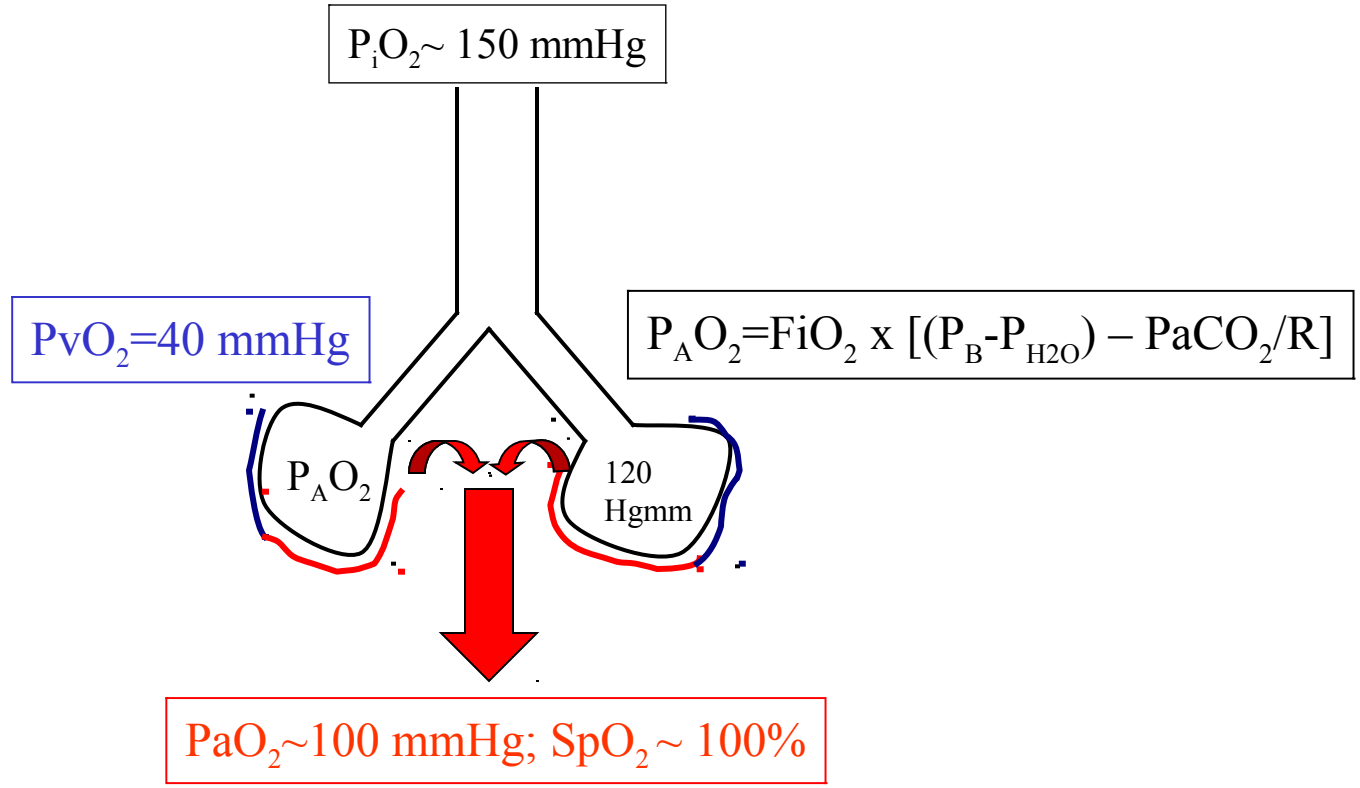
- Hypoperfusion
- Hypotension
- Hypoxia

The debt…

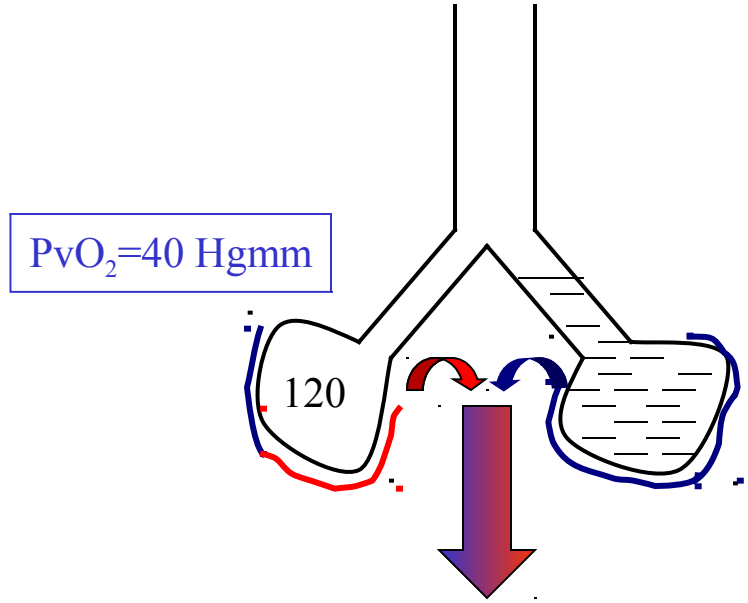
- $DO_2 = \underbrace{(SV \cdot P)}_{CO} \cdot \underbrace{(Hb \cdot 1.39 \cdot SaO_2 + 0.003 \cdot PaO_2)}_{CaO_2} \sim 800 ml/p \ (SaO_2 = 88\%)$
- $VO_2 = CO \bullet (CaO_2 - CvO_2) \sim 400 \ ml/p \ (ScvO_2 \sim 50\%)$

Respiratory

Alveolar oxygenation

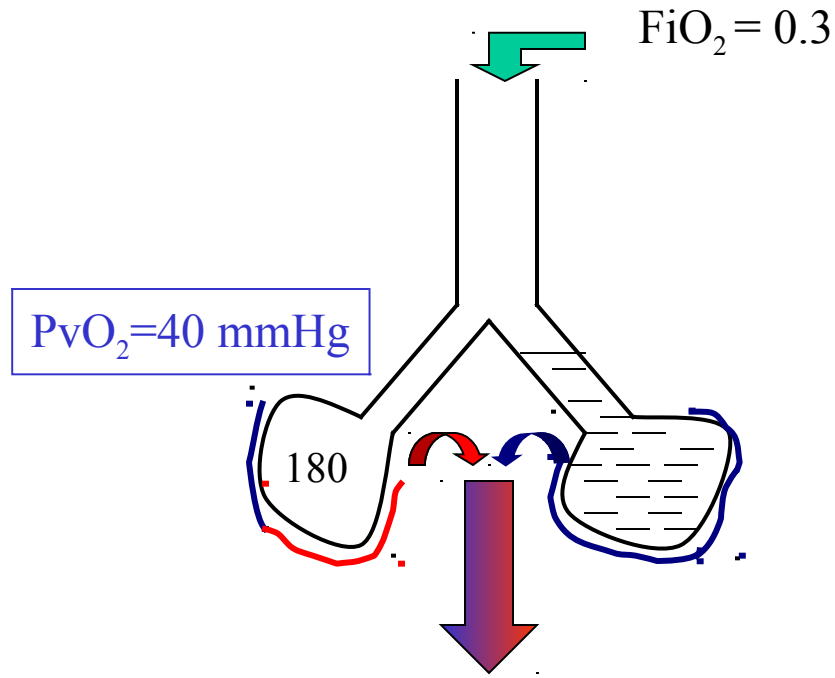


Venous admixture



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

Venous admixture + O_2



$PaO_2 = (120+40)/2 = 80$ mmHg

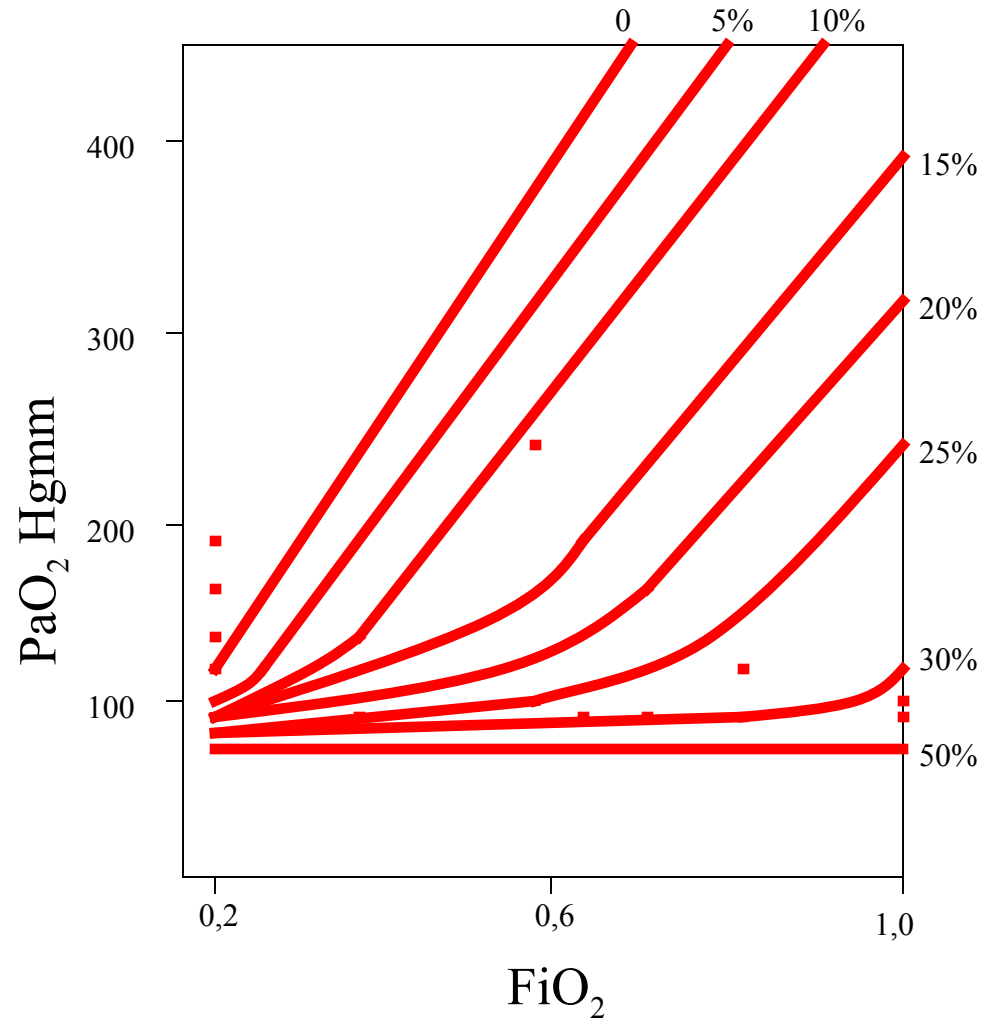
Vs.

$PaO_2 = (180+40)/2 = 120$ mmHg

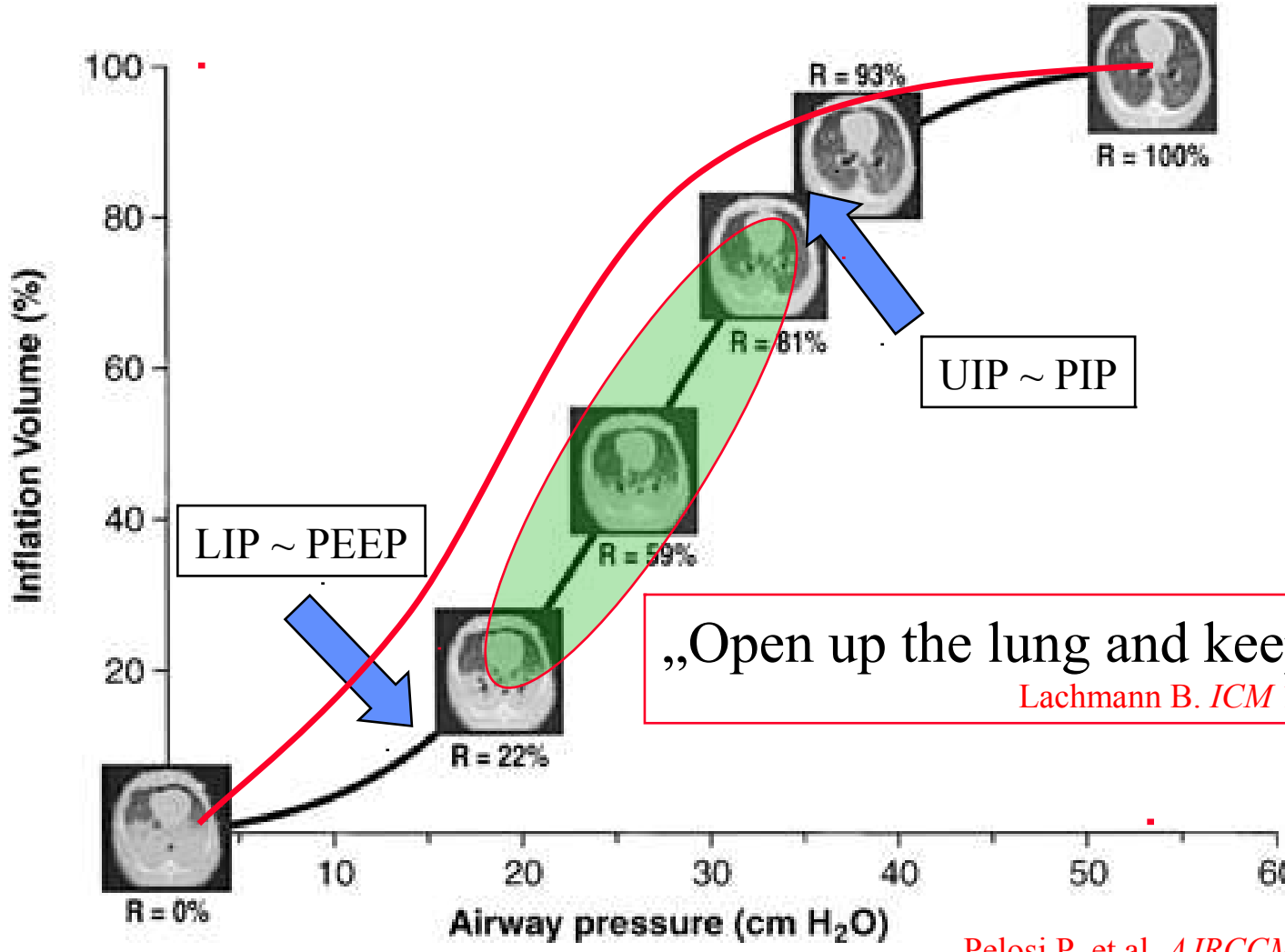
Degree of shunt

- „Iso-shunt” diagram

  Nunn JF. Appl. Resp Physiol., 1993



Alveolar recruitment



„Open up the lung and keep it open!"
Lachmann B. *ICM* 1992; 18: 319-321

Pelosi P, et al. *AJRCCM* 2001; 164: 122
Gattinoni L, et al *AJRCCM* 2001; 164 1701

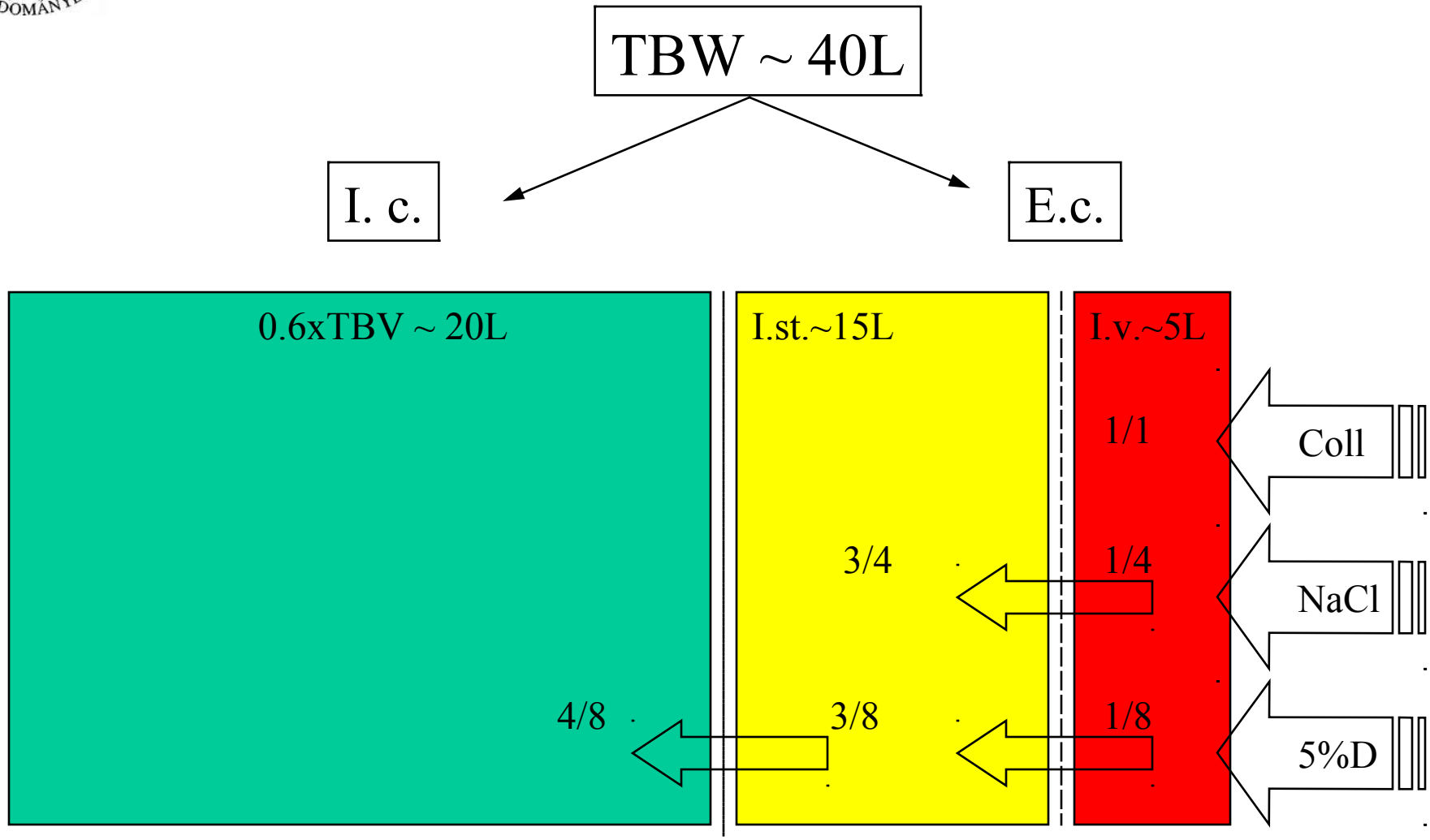
The debt…

- $DO_2 = \underbrace{(SV \cdot P)}_{CO} \cdot \underbrace{(Hb \cdot 1.39 \cdot SaO_2 + 0.003 \cdot PaO_2)}_{CaO_2} \sim 800 ml/m$ (SaO_2=88%)
- $VO_2 = CO \bullet (CaO_2 - CvO_2) \sim 400$ ml/m ($ScvO_2$~50%)

- Oxygen therapy:
  - O_2 4-10 l/m (mask)
  - Target: $SpO_2 > 90\%$

Fluid therapy

Fluids and distribution



Main points

- Fluid distribution:
  - Water (5%D) distributed in TBW (1/8)
  - Na^+ in e.c. space (1/4)
  - Colloids in i.v. space (1/1)
- Therefore:
  - 1 L blood loss…
  - …4 L isotonic saline, or…
  - …1 L colloid.

Vasopressors

- Noradrenalin (NA)
  - First choice (D)

Beale RJ et al. *Crit Care Med* 2004; 32(S): 455-65

  - ~20% increase in CO

LeDoux et al. *Crit Care Med* 2000; 28: 2729-32

- Dopamine
  - One of the first choices
  - Not as effective as NA

Martin C et al. *Chest* 1993; 103: 1826-31

- Adrenaline
  - Biggest sin: decreased pHi

Levy B, et al. *Intensive Care Med* 1997; 23:282–287

Vasopressor therapy - practice

- Noradrenaline (NA)
  - 3 mg/50 ml 0.9% NaCl (ml/h ~ µg/p)
  - 3 – 20 – 40 … as required
- Dopamine
  - 250mg/50 ml 0.9% NaCl (ml/h ~ µg/kg/min)
  - 5 – 20 – 30 …as required
- Adrenaline
  - 1 mg/10 ml, or 3mg/50 ml

The debt…

- $DO_2 = \underbrace{(SV \cdot P)}_{CO} \cdot \underbrace{(Hb \cdot 1.39 \cdot SaO_2 + 0.003 \cdot PaO_2)}_{CaO_2} \sim 800 ml/m$ (SaO_2=88%)
- $VO_2 = CO \bullet (CaO_2 - CvO_2) \sim 400$ ml/m ($ScvO_2$~50%)

- Oxygen therapy:
  - O_2 4-10 l/m (mask)
  - Target: $SpO_2 > 90\%$
- Venous access + fluid
  - Christalloid 500 ml
  - Colloid 500 ml
  - Pain relief/sedation: morphine i.v. (2-4-... mg)
  - +/- diuretics, positive inotrope treatment

Case – the end

- O_2 + fluid
  - More alert
  - Tachypnoe reduced (~25/min)
  - HR = 118/p, BP = 105/55 mmHg
  - SpO_2 = 92%, PaO_2=72 mmHg
  - T: 39 C
- Biochem:
  - PCT = 0.3 nmol/l
  - FVS = 9 G/l

Conclusion

- Two easy steps – so much knowledge…
- Diagnosis
  - Viral infection?
  - H1N1?
- To be determined later

Motto

Diagnosis can wait, but cells can’t!