CLINICAL BIOCHEMISTRY

Clinical laboratory diagnosis of kidney and urinary tract disorders

Nitrogen balance
Energy expediture and energy supply
Oxygen metabolism in the body

Clinical laboratory diagnosis of liver and biliary tract disorders

Oxygen metabolism in the body

Normal respiration depends on the combination of

- ventilation
- gas exchange in the lungs
- oxygen binding to hemoglobin
- cardiac output

Composition of dry atmospheric air

78%	nitrogen
21%	**oxygen**
0,03%	carbon dioxid
0,1%	inert gases

Oxygen gradient

	pO_2 (kPa)
Inspired air	21,4
Arterial blood	13,4
Venous blood	5,3
Expired air	15,4

Atmospheric pressure 101,5

The airways are divided into two zones:

the conducting zone

trachea, bronchi, terminal bronchioles

the respiratory zone (the structures in which gas exchange occurs)

respiratory bronchioles, alveolar ducts and alveoli

FiO_2

Fraction of inspired oxygen

Atmospheric air	0,21
Arteficial ventilation usually…	0,4
Pure oxygen	1,0

Dead space volume

- anatomic dead-space (conductinc system)
- alveolar-dead-space (nonperfused alveoli)

Perfusion

Perfusion is greater at the base of lungs than at the apex (upper areas)

Ventilation

is the exchange of gases between ambient air and lungs

possible causes of hypoxia

atmospheric air

low oxygen parcial pressure

high altitude – high mountains, high flights of aircrafts
consumed oxygen – fire in the closed space

hypoventilation

deppression of respiratory (breathing) center in brain (Morphine)
weakness of breathing muscles (energy exhausted persons)
pain during breathing (chest injury, pleuritis)

possible causes of hypoxia

diffusion across the alveolo-capillar membrane

pulmonary aedema
fibrotic process

ventilation / perfusion ratio

alveolar ventilation is approximatelly 4 l/min.
cardiac output averages 5 l/min
V/P ratio = 0,8

possible causes of hypoxia

hemoglobin

concentration of total hemoglobin

anemia

effective concentration of hemoglobin

oxyhemoglobin

karbonylhemoglobin
methemoglobin

Oxygen dissociation curve

relation between pO_2 and hemoglobin saturation

The position of the oxygen dissociation curve reflects the affinity of hemoglobin for oxygen.

Affinity is reduced by:
(shift to the right)

- Increases in temperature
- Decreases in pH
- Increases in pCO2
- Increases in the erythocyte 2,3-diphosphoglycerate

possible causes of hypoxia

Cardiac output

heart failure

myocard infarction

Tissues perfusion

hypovolemia

shock

centralization of circulation

Specimens for oxygen measurement

Arterial blood is the most suitable specimen for oxygen measur..
(arteria puncture is relative invasive)

Arterialised capillary blood from ear lobulus.

Blood drawing must be done anaerobically

Blood ga
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LOT
/Exp.
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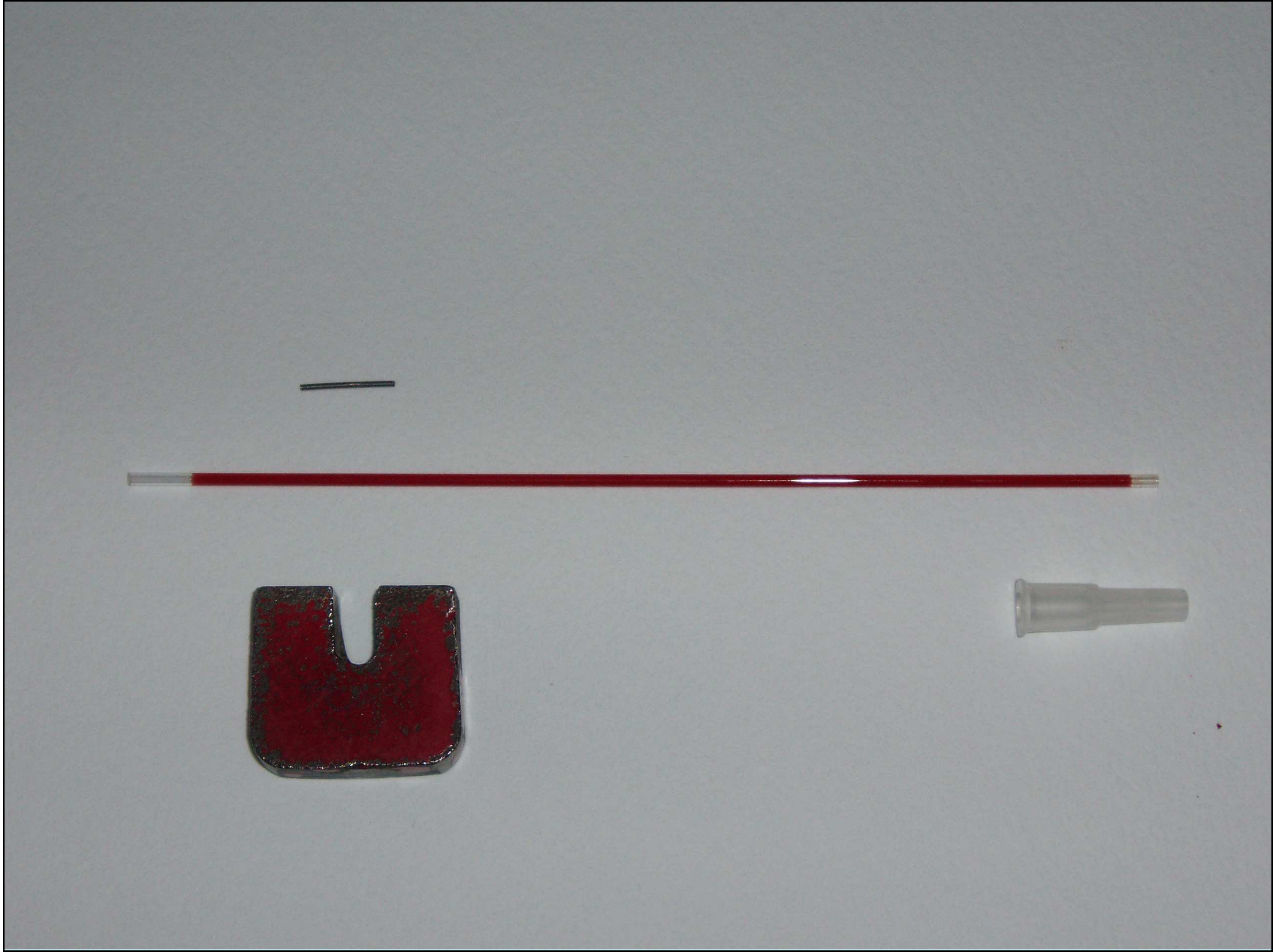

Hypoxia
lack of oxygen in the tissues

Lactic acid - product of anaerobic metabolism

Energy expediture and energy suplly

Energy need differs - patient to patient,
disease to disease,
hour to hour

Calculation of basic energy expediture

Harris-Benedict equations

high (cm) …. waight(kg)…. age(years)…. sex (M/F)

1°C over 37°C……………. + 10 %
middle stress ……………. + 30 %
severe stress ………………. + 100 %

Indirect calorimetry

Strong relationship between energy expediture and oxygen consumption

Investigation of oxygen consumption

diference between oxygen content in inspired a expired air

Indirect calorimetry

$$O_2\ [l/min] \times 1440 \times 4{,}83 \times 4{,}18 = kJ$$

Energetic equivalent
[kcal/l consumed oxygen]

glucose……..5,05 kcal
fat…………..4,69 kcal
protein………4,49 kcal