

DIFFERENCES OF LABORATORY INVESTIGATIONS IN PEDIATRICS

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Children

- **aren't small adults**
- are unique group with many differences
- their organs, systems and functions gradually mature after the birth
- the **important physiological and maturational changes** occur in their development, especially during **early childhood** and then during **puberty**

Anatomical and functional traits

- a **bigger body surface** to body weight
- **more water** and **less fat** in their bodies
- **less protective muscles** around their organs
- **smaller airways**
- **higher metabolic rate**
- **lower blood pressure, faster heart rate**
- **less mature immune system** etc.

Metabolic differences in newborns

- These differences reflect the trauma of birth and postnatal adaptation of newborn to an independent existence
- **Arterial blood oxygen** saturation is very low initially
- **Metabolic acidosis** is developed
- **Plasma proteins** increase in blood
- Serum activities of several enzymes such **GGT**, **CK** and **AST** are higher
- Concentration of **bilirubin** increases after birth and peaks around the third to fifth day of life, usually doesn't exceed 85 $\mu\text{mol/l}$

Metabolic differences in newborns and in infants

- Blood **glucose** concentration is low in newborns
- **Clearance of creatinine** is low, especially in preterms neonates
- **Potassium** concentration – may be as high as 7 mmol/l after birth, but then it rapidly falls
- **Calcium** concentration – is also high initially, it decreases during the first day
- Serum **IgG** - concentration decreases during the first three months, later gradually increases

Metabolic differences at puberty

- **Serum alkaline phosphatase** activity rises with skeletal growth
- Rising concentrations of **sex hormones** due to sexual maturation
- Serum **creatinine concentration** increases from infancy to puberty parallel to development of skeletal muscle, especially in boys

Specimen collection and processing

- Collection of biological material in childhood has its own specificities
- Blood collection - **traumatic, invasive procedure**
- 3 techniques: **capillary blood, syringe-needle technique, evacuated blood tube**
- In small children blood may be obtained by skin puncturing
- In neonates and infants - **heel skin puncture**, in older children - **finger prick**

Sample collection by skin puncturing



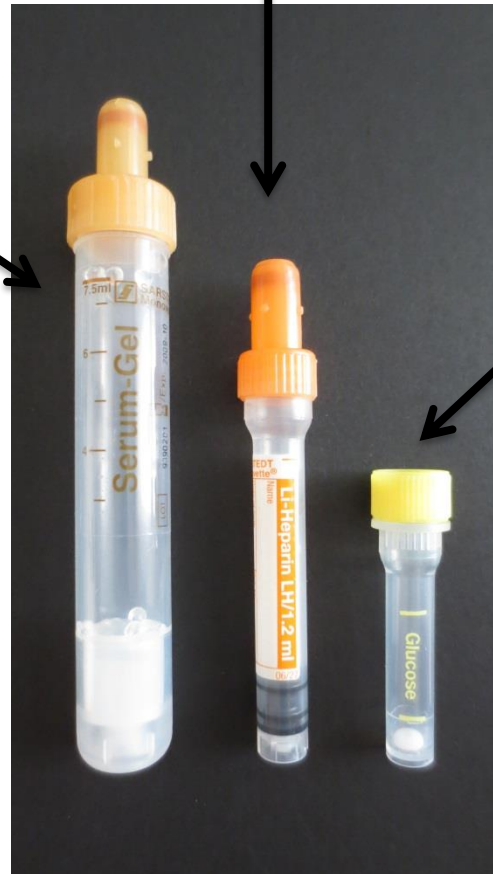
Collection on filter paper



Sample tube
volume 7,5 ml

Sample tube
volume 1,2 ml

Sample tube
volume 0,6 ml

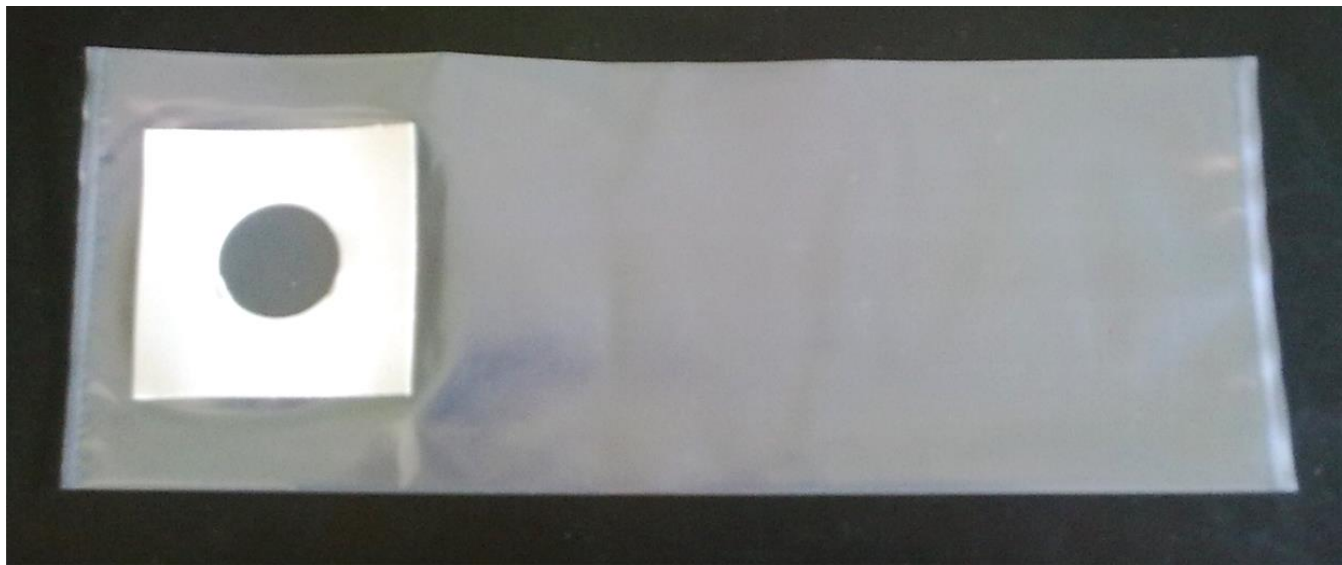


Recommended maximum volume of drained blood for children

(University Hospital Motol)

Patient weight (kg)	Maximum for one collection (ml)	Maximum for month (ml)
0,5-0,9	1	8
0,9-1,8	1,5	12
1,8-3,0	2	17
3-4	2,5	23
4-5	3,5	30
5-7	5	40
7-9	10	60
9-11	10	70
11-14	10	80
14-16	10	100
16-18	10	130
18-21	20	140
21-23	20	160
23-25	20	180
25-27	20	200
27-30	25	220
30-32	30	240
32-34	30	250
34-36	30	270
36-39	30	290
39-41	30	310
41-43	30	330
43-46	30	350

Collection of urine from children

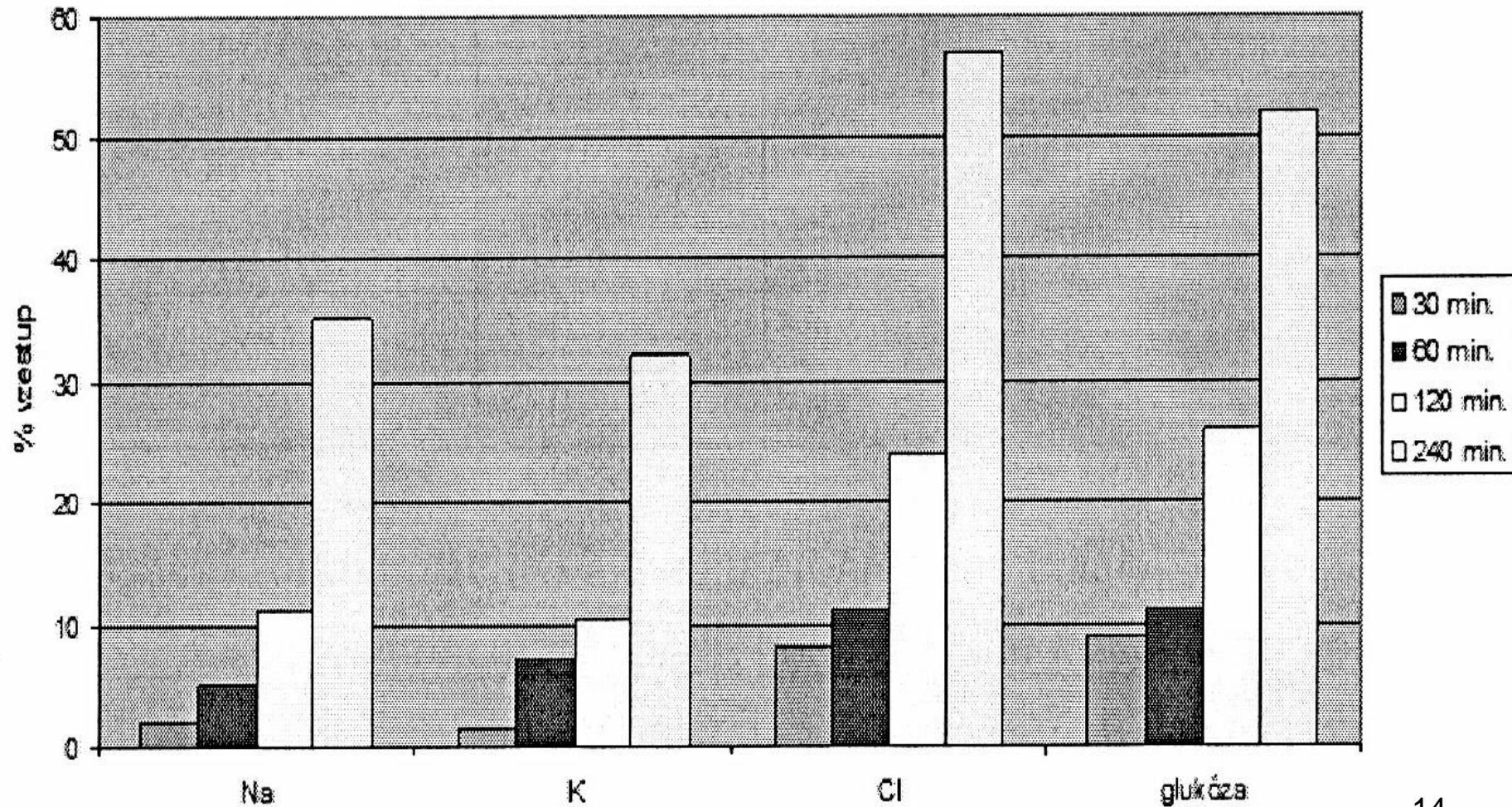


Plastic bag for collection of urine

Differences in processing of biological material of children

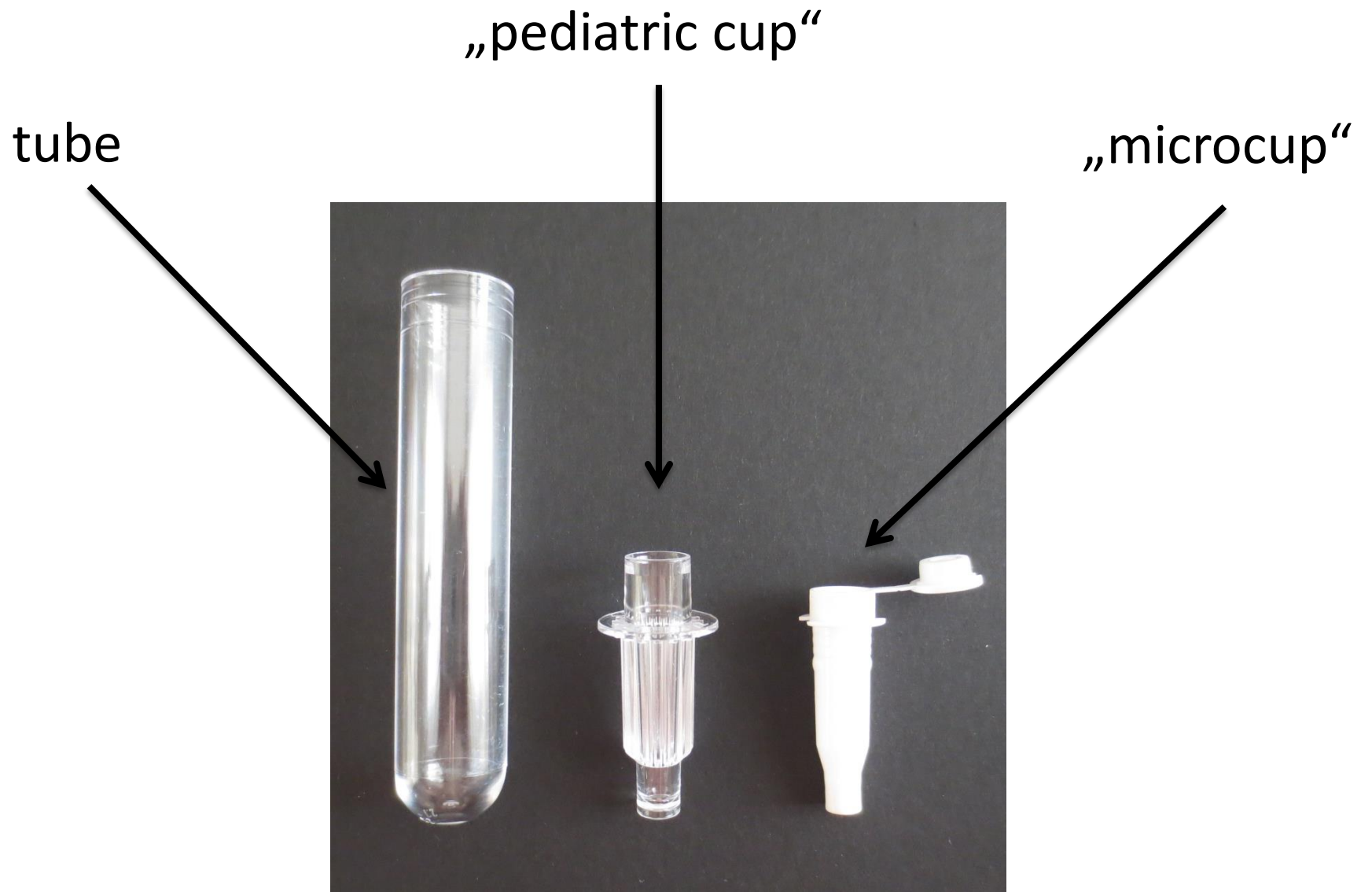
- **Prevent sample evaporation**, it is very important for small volumes of samples, especially in summer

Evaporation of serum sample (0,1 ml) at laboratory temperature



Differences in processing of biological material of children

- **Prevent sample evaporation**, it is very important for small volumes of samples, especially in summer
- **Use appropriate analytical systems** in laboratories , which require **low volume** of the sample.



Differences in processing of biological material of children

- **Prevent sample evaporation**, it is very important for small volumes of samples, especially in summer
- Use appropriate analytical systems in laboratories , which require **low dead volume** of the sample.
- The use of **POCT** devices

POCT ABR

65µl blood, 35 sec., 17 (19) parameters

- ABR (pH, pO₂, pCO₂, saturation Hb)
- Ions (Na, K, Cl, Ca⁺⁺)
- Hb (totalHb, MetHb, COHb, OxyHb, ...)
- Bil
- Glu, Lact
- Urea, creatinine ??



Pediatric reference ranges

- Using of corresponding reference values for children is necessary
- Establishing age-specific reference ranges is difficult process
- **Results of laboratory test within or without reference ranges \neq definitive indicators of health or ill**

Reference ranges of Creatinine (S/P)

	age (up to)	reference range [mmol/l]	
		from	to
children	1 month	27,0	77,0
	1 year	14,0	34,0
	3 years	15,0	31,0
	5 years	23,0	37,0
	7 years	25,0	42,0
	9 years	30,0	47,0
	11 years	29,0	56,0
	13 years	39,0	60,0
	15 years	40,0	68,0
M		59,0	104,0
F		45,0	84,0

Pediatric reference ranges

- Steven J.Soldin: „Pediatric reference intervals“ (7th edition, 2011, 250 chemistry and hematology analytes)
- www.ifcc.org (International Federation of Clinical Chemistry and Laboratory Medicine)



Children aren't small adults!