

# Rehydration (pediatrics)

**Rehydration** is a therapeutic procedure, the task of which is to replace the lost amount of body fluids and thus ensure an adequate circulation volume, while maintaining the physiological concentration of ions. When planning fluid therapy, the goal is to:

- supply the child with his basal fluid needs;
- adjust sodium and water deficit;
- replace the ongoing losses of water and electrolytes that occur during treatment (diarrhoea, vomiting,...).

## Daily fluid and ion needs in children

- the younger the child, the greater the percentage of body water (newborn 75–80 %);
- water consumption depends on energy intake and water losses;
- an infant needs significantly more water per 1 kg than an adult;
- a healthy infant needs water 10-15% of its weight daily (adults need 2-4%);
- an infant needs 85–170 ml/kg/24h (versus 40–50 ml/kg/24h in an adult).

## Fluid needs in childhood

age	Need for fluids	
	ml/kg/den	ml/den
10 days	125–150	400–500
3 months	140–160	750–850
6 months	130–155	950–1100
9 months	125–145	1100–1250
1 years	120–135	1150–1300
2 years	115–125	1350–1500
4 years	100–110	1600–1800
6 years	90–100	1800–2000
10 years	70–85	2000–2500
14 years	50–60	2200–2700
18 years	40–50	2200–2700

## Procedure for approximate estimation of daily basal fluid requirement (for children over 10 kg)

- for each kg up to 10 kg → 100 ml;
- for every kg between 10 and 20 kg → 50 ml;
- for each additional kg → 20 ml.

## As a guide, you can count on this daily fluid requirement

- up to 6 months of age: 150 ml/kg/day;
- infant: 130 ml/kg/day;
- 1-2 years: 120 ml/kg/day;
- preschool child: 90-100 ml/kg/day;
- younger school child: 70-90 ml/kg/day;
- adult: 45-50 ml/kg/day

Furthermore, it must be taken into account that water loss in hyperpyrexia increases by 10-15% for every degree Celsius.

## Basal requirement of selected ions

- **Na<sup>+</sup>**: 3–5mmol/kg/daily;
- **K<sup>+</sup>**: 1–2mmol/kg/daily;
- **Ca<sup>2+</sup>**: 0,25 mmol/kg/daily (newborns about 4 times as much);
- **Mg<sup>2+</sup>**: 0,25–0,5 mmol/kg;
- **phosphates**: 0,3–0,4 mmol/kg/daily (newborns more)

## Daily energy requirement

During rehydration treatment, it is necessary not only to cover fluid losses, but also to cover energy needs.

- energy intake is more related to body surface area than weight, but depends on growth, output, movement, fever...;
- the total energy requirement (the number of J needed per day) increases with the age of the child: newborn **2600–3600 kJ** (then every three years a decrease of 42 kJ/kg), adult **10000–12000 kJ**;
- the energy equivalent (number of J per kg per day) decreases with the age of the child: infant **400 kJ/kg/day**, adult **125–210 kJ/kg/day**.

## Daily nutrient requirements

### The need for sugar

- an adult tolerates a maximum of 0.3 g/kg/hour (if we want to give more, we have to give insulin);
- neonate: 0.5–0.7 g/kg/hour;
- toddler: 0.5 g/kg/hour;
- preschool child: 0.3–0.4 g/kg/hour;
- conversion to body surface: 75–100g glc/m<sup>2</sup>/24 hours

### Protein requirement (AMK)

- adult: 1.5 g/kg/day (during convalescence 2 g/kg/day);
- newborn: 2 g/kg/day;
- to reduce protein catabolism in acute conditions, it is not enough to cover the energy need, it is necessary to supply essential AMK in a suitable ratio.

### The need for fats

- not to exceed 2 g/kg/day;
- Fat KI: DIC, severe sepsis.

## Oral hydration

- oral fluids are preferred whenever possible;
- because there is evidence that glucose (and small organic molecules – e.g. AMK) increase the absorption of Na<sup>+</sup> from the intestine;

### WHO solution (oral glucose-electrolyte solution)

- 3.5 g NaCl, 1.5 g KCl, 2.5 g NaHCO<sub>3</sub> and 20 g glucose → dissolved in 1 liter of boiled water; it therefore contains: 90 mmol/l Na<sup>+</sup>, 15 mmol/l K<sup>+</sup>, 75 mmol/l Cl<sup>-</sup>, 30 mmol/l HCO<sub>3</sub><sup>-</sup>, 111 mmol/l glc (2%).

### Valík's solution

- a rehydration solution for children that can be prepared at home;
- contains more glucose, less K<sup>+</sup> and Na<sup>+</sup>;
- the solution is intended for the treatment of the initial stages of dehydration (diarrhea, vomiting);
- homemade preparation: 4 spoons of sugar, 1 teaspoon of baking soda, ¾ teaspoon of salt, a cup of orange juice and make up to 1 liter with water.

### ESPGHAN solution

- it is a solution with a composition recommended by the European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN). It differs from the WHO solution in its composition adapted to the needs of the European child population. It is available as a pharmaceutical preparation in the form of a powder designed to be dissolved in water under various trade names (Kulíšek, Enhydrol, etc.). the solution is given cooled to 4–8°C, spoonfuls;
- after 5–10 minutes, 5–10 ml of the solution each time (one today's teaspoon has a volume of 4 ml);
- it is not suitable to flavor the solution with fruit juice or juice;
- when treating dehydration at home, we never serve drinks like Coca-Cola or juices - they contain a minimum of minerals and an excess of sugar;
- rehydration must be quick and should be completed within 4 hours, during which time it is recommended to administer 30–50 ml of solution per 1 kg of the child's weight.

## Parenteral rehydration

- in severe forms of dehydration, or when it is impossible to administer per os (unconsciousness, vomiting);
- treatment is planned for 24 hours and is usually divided into 3 phases:

### 1. Urgent phase

- only with symptoms of circulatory shock;
- rehydration necessary in the shortest possible time;
- 10 ml of solution/kg (crystalloids or colloids, primarily volume, not ions) is administered during the first ten minutes;
- in the first hour we replenish the lost intravascular volume (preferably full physiological solution, possibly artificial plasma expanders, plasma, 5% albumin);

- solutions are administered by positive pressure infusion;
- calculation of lost intravascular volume: 8% of the child's current weight (in grams) is subtracted from 8% of the original weight before dehydration; the resulting number indicates how many milliliters of solution should be given in the first hour.

## 2. Correction phase

- the goal is to adjust the ECT volume over the course of 6-8 hours;
- the Na<sup>+</sup> concentration is adjusted according to current needs (from 50 to 70 mmol/l – or  $\frac{1}{3}$  or  $\frac{1}{2}$  physiological solution); patients with isonatremia or hyponatremia are given half of the
- planned amount for 24 hours during the first 8 hours;
- hyponatremia must be managed within 24 hours;
- in case of hypernatremia, the adjustment should be slower and balanced (within 24-48 hours);
  - hypernatremia must be managed as long as it occurs!!!
  - e.g., with a natremia of 175 mmol/l, we must correct it with a FULL physiological solution, because if hypernatremia occurs for a longer time, the intracellular osmolarity will increase compensatory and in the case of administration of a hypotonic solution there is a risk of CNS edema;
- potassium can be given in the infusion only after diuresis is restored!!!
- the amount to cover losses during treatment is best estimated from continuous monitoring of weight and environmental parameters;
- children with isonatremic dehydration are given hypotonic solutions:
  - $\frac{1}{3}$  physiological solution (Na content 50 mmol/l) for infants;
  - $\frac{1}{2}$  physiological solution (70mmol/l) for older children;
  - but not in the acute phase, when we replenish the intravascular volume - that's when we administer "full" physiological solution.

## 3. The finishing stage

- lasts about 16 hours, aims to adjust the lost intracellular volume.

## Links

### related articles

- Factors affecting nutritional needs
- Nutrition of children
- Disorders of acid-base balance

### Source

- HRODEK, Otto a Jan VAVŘINEC, et al. *Pediatric*. 1. vydání. Praha : Galén, 0000. 0 s. ISBN 80-7262-178-5.
- BENEŠ, Jiří. *Studijní materiály* [online]. ©2007. [cit. 08.03.2012]. <<https://www.stefajir.cz/index.php?q=pediatric>>.