Dehydration (pediatrics)

Hydration

The proportion of total body water in body weight is highest in newborns, at 75-80%. It steadily declines throughout life, reaching only 55-60% in adulthood. In old age, the proportion is even lower.

Average daily water requirement for children of different ages under normal conditions

Age	Average b. wt. (kg)	Total water requirement in 24 h (ml)	Water requirement per 1 kg of body weight per 24 h (ml)
3 days	3,0	250–300	80–100
10 days	3,2	400–500	125–150
3 months	5,4	750–850	140–160
6 months	7,3	950–1100	130–155
1 year	9,5	1150–1300	120–135
4 years	16,2	1600–1800	100 –110
10 years	28,7	2000–2500	70–85
18 years	54	2200–2700	40–50

An alternative for easier memorization is the following rule for calculating a child's daily needs (mainly in neonatology)

- 1st day after birth: 50 + 10 ml/kg
- 2nd day: 50 + 20 = 70 ml/kg
- 3rd day: 50 + 30 = 80 ml/kg (50 + n-th day × 10)
- etc. up to 10th day: 50 + 100 = 150 ml/kg
- from the 10th day to the 1st month: 150 ml/kg
- from the 1st month to body weight of 10 kg: 200 ml + 100 ml/kg
- from a body weight of 10 kg to 20 kg: 500 ml + 50 ml/kg
- from a body weight of 20 kg: 1000 ml + 20 ml/kg

e.g. A newborn on the 7th day after birth weighing 3.5 kg has a daily water requirement of 3.5 × (50 + 70) = 420 ml.

A child weighing 7.4 kg (older than one month) has a daily water requirement of 7.4 kg × 100 ml/kg + 200 ml = 940 ml.

Dehydration

A child's organism is much more susceptible to dehydration when compared to an adult's organism. It is mainly due to higher metabolic activity (growing organism, low weight/body surface ratio), immature kidney function, and small compensatory reserves. While in an adult, dehydration develops only after a few days, in a child this condition occurs much faster (in the order of hours). In addition, the cause of dehydration and other problems (nutrition disorder, acute gastroenteritis) must also be taken into account. (For example, if the mother stops breastfeeding, the child is at risk of both dehydration and starvation, causing metabolic acidosis and hypoglycemia.)

Dehydration in cholera patient

Types of dehydration

- **Hypertonic dehydration**: serum concentration Na^+ > 150 mmol/l
- **Isotonic dehydration** : serum concentration Na^+ 150–130 mmol/l
- **Hypotonic dehydration**: serum concentration Na^+ < 130 mmol/l

This classification mainly helps to find out the cause of the pathological condition and the treatment method.

Clinical assessment of dehydration

We evaluate the following clinical symptoms: skin color (pink, pale to gray-white), skin turgor, moisture of the mucous membranes, fontanel (whether it is sunken), blood pressure, pulse, muscle tone, state of consciousness, diuresis, breathing, decrease in body weight.

- **mild dehydration: 5–10 %**
  - reduced turgor, pale skin, slightly dry mucous membranes, oliguria, muscle tone may be weakened, consciousness preserved
  - BP is normal, tachycardia may be present, fontanelle is not sunken, breathing is normal
- **moderate dehydration: 10–15 %**
  - reduced turgor, pale skin, dry mucous membranes, oliguria or even anuria, muscle tone weakened, BP decreased, tachycardia, slightly sunken fontanel, weakened superficial breathing
  - the child is apathetic, but still reacts to painful stimuli
- **severe dehydration: 15 % and more**
  - progression of symptoms: gray-white skin, low turgor, dry mucous membranes, sunken fontanel, periorbital dark circles, centralization, i.e. acral coldness but centrally increased temperature, anuria, very low BP, tachycardia (rhythm disturbances may occur), in addition, there is a disturbance of consciousness up to coma and subsequent death. (hypovolemic shock develops)

To specify the degree of dehydration, we assess the decrease in body weight. I.e. the difference between the current weight and the weight in the state of sufficient hydration. For a newborn, the weight of 1-2 days old is already relevant. Older children become dehydrated and therefore lose weight more slowly. In these cases, we will be content with data that is e.g. a week or a month old.

Basic fluid therapy

The process of treatment and reimbursement of solutions is very complex and requires a comprehensive approach of an experienced doctor. The following points only approximate the method of treatment in a few basic steps.

The basis of treatment is the parenteral administration of volume-expanding solutions.

- monitoring of vital functions (BP, pulse, respiratory rate, diuresis, temperature, oxygenation, etc.) and ensuring vascular access
- basic sampling and assessment of the state of the internal environment (mainly: **glycemia**, **natremia**, **kalemia**, pH, Na+, urea, lactate)
- assessing the child's condition and determining the basic daily water requirements
- based on the weight difference, clinical symptoms, and the onset of complications, we estimate the approximate degree of dehydration and the amount of water deficit that needs to be replaced
- infusion dosage:

1. for the first 8 hours, we administer 1/2 of the required amount of infusion solution (the sum of the daily requirement and the resulting water loss)
2. and for the next 16 hours, we serve the remaining 1/2

- for the first 2 hours, we administer full saline solution (or Ringer's solution)
- the most serious complications during rehydration include hypoglycemia and hypokalemia, which can have fatal consequences!!! It is therefore necessary to monitor and possibly supplement basic metabolites during the treatment.

*E.g. Newborn 3.3 kg, 20 days old, not breastfed for 1 day. According to the scale, weight loss of 0.3 kg, i.e. 10%, symptoms also correspond to moderate dehydration (10%). Calculation: a newborn with an original weight of 3.3 kg ...**daily water requirement 3.3 × 150 = 495 ml** water loss, i.e. **10% of 3.3 kg = 330 ml. Sum 495 + 330 = 825 ml**. In the first 8 hours, we will administer 412 ml at a rate of 412/8 = 51 ml/h. For the next 16 hours, we will administer at a rate of 412/16 = 25.5 ml/h (the composition itself and the type of infusion solution depends on other factors).*

Links

Bibliography

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