Dehydration

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In physiology, **dehydration** is a deficit of total body water,[1] with an accompanying disruption of metabolic processes. Dehydration can also cause hypernatremia. Dehydration is distinct from hypovolemia (loss of blood volume, particularly plasma).

Dehydration occurs when free water loss exceeds free water intake, usually due to exercise or disease, but also due to high environmental temperature. Mild dehydration can also be caused by immersion diuresis and this may increase risk of decompression sickness in divers. Most people can tolerate a three to four percent decrease in total body water without difficulty or adverse health effects. A five to eight percent decrease can cause fatigue and dizziness. Loss of over ten percent of total body water can cause physical and mental deterioration, accompanied by severe thirst. Death occurs at a loss of between fifteen and twenty-five percent of the body water.[2] Mild dehydration is characterized by thirst and general discomfort and is usually resolved with oral rehydration.

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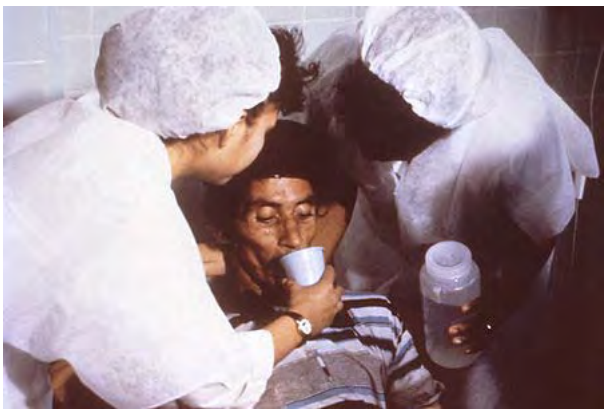

Nurses encourage a patient to drink an oral rehydration solution to reduce the combination of dehydration and hypovolemia he acquired from cholera. Cholera leads to GI loss of both excess free water (dehydration) and sodium (hence ECF volume depletion—hypovolemia).

Classification and external resources

Specialty	Critical care medicine
ICD-10	E86 (http://apps.who.int/classifications/icd10/browse/2016/en#/E86)
ICD-9-CM	276.51 (http://www.icd9data.com/getICD9Code.ashx?icd9=276.51)
DiseasesDB	3520 (http://www.diseasesdatabase.com/ddb3520.htm)
MedlinePlus	000982 (https://medlineplus.gov/ency/article/000982.htm)
eMedicine	article/801012 (http://emedicine.medscape.com/article/801012-overview)
MeSH	D003681 (https://www.nlm.nih.gov/cgi/mesh/2017/MB_cgi?field=uid&term=D003681)

Definition

Dehydration occurs when water intake is insufficient to replace free water lost due to normal physiologic processes (*e.g.* breathing, urination or perspiration) and other causes (*e.g.* diarrhea or vomiting). Hypovolemia is a related condition specifically meaning a decrease in volume of blood plasma— not of total body water. Both (total

body water and plasma volume) are regulated through independent mechanisms in humans [1] and should not be conflated. Some authors have reported three types of dehydration based on serum sodium levels: hypotonic or hyponatremic (referring to this as primarily a loss of electrolytes, sodium in particular), hypertonic or hypernatremic (referring to this as primarily a loss of water), and isotonic or isonatremic (referring to this as equal loss of water and electrolytes).[3] Indeed, in humans, it has been commonly thought that the most commonly seen type of dehydration (by far) is isotonic (isonatraemic) dehydration. This usage is incorrect [1] and the terms *isotonic*, *isonatremic*, and *eunatremic dehydration* actually all refer to hypovolemia and should therefore be abandoned in favor of the latter. *Hyponatremic* dehydration cannot exist because by definition depletion of total body water can only lead to hypernatremia[4][5] so this term actually refers to coexistence of two separate disorders - hyponatremia and hypovolemia and again the term dehydration must be avoided. A classic example of hyponatremia coexisting with hypovolemia is Addison's disease where cortisol deficiency leads to ADH excess and hyponatremia but mineralocorticoid deficiency simultaneously leads to sodium loss and hypovolemia. The latter subjects are not dehydrated, on the contrary they are over-hydrated (from free water retention due to ADH excess).

Dehydration is thus a term that has been very loosely used to either mean *true* dehydration or as a proxy for hypovolemia and only the former is the proper use of this term.[1] This is important[6] because total body water is not controlled via sodium regulation, only intravascular volume is so controlled and this distinction is important to guide therapy. Dehydration can be life-threatening when severe and lead to seizures or respiratory arrest, and also carries the risk of osmotic cerebral edema if rehydration is overtly rapid.[7]

Signs and symptoms

Patients who lose enough extracellular fluid (ECF) volume develop skin tenting (loss of skin elasticity), flat neck veins, and orthostatic or frank tachycardia and dizziness or fainting when standing up due to orthostatic hypotension, are often said to be dehydrated or *dry*. This is incorrect since these findings are *not* signs of dehydration and indicate ECF depletion, or hypovolemia for short.[8]

The hallmarks of dehydration include thirst and neurological changes such as headaches, general discomfort, loss of appetite, decreased urine volume (unless polyuria is the cause of dehydration), confusion, unexplained tiredness, purple fingernails and even seizures. The symptoms of dehydration become increasingly severe with greater total body water loss. In people over age 50, the body’s thirst sensation diminishes and continues diminishing with age. Many senior citizens suffer symptoms of dehydration. Dehydration contributes to morbidity in the elderly especially during conditions that promote insensible free water losses such as hot weather. A Cochrane review on this subject defined water-loss dehydration as *people with serum osmolality of 295 mOsm/kg or more* and found that the main symptoms in the elderly were expressing fatigue, missing drinks between meals and bioelectrical impedance analysis.[9] However, this Cochrane review was also plagued by the same lack of clarity regarding the distinction between dehydration and hypovolemia seen in the literature, but confusion was avoided to a large extent by their use of hypertonicity to define dehydration. It must be pointed out that dehydration and hypovolemia may occur simultaneously in the same person at the same time and thus explains the lack of clarity in the literature regarding the symptoms and signs associated with these two conditions - however, their distinction is essential to guide therapy.[6]

Cause

Risk factors for dehydration include but are not limited to: exerting oneself in hot and humid weather, habitation at high altitudes, endurance athletes, elderly adults, infants and children and people living with

chronic illnesses.[10]

In the elderly, blunted response to thirst and/or inadequate ability to access free water in the face of excess free water losses (especially hyperglycemia related) seem to be the main causes of dehydration.[11] Excess free water or hypotonic water can leave the body in two ways - *sensible* loss such as osmotic diuresis, sweating, vomiting and diarrhea, and *insensible* water loss, occurring mainly through the skin and respiratory tract. In humans, dehydration can be caused by a wide range of diseases and states that impair water homeostasis in the body. These occur through the following main mechanisms:[12]

Impaired thirst or water access

- Insensible respiratory losses
- Fluid loss with a sodium plus potassium concentration less than that in the plasma, such as urinary losses in hyperglycemia (osmotic diuresis)
- Transient hypernatremia can occur when water shifts intracellularly caused by activities, such as severe exercise, and on cessation of activities the sodium returns to normal within 5 to 15 minutes

Sodium excess

- Hypertonic sodium intake without appropriate water intake leads to hypernatremia, as the sodium load is excreted in water, leading to free water loss. This is the mechanism of free water loss when hypertonic saline is given in SIADH.

Prevention

For routine activities, thirst is normally an adequate guide to maintain proper hydration. With exercise, exposure to hot environments, or a decreased thirst response, additional water may be required.

In resting, thermoneutral individuals, whole-body insensible water loss is widely accepted to occur at about .03L/h and approximately 50% of this passes through the skin.[13] The remaining 50% of normal insensible water loss occurs through the lungs as water vapor. Additional losses throughout the day occur through the kidneys as urine (some of which is obligatory water excretion that gets rid of solutes) and some water, in the absence of diarrhea, is also lost through the feces.

In warm or humid weather or during heavy exertion, however, the water loss can increase markedly, because humans have a large and widely variable capacity for the active secretion of sweat. For example, whole-body sweat losses in men can exceed 2 L/h during competitive sport, with rates of 3–4 L/h observed during short-duration, high-intensity exercise in the heat.[13] When such large amounts of water are being lost through perspiration, electrolytes, especially sodium, are also being lost.

In most athletes exercising and sweating for 4–5 hours with a sweat sodium concentration of less than 50 mmol/L, the total sodium lost is less than 10% of total body stores (total stores are approximately 2,500 mmol, or 58 g for a 70-kg person).[14] These losses appear to be well tolerated by most people. On the other hand, the inclusion of some sodium in fluid replacement drinks has some theoretical benefits[14] and the addition of sodium poses little or no risk, so long as these fluids are hypotonic (since the mainstay of dehydration prevention is the replacement of free water losses).

Treatment

The treatment for minor dehydration, often considered the most effective, is drinking water and stopping fluid loss. Plain water restores only the volume of the blood plasma, inhibiting the thirst mechanism before solute levels can be replenished.[15] Solid foods can contribute to fluid loss from vomiting and diarrhea.[16] Urine concentration and frequency will customarily return to normal as dehydration resolves.[17]

In more severe cases, correction of a dehydrated state is accomplished by the replenishment of necessary water and electrolytes (through oral rehydration therapy or fluid replacement by intravenous therapy). As oral rehydration is less painful, less invasive, less expensive, and easier to provide, it is the treatment of choice for mild dehydration. Solutions used for intravenous rehydration must be isotonic or hypotonic. Pure water injected into the veins will cause the breakdown (lysis) of red blood cells (erythrocytes).

When fresh water is unavailable (e.g. at sea or in a desert), seawater and ethanol will worsen the condition. Urine contains a similar solute concentration to seawater, and numerous guides advise against its consumption in survival situations. If somebody is dehydrated and is taken to a hospital, IVs are also used. [18][19][20][21]

For severe cases of dehydration where fainting, unconsciousness, or other severely inhibiting symptom is present (the patient is incapable of standing or thinking clearly), emergency attention is required. Fluids containing a proper balance of replacement electrolytes are given orally or intravenously with continuing assessment of electrolyte status; complete resolution is the norm in all but the most extreme cases.

Some research indicates that artificial hydration to alleviate symptoms of dry mouth and thirst in the dying patient may be futile.[22]

See also

- Hydrational fluids
- Terminal dehydration
- Dryness (medical)

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Notes

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External links

- Definition of dehydration by the U.S. National Institutes of Health's MedlinePlus medical encyclopedia (https://www.nlm.nih.gov/medlineplus/ency/article/000982.htm#visualContent)
- Rehydration Project at rehydrate.org (http://rehydrate.org/index.html)
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