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Water Administration in the ICU

Dr. Jean-Charles Preiser, MD, PhD
******@***erasme.ulb.ac.be

Department of Intensive Care,
Erasme University Hospital
Brussels, Belgium

The management of fluids in critically ill patients is a continuing challenge. Although the infusion of generous amounts of intravenous fluids is usually required during the early stage of resuscitation, fluid restriction is often desirable after the initial phase and stabilisation. Indeed several groups reported a poorer outcome when intravenous fluids were administered following a liberal policy, as opposed to a restrictive policy, in different clinical circumstances, including acute respiratory distress syndrome (National Heart, Lung, and Blood Institute Acute Respiratory Distress Syndrome (ARDS) Clinical Trials Network et al. 2006; Lobo et al. 2011; Sakr et al. 2005), renal failure requiring replacement therapy (Vaara et al. 2012; Teixeira et al. 2013; Silversides et al. 2014) and after surgery (Varadhan and Lobo 2010). Hence several recommendations and clinical routines have been adapted, and now aim at the minimisation of the risk of fluid overload after the initial resuscitation phase. However, the infusion of small amounts of balanced crystalloid solution carries the risk of depletion of free water, haemoconcentration and cell shrinkage as a result of the distribution of water in the body (see Figure 1). The challenge is then to correct the hydration status while avoiding an increase in extracellular volume (interstitial and intravascular). In patients unable to drink for any reason, hypotonic water ('free-water') solutions can only be infused by the enteral route.

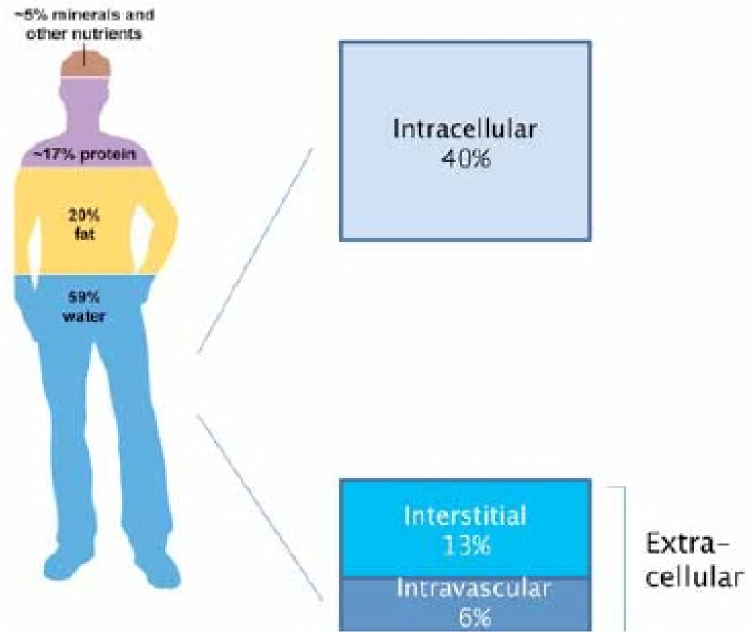

Figure 1. Distribution of Water in the Body

Water Absorption by the Gastrointestinal Tract

The absorption of water along the gastrointestinal tract is a highly regulated process. Dietary or exogenous water plus endogenous water contained in saliva and digestive juices (about 10 litres per day in adults) is mainly absorbed in the small intestine, along with sodium, itself co-transported with glucose and amino acids. Water can also be absorbed in the colon. In both locations the absorption of water is driven by osmotic pressure. Even though intestinal aquaporin channels can play a role in this process, their physiological importance is still incompletely understood. In critically ill patients with a functioning gut the absorption of water is similar to that in healthy individuals. Therefore the co-administration of water and nutrients is also possible by the enteral route and obviously desirable. The water content of commercially available enteral nutrition formulas meets recommended daily allowances for a healthy population, e.g. 75-90% of the volume. For instance, a caloric intake of 25 kcal/kg/day from a standard enteral nutrition formula implies the co-infusion of 1600ml of water, which can be insufficient to restore a normal hydration status in case of depletion.

Sensing of Dehydration and Assessment of Hydration Status

Physiologically dehydration is rapidly sensed, as plasma osmolality rises sharply (above 280 mOsm/kg in healthy subjects). The sensing of raised osmolality by the hypothalamus triggers the release of antidiuretic hormone (ADH) and the feeling of thirst. In addition a feeling of dry mouth induced by a lowered output from the salivary glands will further amplify the thirst. As a result renal reabsorption of water following the activation of type 2 vasopressin receptors and increased water intake in response to thirst will increase the circulating volume and restore osmolality.

In the critically ill these physiological responses can be impaired. In case of altered consciousness or sedation, the feeling of thirst can be absent, while diabetes insipidus and inadequate secretion of ADH frequently complicate the course of the critically ill. On the other hand, numerous medications and the presence of orotracheal tubes can increase the feeling of dry mouth, thereby inducing thirst. Several medications can also increase plasma osmolarity. Fluid balance and weight can also be influenced by several factors unrelated to the body water, especially in case of capillary leakage, digestive losses, fever, or use of diuretics or ultrafiltration. As a result of these changes the hydration status and the water content of a critically ill patient cannot be assessed clinically, and will be indirectly estimated by a daily monitoring of electrolytes (especially sodium) and osmolality. More sophisticated techniques, such as isotopic tracers, in vivo neutron activation, dual x-ray absorptiometry or multiple frequency bioimpedance are not useable at bedside, or are not yet validated as reliable methods to assess body composition in the critically ill.

Compensatory Mechanisms

Not infrequently, after the acute resuscitation phase, critically ill patients experience swallowing disorders and numerous impairments of the regulatory mechanisms of food and water intake (Massanet et al. 2015). Interestingly the feeling of thirst is the most common complaint of conscious patients (nutritionDay in ICU, unpublished data – www.nutritionday.org)

As a result the amount of water ingested may not match the actual requirements, by excess or most often by default. Hence using the enteral access to compensate for the lack of nutrients and water intake is the most physiological approach, especially in case of swallowing disorders. Using a pump-driven infusion for enteral nutrition is the safest way to ensure a continuous flow, with additional administration of water when required

From a practical viewpoint the co-administration of water together with enteral nutrition is likely to prevent tube occlusion, when free water is regularly flushed, and to prevent impairments in gastric emptying, in relation with the lowered osmolarity of a diluted nutrient solution. The monitoring of plasma sodium can be used to adapt the daily infusion rate of water, as recently described in cases of hospital-acquired hypernatraemia (Varun et al. 2013).

Practical Recommendations

Even in the absence of interventional controlled studies, current experience consistently indicates that administration of free water via the enteral route is feasible, efficient and not risky in the critically ill patient, in the absence of contraindication to enteral nutrition. The prescription of enteral free water should be considered in cases of overt dehydration or in cases of hypernatraemia, and monitored by the course of plasma sodium concentration. Whenever required, the co-administration of water with enteral feeding is appropriate.

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