

Why study fluid overload in critically ill children? Medical reversal, heterogeneity, and resistance to change

¿Por qué estudiar sobrecarga de fluidos en niños graves? Revocación médica, heterogeneidad y resistencia al cambio

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Fluid overload has been a recurrent topic of discussion in critical care for the last 20 years. Initially oriented to treating adults, it quickly spread to pediatric patients. A literature search over the last 20 years in the US National Institute of Health's Biomedical and Life Sciences database shows a progressive increase in the number of publications per year, reaching a more than 7-fold increase in recent years. The pediatric studies are around 10 and 20% of the annual total.

In this issue of *Andes Pediatrics*, Chávez-Valdivia et al.¹ report the analysis of a cohort of 170 critically ill children in a multipurpose pediatric intensive care unit, determining that fluid overload is an independent factor for mortality. This study adds to the current body of evidence on the role of fluid overload as an iatrogenic factor in critically ill patients and does not correspond to an epiphenomenon of severity.

The recommendation "consider fluid administration in a critically ill child to improve oxygen delivery to the tissues and restore homeostasis" established more than 50 years ago remains valid to this day. So why are we still studying fluid resuscitation and volume overload?

The administration of fluids to sick children has a long tradition in pediatrics. According to data from

the World Health Organization, acute diarrhea is still the third leading cause of death worldwide in children under five years of age². About half a million children under five years die from diarrhea annually worldwide, and a quarter of them are due to rotavirus. Children are especially susceptible to severe acute dehydration due to increased gastrointestinal losses and their caregivers' dependence on water access. In the last 30 years, thanks to advances in access to clean water, hygiene and sanitation measures, such as rotavirus vaccination, mortality has been reduced by one-third¹. One of the successful measures established since the 1970s is oral rehydration therapy, which in a stepwise manner proposes measures that can be used in all health scenarios, such as water and electrolyte replacement with oral rehydration salts, to invasive measures such as phlebotomy to restore the internal environment.

With the emergence of specialized units for the care of children, children's emergency services, general hospitalization units, and the management of critically ill patients, the successful fluid replacement practice was rapidly embraced. Previous experiences in war medicine and severe infections in adults, biological plausibility, and mechanistic associations led to small clinical studies in children, establishing hypovolemia

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as the main event in severe conditions, sepsis and multiorgan failure in children, one of the leading causes of admission to pediatric critical care units³. Thus, for more than two decades, the development of treatment protocols, clinical guidelines, and international campaigns, supported by scientific organizations and the industry, insisted on the rapid intravenous administration of fluids, equivalent to almost one volemia, to acutely ill children with alterations in the cardiovascular examination^{4,5}.

The systematization of care in “bundles” significantly reduces pediatric morbimortality in the pre-hospital, primary care, and hospital settings. Among these, the Surviving Sepsis Campaign stands out, which includes early diagnosis, and quick and early administration of antibiotics, fluids, and vasoactive drugs, although the weight of each of the components has not been established. Even in contemporary clinical process improvement studies, compliance with its components and measures is low and transient^{6,7}.

The indiscriminate use of these bundles, including the ubiquitous fluid administration intervention, has long been assumed to be without deleterious effects. For example, hospitalized patients frequently receive fluids as a reflex and automatic response to such non-specific signs as tachycardia or fever, termed by some as tachycardiophobia. The futility of the initially proposed therapy slowly gave way to reports of risk groups in which fluid overload was associated with worse clinical outcomes, especially in more critically ill patients in the pediatric intensive care unit. The causes of progressive positive net water balance, the fluid creep, in critically ill children are multiple. Still, fluid administration during the first few hours can easily increase to double or triple physiologic requirements, independent of effective volemia. These actions worsen when these practices extend into the following days or weeks of hospitalization^{8,9}. As we have previously discussed in *Pediatric Andes*, the tipping point on this issue was the work of Maitland et al. in 2011, in which they demonstrated that parenteral fluid resuscitation increased mortality in sub-Saharan African children with severe infections compared to children who did not receive them^{11,11}.

Unfortunately, the response from academia has been insufficient, and only recently have some of the clinical practice recommendations been tenuously modified^{6,8,10,12}.

Resistance to practice change is not new, especially

in science. Fluid resuscitation is one of the most notable cases of medical reversal of pediatric intensive care therapy. Ideally, the established practices (treatments, procedures, diagnoses, etc.) should be changed as new, robust, and good quality evidence emerges, generically called a medical practice replacement process¹³. However, this replacement is often based on inaccurate, biased, or partial data, or worse, driven by other stakeholders, like political, industry, commercial, and other agendas. The deficit of quality data and studies leads to recommendations, which, for the most part, are very weak. Only after many years and thousands of children treated with iatrogenic or futile treatments, we realize the need for revocation of a previously consensual management such as fluid resuscitation up to 60ml/kg in critically ill children, independent of their cardiovascular status, comorbidities, previous treatment, disease course and sociodemographic background of the patients^{6-8,10,12,14}.

The research by Chávez-Valdivia et al.¹ reminds us that the time for action has come since the change in practices has been delayed for more than a decade. There is a global need for all involved in the management of children to improve the quality of care. Especially when the response from academia and scientific societies is slow and deficient, personalized management by clinicians at the patient's bedside should force change.

Academia is proposing a randomized controlled trial of the highest quality to generate evidence. However, the real question to be asked is who would consider treating critically ill children with uncontrolled or non-protocolized fluid administration (liberal strategy). After having witnessed for almost two decades the negative effects of fluids and the consequent volume overload, it is advisable, in light of current knowledge, to evaluate on a case-by-case basis, to tailor the best fluid strategy and not systematically apply medical therapy as it is currently used in many centers. Therefore, the rational thing to do is to say no, even at the risk of facing a future revocation of this proposed medical practice.

Conflicts of Interest

Member of the Editorial Committee of *Andes Pediátrica/Revista Chilena de Pediatría*.

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