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Fluid Creep in ARDS after Shock Resuscitation of Trauma, Burns, Sepsis, and Acute Pancreatitis Patients: How Much, Where, and How to Find it?

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Opinion
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Abbreviations: AP: Acute Pancreatitis; HLS: Hospital Length of Stay; ARDS: Acute Respiratory Distress Syndrome; VO: Volumetric Overload; FC: Fluid Creep; BW: Body Weight.

Opinion

I peer-reviewed this article with great interest but was rejected by the editor [1]. The retrospective study compares two fluid regimens in acute pancreatitis (AP) "resuscitation" or more accurately "management" and there is a difference. Two cohorts were created: aggressive IVF resuscitation (>3ml/kg/hr) and non-aggressive (≤ 1.5 ml/kg/hr) IVF resuscitation. The authors gave reference to the hospital length of stay (HLS), the onset of complications of acute kidney injury, sepsis, and mortality. The conclusion was: "No significant difference in mortality and HLS was identified between rates of IVF resuscitation, even in patients with severe pancreatitis." This is a surprising negative conclusion, but why!? There are two possible explanations that will be discussed later.

The authors never mentioned the volume of intravenous fluid given in the accident and emergency (ER) before the start of the fluid regimens and did not consider acute respiratory distress syndrome (ARDS) among the complications. There is a widely received misconception that ARDS and fluid retention are not path-aetiologically related. This discussion is not limited to AP but also applies to shock resuscitation of trauma, burns, and sepsis in which ARDS with fluid creep are common complications.

The above regimens do not make any sense unless the total volumetric overload (VO) of fluid creep (FC) that is characteristically retained in a patient's body and given within a specified time of the resuscitation is identified [2]. The VO or FC starts with IVF resuscitation in ER. This occurs not only in patients presenting with AP but also in septic and all types of Shock, Burns, Trauma, and also during Prolonged Major Surgery. The main objective of the analysis is to identify the subgroup of patients in whom the FC occurs during IVF resuscitation, particularly in those who became critically ill with ARDS or multiple organ failure where most of the mortalities occur. I accept that this subgroup of patients may occur with both fluid regimens with an expected higher incidence among the aggressive regimen group which did not show in this study analysis.

The above two regimens reported by the authors more precisely refer to fluid "maintenance" therapy over a minimum of 24 hours period. There is always an initial bolus of IVF or VO on the initial presentation that consists of giving a few liters (L) of fluids over a couple of hours for resuscitation which is used in both regimens at ER, but not documented in this study. The authors should segregate the subgroups of patients who are critically ill in ICU and suffer ARDS and precisely quantify the VO of fluid retained in their

body comparing them with the rest of the patients who may be used as controls. They should also precisely the VO or FC in the surviving and dead ARDS patients.

The aggressive regimen of 3 ml/kg/hr means that in 24-hours the adult patient of 70 kg receives approximately 5 L per day which is a 7% of body weight (BW). This volume alone may induce FC if the therapy continues for a few days at the same rate while replacing the urine output and more so if the kidneys fail to produce any urine at all. If the VO of 5 L is only for 24 hr it may be considered within the physiological capacity of the kidneys to correct over the next couple of days. The complications of fluid therapy occur in a dose-dependent fashion. There was no detected difference between the two regiments perhaps because both have VO within the physiological domain that the kidneys can handle in most patients. The other reason there was no attempt to identify and segregate the group of patients who suffer from FC and ARDS and quantify the VO retained in their bodies.

The VO or FC is of two types depending on the type of fluid that initially present as volume kinetic or VO Shock (VOS) [3]. Type 1 is induced by sodium-free fluid of 3.5-5 L in an adult patient of which hyponatremia of <120 mmol/L is characteristic, and the TUR syndrome is an example. Type 2 is induced by sodium-based fluid of 7-10 L, including Saline, Hartmann's and Ringer, Plasma, and plasma substitutes. VO or FC is represented by the quantity of fluid retained in the body of the patient at the onset of ARDS and death and is well documented in the original report on ARDS to be 10-12 L in dead patients [4]. In recent huge prospective multicentre clinical trials, fluid retention is 7-10 L in surviving ARDS patients [5].

Should the authors care to take the above points into consideration while reviewing and re-analyzing the data I believe they will reach the correct conclusion that serves the purpose of their study, and they may use the reported 3 articles of mine attached here as references. If they could not retrieve the data, may I ask the editor-in-chief to consider it as a peer reviewer's comments on the article? In this case, the authors may wish to reply to it justifying their stand. This means that the article should be accepted for publication with or without the suggested essential major modification.

In the last paragraph of the discussion, the authors stated: "Our study carries several limitations, largely due to the retrospective nature. Patients with AP presenting to the emergency department were potentially in different stages of pancreatitis presentation, which may lead to the initiation of differing IVF rates and may not account for the severity of the disease. Our study also did not consider the state of enteral nutrition, or the type of fluid used for IVF resuscitation, which may affect the disease progression and healing. This study is a retrospective review with inherited selection bias limitations and the inability to assess incidence. The utilization of a de-identified database also decreases the ability to find confounders that may affect individualized patient care and treatment decisions." Hence, I am not sure if the authors can retrieve the data on VO or FC from the computer system and if the bolus fluid therapy given in ER b is available.

Finally, it is time to reject the old scientific foundation of fluid resuscitation in shock that is based on the erroneous Starling's law for the capillary-Interstitial fluid transfer [6] and to welcome the new scientific foundation based on the new 13 scientific discoveries in physics, physiology, and medicine recently reported in a book [7]. The hydrodynamics of the porous orifice (G) tube is the correct replacement for the wrong Starling's law.

In summary, future authors should identify the subgroups of patients in whom fluid creep occurs during the initial resuscitation at ER giving precisely the volume retained and the period during which this occurred until the onset of ARDS and death. A further subgroup belonging to those who survived and those who died should also be made.

The remaining patients among the two main groups of aggressive and standard IVF therapy should be segregated and used as controls while also quantifying the VO and the period of resuscitation. The VO of FC is calculated from the IVF input VO (in L) during shock resuscitation or the difference in body weight on admission and at the onset of ARDS fluid creep or death in kg. Please do your analysis and statistics on these data and I am sure your report result will give a totally different and correct conclusion.

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