Pediatric septic shock is associated with severe hypovolemia. Children frequently respond well to aggressive volume resuscitation. Contrary to the adult experience, low cardiac output (CO) and not low systemic vascular resistance, is associated with mortality in pediatric septic shock.

The aim of resuscitation is to increase blood flow and perfusion pressure. Fluid challenge is the gold standard test to assess the preload dependence of the patients. Changes in CO or stroke volume of more than 10–15% are used to define a positive response to fluids. Fluid infusion is best initiated with boluses of 20 mL/kg, titrated to assuring an adequate blood pressure and clinical monitors of CO including heart rate, quality of peripheral pulses, capillary refill, level of consciousness, peripheral skin temperature, and urine output. Initial volume resuscitation commonly requires 40-60 mL/kg but can be much.

Targeted fluid resuscitation relieves overt tissue hypoxia; however, over-aggressive fluid therapy has deleterious effects on patient outcomes. We discuss goals of resuscitationfluid responsiveness and theconsequences of tissue edema. Furthermore, we explore new directions in early goal-directed therapy and the choice of fluid therapy.

Fluid overload is a relatively frequent occurrence in critically ill patients and is often a consequence of critical care intervention. Fluid overload in the critically ill is independently associated with increased morbidity and mortality. Thus, intravenous fluids need to be dosed appropriately to reduce the risk of harm associated with this potentially life-saving therapy.

Fluid extravasation into the interstitial space can adversely affect multiple organ systems. Although characterizing fluid overload in every organ system is difficult (that is some systems lend themselves to fluid measurement and correlation with function more than others), increasing evidence has been noted in the pulmonary, cardiac, renal and gastrointestinal systems. Graded increases in extravascular lung water impair oxygenation and are independently associated with mortality.

In patients with septic shock who have been adequately resuscitated, conservative fluid management leading to negative fluid balances is associated with a decrease in hospital mortality. These principles can be applied during the resuscitation of patients with shock which can be viewed as occurring in four phases corresponding to the acronym ‘ROSE’: resuscitation, optimization, stabilization and evacuation. The goals of fluid administration as well as the associated risk and benefits will vary depending on phase of resuscitation. The primary goal of fluid administration during the resuscitation phase is to rapidly correct systemic hypotension. During the optimization phase, the goal of fluid administration is to improve oxygen delivery to the tissues. In the stabilization phase, patients are hemodynamically stable and fluid administration should be restricted. In the evacuation phase, interventions are targeted at fluid removal.

We know that total water content in extravascular interstitial sector in infants and children are in 3 and 2 times higher than in adults, whereas the total water content is only 20% and 10% higher compared with adults. That’s why fluid boluses of 60 ml / kg and more in children can lead to fluid overload especially overload the interstitial sector because circulating time of crystalloid solutions in the bloodstream is low.

The use of albumin-containing solutions in critically ill patients has been recently revisited, following evidence on harmful effects of synthetic colloids, and novel randomized controlled trials in sepsis. We know that permeabilityof the endothelial barrier to albumin widely varies,depending on different organ systems. In diseased states, the altered capillary permeabilitynullifies the oncotic properties of albuminat different extent. The classical Starling’s view has been revised in the last 10 years,after the identification of the glycocalyx as a crucialstructure regulating transvascular fluid exchange. According to this paradigm, the impermeabilityto albumin occurs at the endothelial glycocalyx layer. Nonetheless, in our opinion, it does not modifyessentially the Starling’s concept, at least at the venularside. This is quite evident in full-blown sepsis,wherein the capillary permeability is altered at suchextent that the amount of fluid given to achieve apredefined hemodynamic target is similar, whetherincluding
crystalloids, with or without albumin, or synthetic colloids. Albumin is the main protein responsible for plasma colloid osmotic pressure; it acts as a carrier for several endogenous and exogenous compounds, with antioxidant and anti-inflammatory properties, and as a scavenger of reactive oxygen and nitrogen species and operates as a buffer molecule for acid–base equilibrium.

Children under the age 1 year do not have the effective reabsorption of sodium in renal tubules with increased fractional excretion of sodium and reduced glomerular filtration rate. Finishing of formation renal cortex comes only up to 5 years. Therefore, fluid overload in children may lead to the development of tissue edema.

Crystalloids and colloids have clearly different anticoagulant side-effects. First, the unspecific dilutional effect on coagulation is determined by the fluid’s volume efficacy, with colloids having a higher efficacy compared with crystalloids. Also the transfusion of packed red blood cell concentrates with or without mixing it with fresh frozen plasma and reconstitution of whole blood results in haemodilution and may induce dilutional coagulopathy. If colloids are infused restrictively and according to individualized preload and/or microcirculatory targets (and if colloids are not abused for general fluid substitution), dose-dependent side-effects on clot strength are suggested to be minimal and – most likely – not requiring reversal. The dose-dependent risk of dilutional coagulopathy differs between colloids (dextran > hetastarch > pentastarch > tetrastarch, gelatins > albumin). The use of hyperoncotic albumin solutions will maintain a higher level of central venous pressure and mean arterial pressure with lower overall fluid balance in patients with severe sepsis and septic shock.

Due to anatomical and physiological characteristics of the fluid distribution and kidney function in children and the impact of large volume of intravenous solutions on hemostasis, we can say that strategy without volume overload in severe sepsis and septic shock may improve survival of children.