**The Role of CytoSorb Hemoadsorption Therapy in Protecting Endothelial Integrity in Sepsis and Systemic Hyperinflammation**

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| **Introduction**  Sepsis and other systemic hyperinflammatory states are a serious and potentially life-threatening condition caused by the body's intense reaction to an infection or a strong sterile noxious trigger. This reaction triggers the release of substances like pro-inflammatory cytokines and mediators, which cause widespread inflammation. This intense inflammation harms the endothelium, the thin layer of cells lining blood vessels. As a result, capillary leakage and vasoplegic shock can develop, marked by severe circulation problems and organ failure.  Damage to the endothelium is a key factor in hyperinflammatory shock, as it makes blood vessels more "leaky," allowing fluids to escape into surrounding tissues. This fluid loss worsens circulation and tissue oxygenation issues and requires careful management with fluids and cardiovascular drugs to stabilize the patient. CytoSorb hemoadsorption is an emerging adjunctive treatment that can help protect the endothelium and reduce the need for fluid and vasoactive therapy in septic and other hyperinflammatory shock states. |
| **CytoSorb hemoadsorption and its mechanisms**  CytoSorb hemoadsorption is a treatment to restore physiological balance by blood purification outside the patient’s body. Held in a cartridge, the adsorbing beads are made of safe, biocompatible materials. The adsorption process removes excessive levels of potentially harmful substances, such as inflammatory molecules (cytokines) and toxins, from the blood. The goal is to control the overactive immune response and protect the endothelium, the blood vessels' inner lining, which is heavily affected during systemic hyperinflammation.  CytoSorb works by specifically capturing inflammatory substances like tumor necrosis factor alpha (TNF-α), interleukin-6 (IL-6), and interleukin-1β (IL-1β). These molecules play an important role in triggering inflammation and damaging the endothelium. The therapy also removes other harmful substances, such as procalcitonin (PCT), which can worsen endothelial damage.  By reducing these damaging substances in the blood, CytoSorb helps stabilize the endothelium, resulting in reduced leakage from blood vessels (vascular permeability) and improved blood flow in small vessels (microcirculation). |
| **Endothelial integrity and fluid regulation**  In systemic hyperinflammation, the endothelium is damaged through various processes that affect the structure and function of the vascular walls. One major driver of such shock states is the increased permeability of blood vessels caused by inflammatory cytokines and other harmful substances, as well as direct injury to the endothelium. This damage causes significant fluid leakage from blood vessels into surrounding tissues, leading to a much higher need for fluids to maintain circulation and blood pressure.  A key goal in treating systemic hyperinflammation is to protect the endothelium and prevent excessive fluid buildup in tissues (edema). CytoSorb hemoadsorption helps achieve this by removing inflammatory and other deleterious substances from the blood. This supports stabilization of the endothelial barrier, reduces capillary leakage, and minimizes fluid loss from the bloodstream. |
| **Reduced fluid needs and early fluid removal**  Managing hyperinflammatory shock often involves balancing fluid therapy carefully. Initially, aggressive fluid treatment is used to stabilize circulation, but too much fluid can lead to edema and consequently to impaired oxygenation and worse organ function, particularly in the lungs and kidneys. Early fluid restriction is an important approach that focuses on protecting the endothelium and controlling excessive inflammation.  CytoSorb hemoadsorption helps reduce the need for large amounts of fluids by targeting inflammatory molecules and proteins that damage the endothelium. By stabilizing the endothelium, the therapy lowers capillary leakage and minimizes fluid loss. As a result, patients require less fluid overall, and excess fluids can be removed earlier and faster without negatively affecting tissue perfusion and oxygenation.  This approach interrupts inflammation early, reducing the need for aggressive fluid therapy. It is especially beneficial for patients at risk of lung or kidney complications caused by fluid overload. |
| **Early Clinical Evidence: Reduced Fluid Balance and Better Lung Function with Hemoadsorption** Initial clinical studies show that CytoSorb hemoadsorption therapy may help reduce the need for fluids in patients with septic shock and improve lung function in those with ARDS. By lowering inflammation, the therapy helps stabilize blood pressure and circulation while reducing the risk of fluid overload—a major cause of lung swelling (pulmonary edema).  By limiting fluid buildup, CytoSorb can improve oxygenation and lung function in septic patients. This may also aid in the faster recovery of other organs affected by fluid overload and inflammation. |
| **Conclusion**CytoSorb hemoadsorption offers a valuable approach to removing inflammatory cytokines and other substances that harm the endothelium in hyperinflammatory shock states. By targeting these harmful mediators, the therapy helps protect blood vessel integrity and reduce endothelial damage. This minimizes fluid loss from the bloodstream, lowers the need for large fluid volumes, and allows for earlier removal of excess fluids. These effects may support faster recovery of vital organs, such as the lungs and kidneys, and, ultimately, improve patient outcomes. **References**  Piskovatska V et al, Proteins Adsorbed during Intraoperative Hemoadsorption and Their In Vitro Effects on Endothelium   |  | | --- | | Healthcare 2023; 11(3): 310 | | Kasper R et al, Major endothelial damage markers identified from hemadsorption filters derived from treated patients with septic shock - endoplasmic reticulum stress and bikunin may play a role  Front in Immun 2024; 15:1359097  Papp M et al, Endothelial Protection and Improved Micro- and Macrocirculation with Hemoadsorption in Critically Ill Patients  Journal Clin Med 2024; 13:7044  David S et al, Effect of extracorporeal cytokine removal on vascular barrier function in a septic shock patient.  J Intensive Care 2017; 21(5):12  Duran s et al, Sublingual Microcirculatory Evaluation of Extracorporeal Hemoadsorption with CytoSorb(R) in Abdominal Sepsis: A Case Report  Blood Purif 2022; 51(7):634-638   |  |  | | --- | --- | | Kogelmann K et al, Impact of CytoSorb Hemoadsorption Therapy on Fluid Balance in Patients with Septic Shock  J Clin Med 2024; 13(1):294  Ergin B et al, Hemoadsorption improves kidney microcirculatory oxygenation and oxygen consumption, ameliorates tubular injury, and improves kidney function in a rat model of sepsis-induced AKI  Sci Rep 2024; 14(1): 28552  Szigetvary CE et al, Hemoadsorption as Adjuvant Therapy in Acute Respiratory Distress Syndrome (ARDS): A Systematic Review and Meta-Analysis  Biomedicines 2023; 11(11):3068   |  | | --- | |  | | | |