

## Use of CytoSorb in a patient with hemorrhagic shock and multiple organ failure due to complicated secondary cesarean section

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*This case reports on a 31-year-old previously healthy female patient, who was admitted post-operatively to the intensive care unit (ICU) with hemorrhagic shock and dilutional/ disseminated intravascular coagulopathy following secondary cesarean section with uterine atony, after already two revisions and ultimately an emergency hysterectomy.*

### Case presentation

- On admission to the ICU, the patient was ventilated (pressure-controlled ventilation, with an  $\text{FiO}_2$  of 0.8), hemodynamically unstable with high catecholamine requirements. For hemodynamic stabilization, the patient was given norepinephrine up to 70  $\mu\text{g}/\text{min}$  and dobutamine up to 300  $\mu\text{g}/\text{min}$  in addition to fluid resuscitation. Moreover, the intravascular oncotic pressure was increased by an albumin infusion. While in shock, lactate levels were 10 mmol/l accompanied by severe metabolic acidosis
- Also, following perioperative mass transfusion (including 9 red cell concentrates, 12 litres of Ringer's solution) in postpartum hemorrhagic shock, she had dilutional and disseminated intravascular coagulopathy. In accordance with repeated rotational thromboelastometry (ROTEM) measurements and a confirmed decrease in hemoglobin and platelet levels, as well as an increased bleeding tendency with prolonged aPTT, increased INR and fibrinogen deficiency, she received coagulation factors (a total of 15 g fibrinogen, 4500 IU human prothrombin complex (PPSB), 6000 IU blood coagulation factor XIII, 2000 mg tranexamic acid, 6 g calcium) as well as two platelet concentrates. As a result, her coagulative state was largely normalized intraoperatively under ROTEM control, and there were no further indications of post-operative bleeding
- Chest X-ray examination showed bilateral pleural effusions and evidence of pulmonary hyperhydration, most probably due to the initial massive volume replacement therapy with increased capillary leakage, however without signs of pulmonary infiltrates
- There was also a marked increase in troponin and creatine kinase values. Given the hemorrhagic shock situation, it was assumed that there was ischemic myocardial damage in the context of a type 2 acute coronary syndrome
- Several hours post-operatively, inflammatory markers were clearly elevated: leukocytes 18.4 G/l, C-Reactive Protein [CRP] 62.5 mg/l and Interleukin [IL-6] 119 ng/l
- Due to a confirmed nitrite-positive urinary tract infection, antibiotic therapy with co-amoxicillin was started for a total of 7 days. Repeated urine cultures, however, were negative on all measurements, while no bacterial growth could be detected in subsequent microbiological examinations
- On the first postoperative day, there was also a marked increase in aminotransferases (aspartate aminotransferase [AST] 779 U/l, alanine aminotransferase [ALT] 132 U/l) indicating a shock-induced ischemic hepatopathy
- Moderate ascites with anasarca was also found in the context of the pronounced fluid resuscitation. During the post-operative course, 1000-3000 mls of wound drainage per day was recorded

- Due to acute anuric renal failure with hyperkalemia and hyperphosphatemia, continuous renal replacement therapy (CRRT) was started early, i.e. about 2 hours after admission to the ICU
- Given the pronounced hemodynamic instability with progressive multi-organ failure in the context of severe hyperinflammation following mass transfusion, a CytoSorb cytokine adsorber was started simultaneously with CRRT

### Treatment

- Treatment with CytoSorb was performed for a period of about 48 hours
- CytoSorb was used in combination with CRRT (Prismaflex, Baxter) run in CVVHDF mode
- Anticoagulation: regional citrate. After the onset of citrate accumulation in the context of the most severe shock state with severe lactic acidosis, continuous veno-venous hemodiafiltration (CVVHDF) could be continued without problems following adjustment of hemodiafiltration settings
- Position of the CytoSorb adsorber: post-hemofilter

### Measurements

- Hemodynamics and norepinephrine requirements
- Lactate
- Inflammatory parameters (CRP, Procalcitonin [PCT], ferritin, IL-6)
- Fluid balance (colloids and crystalloids)
- Oxygenation/ventilation

### Results

- Catecholamine therapy with norepinephrine could already be reduced to 3-5 µg/min 24 hours after initiation of combined CRRT/CytoSorb therapy after generous fluid substitution including album administration
- Lactate levels also normalized on the first postoperative day
- One day post-operatively, leukocytes were 14.1 G/l, CRP 72.5 mg/l, PCT 1.7 ng/ml, ferritin 787.7 µg/l and IL-6 86.4 ng/l
- Following hemodynamic stabilization, consistent negative balancing could be achieved from day 4 onwards
- The clinical pulmonary hyperhydration improved daily under negative balancing while chest X-ray examination showed that the pleural effusions had regressed. There was no evidence of transfusion-associated acute lung injury (TRALI). Weaning was also unproblematic, extubation was performed after neurological improvement on day 7

### Patient Follow-Up

- Due to a recurrent febrile episode in the antibiotic window, another sampling was performed, confirming the growth of *Pseudomonas aeruginosa* and *Enterococcus faecium* in the abdominal wound discharge. Consequently, antibiotic therapy was initially changed to piperacillin/tazobactam and daptomycin (for acute renal failure), and was then, according to the resistogram, switched from piperacillin/tazobactam to meropenem and continued for a total of 14 days. Following another recurrence of fever and ultrasound-guided puncture of an intra-abdominal hematoma, *Candida albicans* was detected in the collected sample. After initiating antifungal therapy with fluconazole, inflammatory parameters decreased over time

- After a total of 7 days of CVVHDF with an increase in diuresis, a first discontinuation attempt was started a few days later, which resulted in a renewed increase in creatinine and urea plasma levels. Therefore, intermittent hemodialysis was started and continued until transfer of the patient to a rehabilitation unit
- Following an initial delayed recovery phase (despite reduced sedation, vigilance was still reduced), extubation was finally achieved without complications after a total of 7 days of invasive ventilation. Gas exchange was unproblematic. Due to persistent dyspnoea, a lung scintigraphy was performed without evidence of pulmonary embolism
- After extubation, the patient was temporarily disoriented with hallucinations, which was interpreted as multifactorial delirium. The symptoms improved rapidly and there were no cognitive impairments. In the course of the patient's stay, she developed loss of vision in the right eye, which, after magnetic resonance and ophthalmological examination, was interpreted as ischemic optic neuropathy in the context of the severe shock event
- During the entire intensive care stay, the patient required a total of 7 units of red blood cells. Substrates remained within the normal range and erythropoietin was administered weekly in the presence of dialysis-dependent renal insufficiency with hyporegenerative anemia. At discharge, severe anemia persisted with an Hb of 63 g/l, however with measurable reticulocytosis.
- The patient was discharged to a rehabilitation facility after a total hospital stay of 31 days

### Conclusions

- In this patient with hemorrhagic shock and multiple organ failure due to complicated secondary cesarean section, the post-operative use of CytoSorb, in addition to correcting hypoalbuminemia, led to hemodynamic stabilization by controlling hyperinflammation
- According to the authors, CytoSorb therapy in this complex case presumably contributed to gaining control over the hyperinflammation triggered by the initial mass transfusion within a few hours
- Hemoadsorption with CytoSorb in combination with CRRT was safe and easy to perform in this challenging setting