

Use of CytoSorb in a patient with bacterial septic shock and cytokine storm in the context of COVID-19 pneumonia – with a paragraph on the relevance from a nursing perspective

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This case reports on a previously fit and well 45-year-old male patient who was transferred from an external hospital to the University Hospital St. Pölten already intubated and ventilated.

Case presentation

- One week before admission to our intensive care unit (ICU), the patient presented to the general practitioner (GP) with fever and cough, an initial test for COVID-19 was negative
- The symptoms worsened steadily over the following week, and so the patient was transferred to an external hospital by the emergency ambulance, 7 days after initial presentation to the GP and was immediately intubated
- Oxygenation was insufficient despite maximum therapy and the patient was finally transferred to the University Hospital of St. Pölten for evaluation of Extracorporeal Membrane Oxygenation (ECMO) therapy
- Nitric oxide therapy was instituted immediately after admission and veno-venous (vv) ECMO initiated
- Mechanical ventilation had the following settings: PEEP 18 mbar, P_{insp} 30 mbar
- Anti-infective therapy with meropenem and linezolid was started
- At the same time, there was a relatively high need for sedation
- Argatroban was used for anticoagulation with a target aPTT of 55-65 seconds
- Over the next 2 weeks, the patient's condition improved progressively
- With an initially successful period of pausing ECMO and switching to continuous positive airway pressure (CPAP) ventilation, vvECMO cessation was considered on day 22
- At this time, however, there was a sudden increase in inflammatory parameters, particularly of IL-6, as well as a rapid increase in oxygen demand, and so the ECMO gas flow had to be increased again
- Blood cultures were also taken and broad anti-infective therapy was reinitiated
- The patient became gradually hemodynamically unstable, which was accompanied by rapidly increasing catecholamine requirements (norepinephrine 0.19 µg/kg/min, Vasopressin short-term up to 5 IE/h)
- With the rationale to control the hyperinflammatory reaction and to stabilize the patient hemodynamically, a CytoSorb adsorber was additionally installed into the ECMO circuit
- Under ongoing CytoSorb therapy, levosimendan and dobutamine medication was started due to reduced cardiac pump function

Treatment

- A total of 9 consecutive CytoSorb treatments was performed over the following 5 days (treatment 1-5 for 8 h each, treatment 6 and 7 for 12 h each, treatment 8 and 9 for 24 h each)
- CytoSorb was integrated into the bypass of the vvECMO circuit
- Anticoagulation: Argatroban and from day 23 additionally epoprostenol

Measurements

- Hemodynamics and dosage of vasoactive substances
- Inflammatory parameters

Results

- Following an initial short-term increase in norepinephrine and vasopressin requirements, the administration of all vasoactive substances could be significantly reduced during the course of CytoSorb therapy. One day after discontinuation of CytoSorb therapy, the patient was free from catecholamines
- IL-6 plasma concentrations initially increased in the first hours under CytoSorb (up to >50,000 pg/ml), but were already clearly decreasing over the course of the next day (14,168 pg/ml). In the following 24 hours, IL-6 levels further dropped to 119 pg/ml and this trend continued. After a short increase in C-reactive protein immediately after the start of CytoSorb therapy, it reached normal values at the end of CytoSorb treatment. Procalcitonin (PCT) levels also rose briefly immediately after CytoSorb initiation, but then fell again during ongoing therapy. The increase in PCT indicated a bacterial superinfection

Patient Follow-Up

- Enterococcus faecalis was identified in the blood cultures and catheters were then changed followed by de-escalation of antibiotic therapy. In addition, the oxygenator and the entire vvECMO system, with the exception of the cannulae, were replaced while CytoSorb therapy was still running
- Also whilst still receiving CytoSorb, the first negative SARS-CoV-2 test came back with subsequent cancellation of the patient's isolation
- After cessation of CytoSorb treatment, there was a marked improvement in vigilance, the patient was increasingly alert and could be switched to CPAP ventilation
- Change of ventilation to HighFlow support
- ECMO therapy was finally stopped after 62 days
- In the meantime, the patient was oriented and already mobile with the help of a walking aide
- At the time of documentation, the patient had to be reintubated due to a neurologic symptomatology

Conclusion

- The combined treatment of standard intensive care therapy, anti-infective therapy, vvECMO and CytoSorb hemoadsorption therapy resulted in significant stabilization of hemodynamics and control of the hyperinflammatory situation
- According to the medical team, this case is a good example of the use of CytoSorb therapy in severe septic shock and vvECMO therapy in the context of COVID-19 infection
- The installation of the CytoSorb adsorber into the running ECMO circuit was safe and problem-free, even under anticoagulation with argatroban

REMARKS ON THE CASE FROM A NURSING PERSPECTIVE

- A doctor's order is mandatory for the installation of the CytoSorb adsorber
- The nursing care of unstable patients with sepsis is complex; good specialist knowledge on the part of the nurse is a prerequisite. In addition, continuous monitoring, optimized therapy management and good cooperation and communication between nursing and the treating medical team are crucial
- Nursing takes over more and more activities in different areas. An unstable patient in times when 1:1 care is not possible is very challenging and demands a lot from the assigned caregiver
- Compliance with all applicable hygiene guidelines is a top priority in all nursing and medical activities. It can help prevent sepsis
- With the CytoSorb adsorber, it is possible to stabilize the patient more quickly. Mobilization and therapeutic positioning to promote circulation are possible again - these measures are essential when weaning the patient from the respirator
- A more rapid improvement of hemodynamics with CytoSorb therapy in the septic patient requires less catecholamines, reduced syringe changes and less use of volume solutions, which in turn creates nursing resources that are directly available to this patient or other ICU patients
- The senior service independently performs the priming of the CytoSorb adsorber and integrates it into the dialysis machine. If not already available, the nurse must also prepare the placement of the necessary vascular access and carry out the priming of the dialysis machine
- During operation of the device, the nursing staff must keep an eye on the system pressures of the dialysis machine at all times. Changes that indicate coagulation in the system must be detected at an early stage to ensure that the blood is returned to the systemic circulation
- The control and adjustment of the calcium citrate dose is also the responsibility of the senior service
- When changing the CytoSorb adsorber, it is necessary to disconnect and reconnect the dialysis machine. Potential hemodynamic instability must be counteracted. This includes, if necessary, a prompt increase in catecholamine doses, raise of legs and/or lowering of the head
- At our department, integration of the CytoSorb adsorber into a running ECMO circuit is performed by a perfusionist. However, participation in the implementation and monitoring of the extracorporeal circuit is also the responsibility of the nursing staff
- Running (with the exception of the insertion of required vascular catheters) and monitoring of procedures such as CytoSorb hemoadsorption with the catheter in place, particularly in the context of renal replacement therapy, is regulated in the Austrian Health Care and Nursing Act (GuKG)