Role of immunomodulation therapy with the Selective Cytopheretic Device used in conjunction with extracorporeal membrane oxygenation and pathogen removal in a case of septic shock secondary to Streptococcal toxic shock syndrome

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Introduction

Streptococcal toxic shock syndrome (STSS) is a fulminant disease characterized by sudden onset of shock, hyperinflammation, and organ failure. Mortality typically exceeds 50%. Treatment includes the use of vasopressors to restore sepsis-induced hypotension, which can be limited in refractory cases. Patients can develop catecholamine-resistant shock, which can lead to multiple organ failure and death. Here, we describe a novel multi-extracorporeal intervention strategy in a case of severe septic shock secondary to STSS starting with veno-arterial (VA) extracorporeal membrane oxygenation (ECMO) with subsequent initiation of continuous renal replacement therapy and pathogen hemoperfusion using the Seraph 100 Microbind™ Affinity Blood Filter followed by the Selective Cytopheretic Device (SCD). The SCD promotes an immunomodulatory effect of the host septic response when circuit ionized calcium is maintained at <0.40 mmol/L with regional citrate anticoagulation.

Methods

A 28-year old female patient 5-days post cesarean-section presented with respiratory distress and hypotension. Blood cultures grew *S. pyogenes*. The course progressed to multiple organ failure, including anuric acute kidney injury, shock liver, respiratory failure, and refractory shock. Conventional therapy initially involved stabilization through intubation, fluid resuscitation, vasopressors, and antibiotics. Due to increasing instability, the patient was placed on VA-ECMO and was initiated on Seraph 100 for 36 hours for pathogen clearance, followed by SCD treatment for 12 days.

Results

No device-related adverse events were observed. The patient's condition gradually stabilized, with discontinuation from vasopressors after 4 days, ECMO decannulation after 6 days, evidence of renal recovery after 7 days, and extubation from mechanical ventilation after 14 days. She was transferred to conventional hemodialysis after 13 days and discontinued all kidney replacement therapy 11 days later. Her course was complicated by skin necrosis and extremity ischemia, which required fasciotomy and eventual amputations. She continues to recover with a focus on physical therapy and function.

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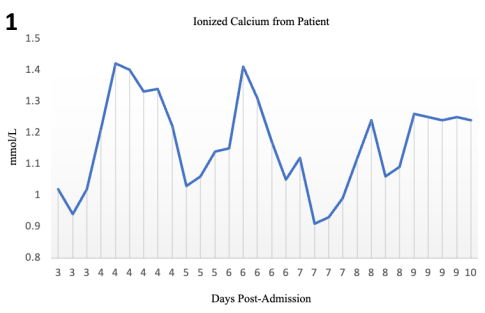

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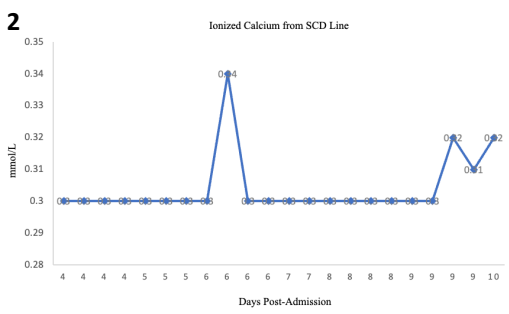

Ionized calcium was measured both directly from the patient (**Figure 1**) and from the SCD lines (**Figure 2**). Ionized calcium from the SCD line was maintained at <0.40 mmol/L with regional citrate anticoagulation.

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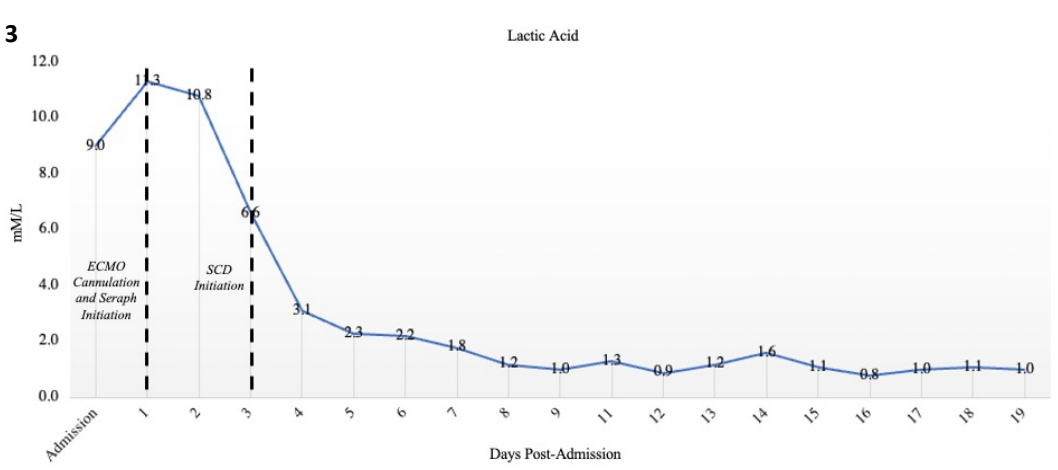

Figure 3 illustrates lactic acid levels in relation to initiation of specific interventions. ECMO and Seraph were initiated on Day 1, while SCD was initiated on Day 3.

Results

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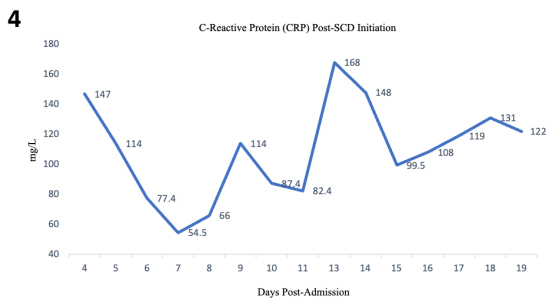

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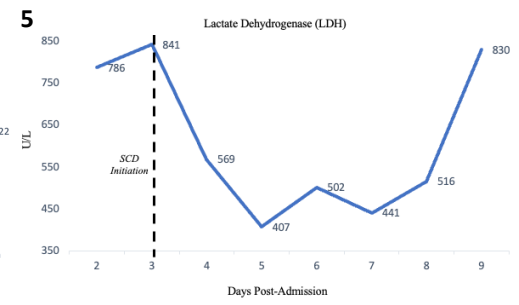

C-reactive protein (CRP), which is a liver enzyme indicative of systemic inflammation, is illustrated in **Figure 4**, while lactate dehydrogenase (LDH) is shown in **Figure 5**. Of note, the patient underwent vascular surgery on Day 7 and debridement on Day 12.

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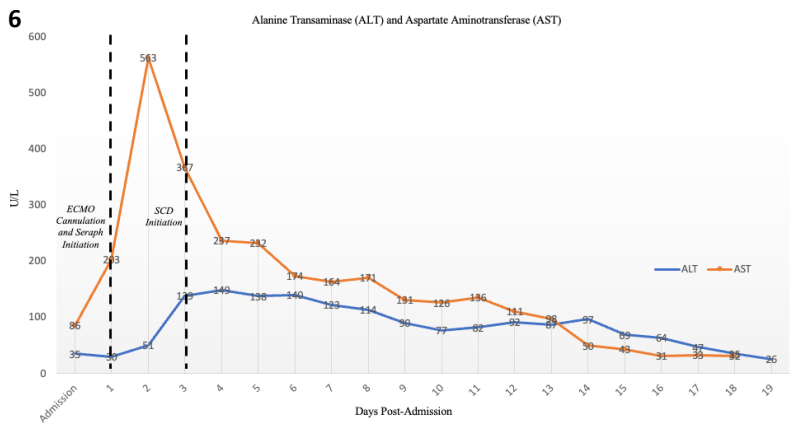

Alanine transaminase (ALT) and aspartate aminotransferase (AST) are graphed in **Figure 6**. These enzymes are indications of liver damage.

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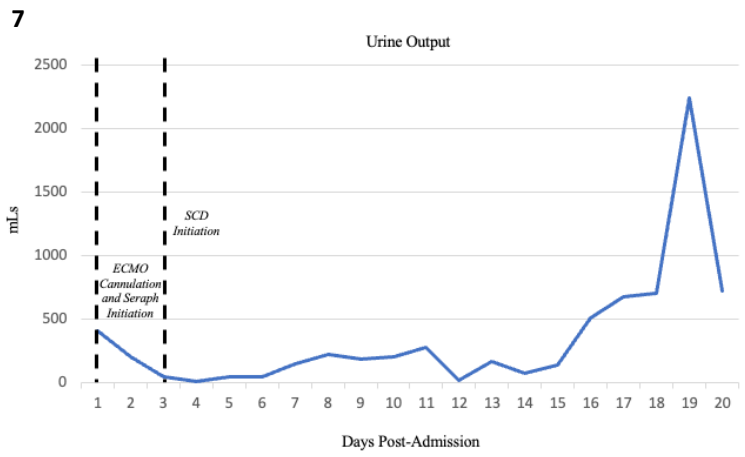

Figure 7 illustrates urine output over time, indicating kidney function.

Conclusions

The patient's outcome in relation to initial prognosis demonstrated success through the use of multiple modalities of extracorporeal support. This is the first reported use of VA-ECMO, Seraph 100 hemoperfusion, and SeaStar Medical's SCD; this strategy combines a cardiopulmonary stabilization on ECMO, pathogen removal, and cell-directed immunomodulation. This multi-modal approach to EC support may represent the future of critical care for the most refractory cases.

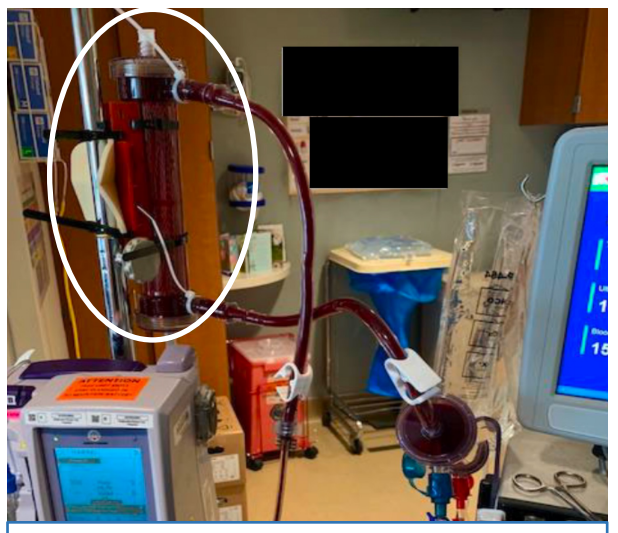

Figure 8. The SCD is illustrated within the circuit.