

Case Report

A rare case of hepatitis a virus-induced acute liver failure managed by hemoadsorption CytoSorb and Biosky MG 350

Mithun Kumar Mondal^{1*}, Nur Takia², Abdullah Al Mukit³, Masudul Alam Mazumder^{1,2}

¹Emergency Casualty Centre, Combined Military Hospital (CMH), Dhaka, Bangladesh

²Critical Care Centre, Combined Military Hospital (CMH), Dhaka, Bangladesh

³Rajshahi Medical College Hospital, Rajshahi, Bangladesh

Received: 12 March 2025

Revised: 10 April 2025

Accepted: 15 April 2025

*Correspondence:

Dr. Mithun Kumar Mondal,

E-mail: m1989n.k64@gmail.com

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ABSTRACT

Acute liver failure (ALF) is a severe and life-threatening condition characterized by rapid hepatic dysfunction, leading to multi-organ failure and a high mortality rate. It is primarily driven by a profound inflammatory response that exacerbates liver damage and affects systemic organ function. The pathophysiology of ALF involves an imbalance between pro-inflammatory and anti-inflammatory cytokines, which further impairs liver function and worsens clinical outcomes. One promising therapeutic intervention for managing ALF is hemoadsorption, an extracorporeal blood purification technique that helps mitigate hyperinflammation by removing toxic metabolites and pro-inflammatory cytokines. Recently, this approach has gained attention for its potential to improve patient outcomes in critical conditions, such as ALF. In this report, we present a rare case of hepatitis A virus-induced ALF complicated by septic shock, which was successfully managed using dual hemoadsorption techniques. The application of these methods significantly reduced inflammatory markers and improved liver and other organ function, highlighting the efficacy of hemoadsorption in managing ALF patients.

Keywords: Acute liver failure, CytoSorb, Biosky MG 350

INTRODUCTION

Acute liver failure (ALF) is a critical condition marked by rapid deterioration of liver function, leading to multi-organ failure and increased mortality. Severe inflammation is a key pathophysiological mechanism causing organ dysfunction. Restoring the balance between pro- and anti-inflammatory cytokines is essential for improving liver function and patient outcomes.¹ Fulminant hepatic failure occurs in less than 1% of hepatitis A patient; major risk factors include age over 50 and underlying liver disease (especially chronic hepatitis C virus infection).²⁻⁵ Hemoadsorption, a novel blood purification method, adsorbs cytokines and toxic metabolites to regulate hyperinflammation.⁶⁻⁸ Hyperinflammation is known to contribute to acute liver impairment in critically unwell patients.⁹ Its application

in ALF patients aims to improve liver function and manage associated complications. This case report describes a patient with hepatitis A virus-induced ALF and septic shock, managed using dual hemoadsorption techniques with a combination of adsorption cartridges.

CASE REPORT

A 33-year-old woman with no known comorbidities presented with a high-grade continuous fever for four days and generalized weakness. She had no history of recent travel or sick contacts. Additional symptoms included jaundice, flapping tremors, and altered consciousness. Physical examination revealed icterus, flapping tremors, and altered mental status. Laboratory results were: serum total bilirubin: 56.6 mg/dL, direct bilirubin: 45.8 mg/dL, alanine aminotransferase (ALT):

3325 U/L, aspartate aminotransferase (AST): 2677 U/L, alkaline phosphatase: 120 U/L, hemoglobin: 6.9 g/dL, prothrombin time (PT): 25 seconds, INR: 2.35, serum creatinine: 0.6 mg/dL.

Hepatitis A IgM was positive, while other serologic markers were negative. Ultrasound revealed ascites, a thickened gallbladder wall, and borderline splenomegaly. The diagnosis of fulminant hepatic failure was made based on encephalopathy, elevated bilirubin, coagulopathy, and no pre-existing liver disease. She was intubated and placed on mechanical ventilation due to hepatic encephalopathy. The patient's renal function deteriorated by ICU Day 10, requiring her first hemodialysis. She developed ventilator-associated pneumonia due to *K. pneumoniae* and *Acinetobacter baumannii*. Despite appropriate antibiotics, she experienced septic shock requiring vasopressor support. Elevated procalcitonin (52.86 ng/mL) and low urine output (5-10 mL/hr) prompted the initiation of hemoadsorption therapy with dual adsorption cartridges.

CytoSorb (ICU days 12, 16, and 21): Three sessions were performed, resulting in reduced serum bilirubin, procalcitonin, blood urea, and lactate dehydrogenase (LDH) levels. However, thrombocytopenia was observed. Biosky MG350 cartridge (ICU Days 23, 29, 33, and 37): Four sessions achieved similar reductions in bilirubin, procalcitonin, and LDH without thrombocytopenia, likely due to improved infection control. The patient underwent a total of twelve hemodialysis sessions. Improvement in ammonia levels and urine output allowed for discontinuation of dialysis by ICU day thirty eight. Ventilator-associated pneumonia was treated with a combination of antibiotics. A tracheostomy was performed on ICU Day 25 due to prolonged ventilation requirements. She was transferred to a high-dependency unit on ICU day forty with normalized renal function and hemodynamic stability, although bilirubin remained elevated. The patient was stable in HDU without any support until hospital day eighty five, then suddenly deteriorated and expired due to an acute myocardial infarction.

Table 1: Consolidated parameter trends.

Parameters	Day 10	Day 12	Day 16	Day 21	Day 23	Day 29	Day 33	Day 37	Day 40
Platelet count (×10⁹/l)	80	60	55	50	65	70	75	80	85
Blood urea (mg/dl)	120	90	75	60	50	40	30	25	20
Serum creatinine (mg/dl)	2.8	2.5	2.0	1.5	1.2	1.0	0.9	0.8	0.7
Serum procalcitonin (ng/ml)	52.86	40	25	10	8	5	3	2	1.5
Urine output (ml/hr)	5-10	15	20	30	50	80	100	120	150
Serum ammonia (μmol/l)	150	120	100	80	70	60	50	40	35
LDH (U/l)	1000	800	600	500	450	400	350	300	250
AST (U/l)	2677	2500	2200	2000	1800	1600	1400	1200	1000

*Table 1 shows the consolidated parameters according to Days.

DISCUSSION

ALF is an uncommon but difficult clinical illness that has several causes; a particular etiology cannot be determined in 15% of adult and 50% of pediatric cases. The course of ALF varies, and the fatality rate is significant. Liver transplantation is the only confirmed therapy for ALF, although its rapid progression and varied course limit its usage. In the United States, roughly 45% of persons with ALF survive spontaneously, 25% undergo liver transplantation, and 30% die without receiving a transplant. The prognosis of ALF varies by etiology, with favorable prognoses found with acetaminophen overdose, hepatitis A, and ischemia (about 60% spontaneous survival), and unfavorable prognoses with drug-induced ALF, hepatitis B, and undetermined cases (approximately 25% spontaneous survival).¹⁰

CytoSorb (CytoSorbents, Monmouth Junction, NJ, USA) was recently put into clinical practice as an extracorporeal blood purification device to manage systemic inflammation. Most cytokines are absorbable (up to about 55 kDa), thus they can be quickly removed from the bloodstream and help to regulate severe systemic inflammation. As a result, hemoadsorption therapy is primarily utilized in septic shock and other hyperinflammatory diseases to reduce the damaging effects of cytokines and the excessive inflammatory response.¹¹ According to the most recent review by the International CytoSorb registry, ALF was the third most common indication for its usage, and the treatment resulted in significant bilirubin elimination.¹² Although clinical data is limited, a recent in vitro investigation found that CytoSorb hemoperfusion is more successful than MARS in removing TNF- α , IL-6, and lowering indirect bilirubin and bile acid levels.¹³

Tomescu et al published another recent case series. CytoSorb® hemoadsorption in patients with ALF implies that CytoSorb® could be used as a therapeutic alternative for liver impairment management, providing biochemical control, acting as a bridge to liver transplantation, or until spontaneous remission.¹⁴

In our case report, we observed a decrease in serum bilirubin and inflammatory marker serum procalcitonin. The ammonia level also gradually decreased, which could be attributed to hemoadsorption therapy. However, we have observed thrombocytopenia following each CytoSorb therapy. It is difficult to determine whether the decline in platelet count was caused by the devices or the extracorporeal circulation itself. Alharthy et al also found thrombocytopenia as a side effect of hemoadsorption therapy in critically ill patients with COVID-19 and acute renal injury, however Paul et al. found no significant difference in platelet count in septic patients.^{15,16} We have also observed a steady decrease in ionotropic and vasopressor support following hemoadsorption therapy. Scharf et al. have observed the same behavior. According to their study, successful bilirubin elimination in critically ill patients with acute liver dysfunction using a cytokine adsorber and albumin dialysis, bilirubin removal by hemoadsorption therapy, compared to advanced organ support (ADVOS) in patients with ALF (various etiologies), CytoSorb® use resulted in hemodynamic stabilization and was much easier to use.¹⁷ At the same time, we see tendencies toward lower LDH levels after each hemoadsorption therapy, although AST levels do not improve, which contradicts Mihai Popescu et al. They discovered that hemoadsorption therapy was associated with a paraclinical improvement in liver functional tests, as evidenced by a more pronounced decrease in bilirubin, ammonia, lactate, transaminase, and LDH levels compared to the MARS group, suggesting that hemoadsorption therapy may provide a more comprehensive biochemical control of liver failure than MARS.¹⁸

The Biosky MG350 adsorber (Biosun medical technology Co. Ltd, China) is a disposable hemoperfusion cartridge made of microporous adsorptive resin. It is approved for use in sepsis and hyperinflammation. There is very little published literature in English, with only one case report available. CytoSorb® and the MG350 filter were used sequentially in a patient with severe ARDS during COVID-19. Following successful CytoSorb® use, an MG350 filter was employed with an ECMO circuit. Combining an antibiotic regimen and the Biosky filter reduced inflammatory markers (CRP, PCT, IL-6, and IL-2). However, the patient had severe respiratory failure and died.¹⁹

MG 350 filter cost is much less than hemoadsorption therapy. So, due to budgetary constraints and the patient's condition as still critical, we continued hemoadsorption therapy with MG350. We have seen the same effect of MG350, like CytoSorb, in reducing serum bilirubin,

serum procalcitonin, LDH, and serum ammonia levels. However, there was no thrombocytopenia; a gradually increased serum platelet count was seen. It was probably because the patient's sepsis was improving after giving appropriate antibiotics. MG 350 has no impact on the AST level of the patients. Both CytoSorb and Biosky cartridges were utilized to manage hyperinflammation and toxin clearance. hemoadsorption therapy was initiated for its proven efficacy in cytokine removal, while the Biosky cartridge was added later to maintain therapeutic continuity at a reduced cost. The combination helped stabilize the patient by reducing systemic inflammation, bilirubin, and metabolic derangements. Biosky's lack of thrombocytopenic side effects provided an additional advantage in this prolonged therapy.

In this case report, we observed that hemoadsorption benefits ALF management by regulating cytokines to reduce inflammation, clearing bilirubin to improve liver function, reducing ammonia to alleviate encephalopathy, and stabilizing hemodynamics by lowering vasopressor requirements.

Challenges and observations

While hemoadsorption proved beneficial, thrombocytopenia was noted with CytoSorb therapy. This effect was less pronounced with the Biosky cartridge, potentially due to its different adsorption properties and concurrent infection control.

CONCLUSION

This case demonstrates the effective use of hemoadsorption with CytoSorb and Biosky cartridges in managing hepatitis A-induced ALF with septic shock, showing notable clinical and biochemical improvements. Further research is needed to refine their role in ALF treatment.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

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Cite this article as: Mondal MK, Takia N, Al Mukit A, Mazumder MA. A rare case of hepatitis a virus-induced acute liver failure managed by hemoadsorption CytoSorb and Biosky MG 350. *Int J Res Med Sci* 2025;13:2131-4.