

Multi Organ Failure (MOF) and a Promising Novel Device

Shahid Kamal*

Department of Nuclear Medicine and Molecular Imaging, Neurospinal & Medical Institute, Karachi, Pakistan.

Acutely ill hospitalized patients are at risk of cascading failure of vital organs leading to prolonged stay in the hospital, persistent dysfunction of vital organs and higher probability of death. It is estimated that 50 to 75% of ICU patients have failure of one or more vital organs and as more organs are involved the risk of death increases [1, 2]. For example in Acute on Chronic Liver Failure (AOCLF) the 28 day probability of death increases from 20% with one vital organ failure to 90% or higher if 3 or more organs are involved. Dysfunction of brain, lungs, heart and kidneys are most commonly seen, kidney involvement is usually poor prognostic sign.

The care of MOF is challenging, quite expensive and requires complex supportive devices and expertise of providers with advanced training. Patients typically require an array of complex machines such as ventilator, ECMO machines, LVAD and specialized dialytic support with other advanced and expensive therapeutic supports. Despite these advanced and expensive interventions, as discussed above, the outcome remains suboptimal.

COVID pandemic underscored the importance of management of the MOF and its impact on patient outcome and the significance of the life sustaining devices. This specialized care needed in the care of these patients with MOF was a huge burden on healthcare to almost breaking point. This often resulted in acute shortages of these essential devices and of staff required. The pandemic underscored importance of the state of the art acute care and the value of life sustaining devices and the staff trained to use these devices. Timely use of devices such as ventilator, dialysis and ECMO were instrumental in saving lives.

Recently, a prototype device has been described that was used at the University of Washington, Seattle, USA, in AOCLF patients with MOF [3]. Ten patients were treated with the new device. These patients were in deep hepatic coma, were on ventilator, had advanced renal failure with significant anasarca using kidney dialysis, had significant hypotension requiring multiple vasopressors and were actively bleeding from multiple sites. The patients had very little chance of survival and had been taken off the transplant list. The use of the new device (discussed below) was associated with clinical improvement in all patients, all becoming alert and oriented, ventilator and vasopressors support were discontinued, and all patients lost significant volume of extra cellular fluid. All patients were activated on the trans-

plant list, 4 received liver transplant, one recovered liver function. Remaining 5 patients died while waiting for an organ to become available. The 28 day survival was over 80% compared to expected survival of less than 10 percent.

The novel device, called Artificial Multi-organ Replacement System (AMOR) used recirculating albumin dialysis with activated charcoal in the circuit and was attached in series to a traditional hemodialysis machine using traditional dialysis and ultra filtration (Fig. 1).

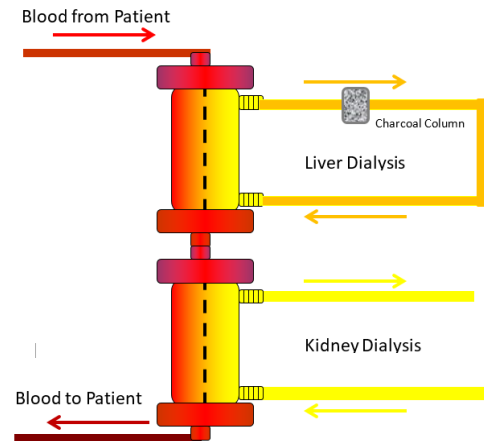


Fig. (1). Amor System.

The albumin dialysis has been widely used in liver failure in an attempt to remove albumin bound hepatic toxins. One such device, the Molecular Adsorbent Recirculating System™ (MARS™) has been commonly used with associated clinical and biochemical improvement. However, both increased survival and bridge to transplantation with MARS has not been reported in similar group with very high probability of death [4]. MARS is also not able to remove such large volume of fluid and the ability to remove renal toxins is also not as efficient. The lead researcher Dr. Suhail Ahmad feels that the combination of effective liver and kidney dialysis by one device that also is very effective in volume control is the reason for the survival benefit and as a bridge to transplant, that has not been previously reported. The novel method to regenerate the charcoal column resulted in better hepatic toxin removal and the arrangement of the liver and kidney dialysis enabled unparalleled fluid removal. The latter, in Professor Ahmad's opinion, was the reason for cardiac and pulmonary improvement in these patients.

*Address correspondence to this author at the Department of Nuclear Medicine and Molecular Imaging, Neurospinal & Medical Institute, Karachi, Pakistan. Email: skamal77@hotmail.com

The AMOR system has been further improved and the entire system is automated, simple to use, is a small, portable device with size and weight of a carry-on baggage. The modular system is simple to use, can be used for home kidney dialysis, liver dialysis and possibly aid in gas exchange, thus providing support for MOF patient by one device rather than three different devices.

CONFLICT OF INTEREST

Declared none.

ACKNOWLEDGEMENTS

I express my sincere thanks to Prof. Suhail Ahmad (Department of Medicine, Department of Mechanical Engineering, University of Washington, Seattle, WA) for his greatly valued contributions. I am also pleased to recognize the proficient and skilled team at the National Journal of Health Sciences. I appreciate the timely endeavors of the editorial staff, including Ms. Maria Baig (Editorial Manager Publications). My gratitude extends to Mr. Muhammad Akif Ali Atif (Manager Publications) for the valuable assistance provided.

REFERENCES

- [1] Pedersen PB, Hrobjartsson A, Nielsen DL, Henriksen DP, Bra-brand M, Lassen AT. Prevalence and prognosis of acutely ill patients with organ failure at arrival to hospital: A systematic review. *PLoS One* 2018; 13(11): 1-13.
- [2] Cholongitas E, Senzolo M, Patch D, *et al.* Risk factors, sequential organ failure assessment and model for end-stage liver disease scores for predicting short term mortality in cirrhotic patients admitted to intensive care unit. *Aliment Pharmacol Ther* 2006; 23: 883-93.
- [3] Ahmad S, Novokhodko A, Liou I, *et al.* Development and first clinical use an extracorporeal artificial multiorgan system in acute on chronic liver failure patients. *ASAIO J* 2014; [Online ahead of print].
- [4] Huber W, Ruiz de Garibay AP. Options in extracorporeal support of multiple organ failure. *Med Klin Intensivmed Notfmed* 2020; 115: 28-36.