

# Accidents supported on Extracorporeal Membrane Oxygenation (ECMO): A case series from the National ECMO Centre of Sri Lanka

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## Introduction

Extracorporeal Membrane Oxygenation (ECMO) is a temporary form of cardiopulmonary support which uses heart-lung bypass techniques for days or weeks, usually in Intensive Care Units (ICU), when there is reversible lung/ heart failure not amenable to maximum conventional treatment. It can be offered across the age groups: neonates, children and adults, and is the highest mode of critical care and therefore is complex. The Oxford dictionary defines an accident as “an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury”. Accidents that result in severe but reversible compromise of the lungs and /or heart that cannot be managed by conventional methods are, therefore, potential candidates for ECMO.

However, injuries can be multiple and other injuries needs to be taken into account when making decisions regarding accidental injury. Also, bleeding can be a problem and has implications as the ECMO circuit needs to be heparinised. As accidents are, by definition, unexpected, it is important that medical personnel are aware of ECMO as a potential option of support for their patients. Furthermore, ECMO is available only in selected centres and these patients may need transport to such ECMO capable centres and thus mobile ECMO becomes an inherent part of the management.

This is a case series of such patients following accidents who were supported on ECMO in Sri Lanka and their outcome.

## Methods and material

A retrospective study was done of the database of the National ECMO Centre (NEC) of Sri Lanka in Galle from October 2014 to October 2023. All patients who were referred for ECMO following accidents/ injuries within the country were included. There were no exclusions.

## Case series

There were 200 patients referred to the NEC of Sri Lanka over nine years of which 18 (9%) referrals were for accidents. Twelve out of 18 (66.7%) patients could not undergo ECMO as they were either not within the eligibility criteria (9/18; 50%) or were not stable enough to be transferred conventionally (3/18; 16.7%) to the NEC (table 1).

Only 6/18 (33.3%) underwent ECMO (Table 2). Their mean age was 20 (11 - 30) years. There were four males and two females. The indications for ECMO were: chemical pneumonitis (2), near drowning (2) poly trauma following a road traffic accident (RTA) (1) and foreign body inhalation (1).

## Case series

Patient	Referring Centre	Age (Years)	Sex	Indication	Reason not to do ECMO	Outcome
1	MICU THK	18	Male	Lung Contusion Causing ARDS	Not eligible with poor prognosis	Death
2	ETU, THK	30	Female	Chemical Pneumonitis	Not eligible with poor prognosis	Death
3	Nawaloka Hospital, Colombo	57	Male	Fat embolism following an open reduction of a fracture	Unable to transfer	Death
4	ETU, THK	19	Male	Drowning	Death before setting up ECMO	Death
5	ETU, THK	23	Male	Saltwater drowning	Death before setting up ECMO	Death
6	Lanka Hospital, Colombo	16	Male	Kerosine oil Inhalation	ECMO held in reserve	Discharged
7	MICU THK	25	Male	ARDS Following Lung Trauma	ECMO held in reserve	Discharged
8	NHSL Neuro trauma unit, Colombo	18	Male	Lung contusion and cerebral damage	Unable to transfer	Death
9	ICU Embelipitiya	11	Male	Polytrauma	ECMO held in reserve	Discharged
10	PICU, THK	07	Female	Pneumonitis following Chlorine Inhalation	ECMO held in reserve	Discharged
11	ICU, BH, Homagama	22	Male	Polytrauma: Head injury; Pneumonia with ARDS with prolonged ventilation Rhabdomyolysis with acute kidney failure	Not eligible with poor prognosis	Death
12	ETU, THK	49	Male	RTA with liver laceration; secondary pneumonia with ARDS	Not eligible with poor prognosis	Death

(MICU – Medical Intensive Care Unit; ETU- Emergency Treatment Unit; THK -Teaching Hospital Karapitiya; NHSL- National Hospital of Sri Lanka; ICU- Intensive Care Unit; PICU- Pediatric Intensive Care Unit; BH- Base Hospital; RTA- Road Traffic Accident; ARDS- Acute Respiratory Distress Syndrome)

**Table 1 : Patients referred for ECMO who but did not undergo ECMO**

Patient	Age (years)	Sex	Indication	Mode of ECMO	Hours of ECMO	Complications	Outcome
1	11	Female	ARDS following chlorine inhalation	VV	238	Pneumothorax; lung infection; clots in circuit	Discharged
2	30	Male	Chemical Pneumonitis following petrol inhalation	VV	28	Pneumonia; sepsis; multiorgan failure	Death
3	28	Male	Fresh water near- drowning following substance use leading to ARDS	VV	78	Renal failure	Discharged
4	18	Male	Salt water near-drowning leading to ARDS	VV	130	None	Discharged
5	19	Female	Traumatic lung contusion with cardiac tamponade following poly trauma due to road traffic accident	VA	28	Renal failure; Brain stem haemorrhage	Death
6	12	Male	Removal of foreign body in right bronchus	VV	01	None	Discharged

**Table 2 :** Patients who underwent ECMO for accidents in Sri Lanka from 2014-2023

### Case series

#### Case 1

An 11-year-old school girl suffered near-fatal ARDS due to severe chemical pneumonitis following accidental chlorine inhalation during a training session in swimming. She was deteriorating despite

maximum conventional management and was therefore transferred from Colombo to the NEC in Galle where she was initiated on VV ECMO at the point of terminal decompensation. Despite a lung infection and a pneumothorax that needed intercostal drainage while on ECMO, the child made a complete recovery.

Comment: Chlorine inhalation is a relatively uncommon cause of ARDS, but its treatment including the use of ECMO is similar to any other cause of ARDS [1].

### Case 2

A 30-year-old doctor accidentally inhaled petrol fumes while attempting to siphon it into his car during the fuel crisis in the country and suffered severe pneumonitis. When he was deteriorating despite maximal conventional ventilatory support, he was transferred from National Hospital Kandy to the NEC in Galle and was initiated on VV ECMO. He developed florid systemic infection for which he was treated with antibiotics and Cytosorb therapy. Eventually he succumbed to unresponsive sepsis and multi-organ failure. The postmortem showed bilateral diffuse pneumonia with multiple MRSA abscesses and an oedematous and septic heart.

Comment: Hydrocarbon aspiration causes areas of necrosis that then dissolves in secondary infection. Staphylococcus is a highly virulent killer that spreads fast in damaged tissue which has lost its natural defenses.

### Case 3

A 28-year-old athlete suffered fresh water near-drowning in a home pool under the influence of alcohol and methamphetamine use at a party. He was resuscitated at the pool side and taken to Colombo South Teaching Hospital. When his lung function was deteriorating despite maximal mechanical ventilation, he was transferred to the NEC and was initiated on VV ECMO and subsequently needed CRRT. Despite his neurological status being unknown initially, he eventually made a successful recovery.

Comment: Fresh water drowning is an indication for ECMO if lung function deteriorates but the outcome is often determined by the extent of the associated neurological insult rather than ARDS. The European Resuscitation Council guidelines state that ECMO should be considered as a rescue therapy to prevent or treat cardiac arrest as a direct result of drowning

[3]. ECMO can also be applied to treat the secondary consequences of drowning, e.g. oedema or pneumonia due to aspiration that develops into acute respiratory failure (ARDS) [4].

### Case 4

An 18 year old student suffered salt water near drowning while having a sea bath and was resuscitated on the beach and taken to Colombo South Teaching Hospital. When he was deteriorating despite maximal mechanical ventilation, he was transferred to the NEC and was initiated on VV ECMO due to severe ARDS. He had a fairly uncomplicated ECMO run and made a complete recovery.

Comment: Salt water drowning tends to have better outcomes than freshwater drowning. Acute absorption of fresh water can lead to haemolysis and end organ damage, particularly of the brain and kidneys.

### Case 5

A 19 year old girl was involved in a high speed motor crash suffering traumatic brain injury, thoracic trauma leading to cardiac tamponade and lung contusion, and long bone fractures. She was successfully resuscitated at Teaching hospital Karapitya Galle from a cardiac arrest and underwent sternotomy for release of cardiac tamponade. She was initiated on VA ECMO due to haemodynamic instability and type 2 respiratory failure. She needed CRRT for renal failure. However, she succumbed to asystole and cerebral/ brain stem haemorrhage and its sequelae.

Comment : Respiratory failure after trauma is often multifactorial and comprises elements of direct trauma with lung contusion and the systemic effects of injury modulated through the inflammatory pathways. ECMO allows for the severest cases to be managed without high pressure ventilation such that barotrauma is not added to the pre-existing lung injury, delaying or preventing recovery.

Whilst severe head injury with intracranial bleeding limits the use of ECMO in some cases of multiple trauma, in others it is often possible to manage the patient with ECMO after the first 24 hours without bleeding from other sites being an issue.

ECPR (Extracorporeal Cardio-Pulmonary Resuscitation) is a rapidly growing category of ECMO support [6]. While it has applicability in the trauma situation, bleeding is a major concern in trauma. Furthermore, the uncertainty of the neurological outcome is a problem in all ECPR patients.

### Case 6

A 12 year old boy had accidentally inhaled a glass bead which became lodged at the carina and was admitted to the emergency department at THK Galle. Multiple attempts to remove it by rigid bronchoscopy under GA in the otolaryngology theatre failed and resulted in hypoxia and the bead was intentionally pushed into the right bronchus to prevent total airway obstruction. With the child stabilized on VV ECMO the bead was eventually removed after a prolonged and difficult manipulation without the need for ventilation. His blood gases remained stable throughout the procedure.

Comment: VV ECMO can provide the surgeon optimum conditions and extra time for endoscopic or surgical procedures on the upper airways without destabilizing the patient with hypoxia and hypercarbia [5].

### **Outcome**

These six patients underwent a total of 506 cumulative ECMO hours (mean 84 hours; range 1 - 238 hours) of support on either veno-venous (5) or veno-arterial (1) ECMO. There were two mortalities: the patients with polytrauma who succumbed to asystole and concomitant cerebral/ brainstem injury and the chemical pneumonitis from petrol inhalation who succumbed to sepsis. Four patients recovered completely (66.6%) and all remain well to date.

### **Discussion and Conclusions**

Accidental injuries causing severe damage to lungs and /or heart that cannot be managed conventionally have benefitted from ECMO. This category of patients appear to be younger. The types of accidents and injuries have been varied. Their survival (66.7%) is highly favorable as compared with overall international ECMO survival (54%) for all causes [6]. The survivors have been free of sequelae.

Three out of 18 (16.7%) who were eligible could not undergo ECMO due the risks of conventional transfer. This problem could have been mitigated with mobile ECMO, which is an integral part of most developed ECMO centers in the world and hopefully will be developed in Sri Lanka in the near future.

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