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ECMO beyond a bridge for lung transplant: Experience from tertiary care hospital in Western India

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Abstract

Introduction: COVID pandemic marked greater use of ECMO (Extra corporeal membrane oxygenation) in the form of rescue cardiopulmonary life support especially for patients awaiting lung transplant however we found it lifesaving in poisoning cases as well.

Methods: We conducted a retrospective study from January 2020 till Jan 2022 in critical care unit in a tertiary care hospital in western India to share our experience of this life saving modality.

Results: 31 patients were provided ECMO support over the past 2-year study period with 24 (70.83%) males and 7 (29.17%) females. The average stay on ECMO was 4.9 days. In 20 (64.52%) patients veno arterial (VA) circuit was used whereas in 9 (29.03%) veno venous circuit was employed. The highest number of cases was of poisoning 9 (29%) comprising of 8 celphos poisoning and 1 silver poisoning. COVID-19 related ARDS and post COVID pneumonia had 5 (16.1%) of cases. Dengue 4 (12.9%) and post operative 4 (12.9%) each consisting of 1 CABG, 1 past DVR and 2 other post operative cases. In terms of survival 8 (25.81%) had favorable outcome. The patients who could be revived by ECMO were mainly of celphos poisoning – 6 cases, followed by ARDS post Dengue – 1 case and 1 case of post viral myocarditis.

Conclusion: ECMO is now an essential arsenal not only for bridging patients for lung transplant but also as rescue in poisoning cases as seen in present study with excellent results in those refractories to conventional therapies.

Keywords: ECMO, Cardiopulmonary Life Support, Celphos Poisoning

1. Introduction

ECMO (Extra Corporeal membrane oxygenation) is a form of cardiopulmonary life support where blood is drained from the vascular system by mechanical pump outside the body and then reinfused in the body [1, 2]. It is indicated as respiratory support in acute respiratory distress syndrome (ARDS), bridge towards lung transplant, lung hyperinflation (Status asthmaticus), pulmonary haemorrhage and to provide rest to lung in situations like airway obstruction, smoke inhalation or pulmonary contusion. ECMO is helpful for maintaining life awaiting improvement of underlying disease and is used to provide oxygenation and Co_2 removal or the bridge to lung transplant [3]. The present study is a descriptive retrospective study pertaining to use of ECMO in a tertiary care hospital in western India.

2. Methods

We conducted a retrospective study on ECMO use in tertiary care hospital over the period of two years Jan 2020 till Jan 2022 in the departmental of critical care as a part of audit for accreditation. Patient identity was anonymised and all patient's privacy and confidentiality were maintained. The data was converted, excel sheet prepared and descriptive statistics applied used free online statistical software (Socscistatistics.com).

All patients who utilized ECMO facility in the hospital during 2-year period were included in the study.

3. Results

The retrospective study comprises of 31 patients over 2-year period who received ECMO in critical care intensive unit at the tertiary care hospital were included in study.

The most common age group was between 30-40 years 8 (25.80%) followed by other 20-30 year, 50-60 year and 60-70 year with 5 (16.13%) subjects each. The mean age was 35.9 years (Table-1)

There was male predominance with 24 (70.83%) male patients in comparison to 7 (29.17%) females. The male: female ratios was 3.4:1 (Table-2)

11 (35.48%) patients were on ECMO for 2-4 days, followed by 7 (22.58%) for 4-6 days. The average stay of patient on ECMO was 4.9 days with the range of days varying from 1-50 days (Table-3)

In 20 (64.52%) patients veno arterial (VA) circuit was used whereas in 9 (29.03%) veno venous circuit was employed. (Table-4)

Table-5 shows the various pathological condition where ECMO was used in our set up, of the total 31 patients, the highest number of cases were of poisoning 9 (29%) comprising of 8 celphos poisoning and 1 silver poisoning. COVID-19 related ARDS and post COVID pneumonia had 5 (16.1%) of cases. Dengue 4 (12.9%) and post operative 4 (12.9%) each consisting of 1 CABG, 1 past DVR and 2 other post operative cases. The rest of the cases were cardiac case – 2 (6.5%), ARDS 2 (6.5%), Sepsis 2 (6.5%), Pneumonia non COVID 2 (6.5%) and viral myocarditis 1 (3.2%).

23 (74.19%) of patients did not have favourable outcome where 8 (25.81%) were able to wean off from ECMO successfully. In terms of survival 8 (25.81%) had favourable outcome. The patients who could be revived by ECMO were mainly of celphos poisoning – 6 cases, followed by ARDS post Dengue – 1 case and 1 case of post viral myocarditis (Table 6,7)

The most favourable outcome was seen in patients younger than < 40 years of age. Patients above 50 years of age had poor prognosis after ECMO (Table – 8). The gender wide prognosis after ECMO is shown in Table-9, as majority of patients were males so obviously male survivors outnumber female.

The recovered patients had ECMO duration varying from 2 to 8 days (Table-10). Celphos poisoning cases had the best survival percentage 6 out of 8, (75%) in the present study dengue complicated by ARDS. 1 out of 4 cases (25%) had second best survival in the present study, followed by 1 case of viral myocarditis. The rest of pathology had unfavourable prognosis even after ECMO – cardiac patients, ARDS, COVID-19, sepsis, pneumonia and as a post operative complication case. In terms of prognosis venovenous circuit did not result in positive outcome in any of the 9 cases while venoarterial circuit had 7/20 recoveries.

Table 1: Age group wise distribution

Age group	No of subjects(N)	Percentage
0-10	2	12.92
10-20	5	3.23
20-30	5	6.46
30-40	7	16.13
40-50	2	25.80
50-60	5	3.23
60-70	5	16.13
Total	31	

Table 2: Gender wise distribution

Sex	No of subjects (N)	Percentage
F	7	29.17
M	24	70.83
Grand Total	31	

Table 3: Days ECMO used

Days on ECMO	No of subjects(N)	Percentage
>10	1	19.35
0-2	10	35.48
2_4	7	22.58
4_6	8	16.13
6_8	4	3.23
8_10	1	3.23
Grand Total	31	

Table 4: Type of ECHMO

Type	Total
Veno arterial	20
Veno venous	9
Veno venous arterial	2
Grand Total	31

Table 5: Etiology requiring ECMO

Diagnosis		No of subjects(N)	Percentage
Poisoning	Celphos	8	25.81
	Silver	1	3.23
Cardiac	Acute coronary syndrome	1	3.23
	Acute MI	1	3.23
Dengue		4	12.90
ARDS		2	6.46
COVID19	ARDS	2	6.46
	Post COVID pneumonia	3	9.69
Sepsis	Pneumonitis	1	3.23
	Pericarditis	1	3.23
Pneumonia		2	6.46
Post operative	CABG	1	3.23
	Post DVR	1	3.23
	Other	2	6.46
Viral myocarditis		1	3.23
	Total	31	

Table 6: Diagnosis wise outcome

	Diagnosis		Total
	Poisoning	Celphos	2
Expired		Silver	1
	Cardiac	Acute coronary syndrome	1
		Acute MI	1
	Dengue		3
	ARDS		2
	COVID 19	ARDS	2
		pneumonia	3
	Sepsis	Pneumonitis	1
		Pericarditis	1
	Pneumonia		2
	Post operative	CABG	1
		Post DVR	1
		Other	2
Expired total			**23**
Recovered	Celphos poisoning		6
	Dengue		1
	Post viral myocarditis		1
Recovered total			**8**
Grand Total			31

Table 7: Outcome after ECMO

	No of subjects(N)	Percentage
Expired	23	74.19 %
Recovered	8	25.81 %
Grand Total	31	

Table 8: Age wise outcome

	Age group	No of subjects(N)
Expired	0-10	2
	10—20	2
	20-30	3
	30-40	5
	40-50	1
	50-60	5
	60-70	5
Total	**23**	
Recovered	10-20	3
	20-30	2
	30-40	2
	40-50	1
Total	**8**	
Grand Total		31

Table 9: Gender wise outcome

	Gender	No of subjects(N)
Expired	Female	6
	Male	17
Expired Total		**23**
Recovered	Female	1
	Male	7
Recovered Total		**8**
Grand Total		31

Table 10: Duration wise outcome

	Days on ECMO	No of subjects(N)
Expired	>10	1
	0-2	10
	2-4	4
	4-6	5
	6-8	2
	8-10	1
Expired Total		23
Recovered	2-4	3
	4-6	3
	6-8	2
Recovered Total		8
Grand Total		31

Table 11: Circuit type

Type circuit	Type	Total
Expired	Veno arterial	13
	Venovenous	9
	VVA	1
Expired Total		**23**
Recovered	Veno arterial	7
	VVA	1
Recovered Total		**8**
Grand Total		**31**

Table 12: Indications and contraindications of ECMO

VA ECMO	VV ECMO
Indications Temporary cardiac support-Cardiac arrest, cardiogenic shock Drug poisoning, Pulmonary embolism, Hyperthermia, Sepsis Bridge to lung transplant	**Indications** ARDS, Pneumonia, aspiration, drowning, pulmonary contusion, status asthamaticus
Contraindications Aortic dissection, aneurysm, aortic regurgitation Irreversible cardiav disease Heparin induced thrombocytopenia Abdominal compartment syndrome	**Contraindications** Irreversible lung disease, ventilated ->7-11 days Intracerebral hemorrhage Cirrhosis Difficult vascular access

4. Discussion

Extra corporeal membrane oxygenation (ECMO) is a rescue therapy that is used for critically ill patients who have cardiorespiratory ailment and without ECMO have higher probability of death [4, 5]. The present study gives a glimpse of ECMO experience at a tertiary care hospital in developed country like India over 2 year time period.

There is lack of availability of advanced treatment options – ECMO been one of them in India. There is paucity of literature pertaining to application of ECMO in Indian scenario and therefore the present study will be valuable for

tertiary care centers aiming to provide ECMO support for patients. ECMO is not a recent discovery, its use in critical care got a into limelight after CESAR trial where cases of severe respiratory failure showed improvement after ECMO support [6].

Table-10 enumerates indications of ECMO and table-11 mentions contraindications to ECMO use. ECMO can be VA (Veno arterial) or VV (Veno venous) type. The VA ECMO provides cardiac support assisting systemic circulation therefore requires arterial and venous cannulation; it bypasses pulmonary circulation and is used in cases where lower perfusion rates are needed e.g., right ventricular failure [7, 8]. The ECMO circuit is connected parallel to heart and lung. In VV ECMO the ECMO circuit is connected in series with heart and lung and therefore it does not provide cardiac support. The VV ECMO requires only venous cannulation and is used in conditions where high perfusion rates are required as it maintains pulmonary blood flow. The annual international ELSO registry reports in 2015, collected data of 65,171 patients, among which 41% of adults were successfully weaned off [9].

In our experience 25.81% had favourable outcome. The lower success rate might be due to resistance of patient's deciding in favor of ECMO as supportive therapy. The present study had successfully outcome for celphos poisoning, dengue and viral myocarditis and perhaps with more experience in near future our patient survived would be surge. The ECMO support was started in COVID pandemic although high cast was major detriment in providing ECMO support to patients although the hospital management supported patients by financial waiver in part of the case of whole procedure.

The meta-analysis by Kollengode Ramanathan *et al* [10] on COVID-19 patients undergoing ECMO included 22 studies with 1844 patients reported 1583 complications where renal complications were most common.

The present study had 8(25.81%) recoveries, the lower recovery rate is attributed partly the delay at the part of attendants in giving consent for ECMO use although repeated counseling was given to them. The institute strictly abides to ethical practices in medicine and always relies on patient autonomy, beneficence, equality and justice as guiding principles for treatment. Another factor that could have affected ECMO outcome was set of patients where family pressure was compelled ECMO use although poor prognosis was already explained to attendants. These scenarios are very common in developing countries where affordability of treatment options are major determinants for decision making on the part of patients or their attendants.

The indications and contraindications of ECMO are shown in table -12. The literature studies cite various complications in ECMO treatment not only related to underlying pathology but also arising due to ECMO therapy per se. In general, ECMO for pulmonary support has fewer complications in compared to ECMO for cardiogenic cause. Similarly, VV ECMO has lesser complication than VA ECMO however contrary to literature the present study did not report complications in VA ECMO [9].

Most frequent complication after ECMO is hemorrhage [11, 12] although there was no such complication in present study as heparin dose titration as well as platelet infusion was done timely to circumvent such complications. Other reported complications in literature include – intra cerebral hemorrhage, pulmonary hemorrhage, thromboembolism and neurological complications. Hypertension, arrhythmias, oliguria, acute tubular necrosis and sepsis are other complications with ECMO [13, 14, 15]. Complications like perforation of vessels, arterial dissection, pseudo aneurysm are rare which can be avoided by a skilled surgeon [16].

5. Conclusion

ECMO is now an essential arsenal not only for bridging patients for lung transplant but also as rescue in poisoning cases as seen in present study with excellent results in those refractory to conventional therapies. The present study is few among the sentinel works from India sharing experiences of ECMO and calls for more research from country pertaining to the use of this technology.

6. Conflict of interest

None

7. Sources of funding

None

8. References

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