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Sepsis Prevalence in Neonatal and Pediatric Cases During ECMO Support after Cardiac Surgery

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Abstract
Background*: Using of ECMO support after pediatric cardiac surgery played a significant role in changing the survival rate of cases with complex cardiac lesions after cardiac surgeries. However, this was associated with increased incidence of sepsis.*
Objectives*: Assessment of the incidence of sepsis in neonatal and pediatric cases during ECMO support after cardiac surgery.*
Patients and Methods*: This is a retrospective descriptive study including all neonates, and pediatrics who need extracorporeal life support following cardiac surgery at San Donato Hospital - Milan – Italy. All Patient laboratory data were assessed and only culture positive patients were considered sepsis positive*
Results: *sepsis developed in 46% of our cohort, Statistical analysis for sepsis prevalence failed to detect any statistically significant data with all the compared parameters regarding patients age, weight, type of surgical repair and length of stay on ECMO*
Conclusion*: Sepsis has a high incidence on patients on ECMO regardless of any other risk factor*

Keywords: *ECMO – Pediatrics – Postoperative –Cardiac – Sepsis*

1. INTRODUCTION

Extracorporeal life support (ECLS) is a general term used to describe temporary support of cardiac or pulmonary function using mechanical devices. When using the "heart–lung machine" to completely bypass the cardiopulmonary circulation, it is referred to as cardiopulmonary bypass. When ECLS is used in the intensive care unit (ICU) or emergency department (ED) to augment oxygenation, ventilation, or cardiac output it is generally referred to as extracorporeal membrane oxygenation (ECMO). **(1)**.

Complications on ECMO are very common and as expected it is associated with significant increase in morbidity and mortality. These complications could be related to the underlining pathology needed ECMO, or of the ECMO condition itself (surgical insertion, circuit tubing, anticoagulation etc.) and as a rule of thumb, the ECMO inserted for pulmonary support has less complication than the ECMO inserted for cardiogenic support. The worst outcomes are reported when ECMO is used after ECPR **(2)**.

Septic complications may also result because the ECMO circuit represents a large intravascular foreign body, and frequent manipulation increases the risk of infection. Metabolic complications include electrolyte imbalances, and hypo or hyperglycemia. ECMO may alter serum concentration of drugs due to increased volume of distribution, and decreased Kidney or liver function. Caution is warranted when narrow therapeutic drugs are administered, and

dose alterations may be necessary. **(3)**

PATIENTS AND METHODS

Our study is a retrospective descriptive study including all neonates, and pediatrics (<18 years of age) who need extracorporeal life support following cardiac surgery at San Donato Hospital – Milan – Italy . Data were collected retrospectively from patient's medical records database of ECMO/ECLS Unit , and Post-operative cardiac ICU of San Donato Hospital - Milan – Italy .

Inclusion criteria were all pediatric patients from 1 day of age till 18 years of age , both genders were included , all cardiac operations are included (open – closed) , and all pediatric patients undergoing cardiac surgery and need extracorporeal life support in operation theatre , in the post operative ICU, or post cardiotomy CPR . Exclusion criteria were patient with insufficient data

Assessment of the incidence of Sepsis during ECMO support in pediatric postoperative cardiac surgery by the imaging findings (Brain CT, Brain MRI, and EEG) . According to the neuroimaging , neurological complications were classified to ischemic stroke , hemorrhagic stroke , and epileptogenic focus .

Statistical Analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0**. (**Armonk, NY: IBM Corp**).** Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median and interquartile range (IQR). Categorical data were compared using Chi-square or Fisher's exact test , while numerical data were compared using student t test .

2. RESULTS

Our study is a retrospective descriptive study including all pediatric cases who need extracorporeal life support following cardiac surgery at San Donato Hospital - Milan – Italy .

Sepsis was found in (46 %) on neonates and pediatrics during ECMO support after cardiac surgery .

Statistical analysis for sepsis prevalence failed to detect any statistically significant data with all the compared parameters**.**

Table 1: different parameters in relation to sepsis

	Sepsis				P
	No (n = 34)		Yes (n = 29)		
	No.	%	No.	%	
Age (months)					
Min. – Max.	0.67 – 156.0		0.83 – 108.0		
Mean ± SD.	30.11 ± 41.37		17.11 ± 25.36		0.294
Median	12.0		4.0		
Weight (Kg)					
Min. – Max.	2.30 – 46.0		2.20 – 21.0		
Mean ± SD.	9.96 ± 9.38		6.88 ± 4.91		0.294
Median	6.15		5.30		
CHD (Cyanotic)					
No	20	58.8	13	44.8	0.268
Yes	14	41.2	16	55.2	
Heterotaxy					
No	28	82.4	28	96.6	
Yes	6	17.6	1	3.4	0.112
Repair nature					
Biventricular	27	79.4	27	93.1	
Univentricular	7	20.6	2	6.9	0.160
Repair stage					
1st intervention	30	88.2	28	96.6	
2nd intervention	4	11.8	1	3.4	0.363
Bypass time (minute)					
Min. – Max.	0.0 – 481.0		0.0 – 423.0		
Mean ± SD.	184.65 ± 89.19		192.34 ± 107.52		0.934
Median	180.0		190.0		
Cross clamp time (minute)					
Min. – Max.	0.0 – 200.0		0.0 – 192.0		
Mean ± SD.	82.24 ± 41.86		75.03 ± 39.93		0.614
Median	70.0		75.0		
Timing of ECMO					
Intraoperative	26	76.5	16	55.2	0.074
Postoperative	8	23.5	13	44.8	
Type of anticoagulant on ECMO					
Heparine	20	58.8	17	58.6	0.987
BIV	14	41.2	12	41.4	
Overall Outcome					
Discharge to home	22	64.7	19	65.5	
Mortality on ECMO	4	11.8	8	27.6	0.091
In hospital mortality	8	23.5	2	6.9	

3. DISCUSSION

Mechanical circulatory support (MCS) is well-established therapy for children with severe refractory pulmonary or cardiac failure.1 In the 1970s, the first use of extracorporeal circulatory support in infants with congenital heart disease (CHD) was reported, followed by a longer extracorporeal membrane oxygenation (ECMO) run after surgical correction of tetralogy of Fallot. Despite the availability of other modes of support, including ventricular assist devices, ECMO remains the most commonly used form of MCS in the pediatric population.

In January 2019, the Extracorporeal Life Support Organization (ELSO) Registry reported 19,629 cardiac ECMO cases in neonates and children from 350 international centers between 1990 and 2019 (https://www.elso.org/Registry/ Statistics/International Summary. aspx). According to the ELSO Registry, hypo plastic left heart syndrome (HLHS) was the most common CHD diagnosis for neonates supported with ECMO, and cyanotic CHD with decreased pulmonary flow (e.g., tetra logy of Fallot, double outlet right ventricle, and Ebstein's anomaly of the tricuspid valve) were the most common CHD diagnoses associated with cardiac ECMO in children.

The high prevalence of infections on ECMO is multi-factorial. Most patients on ECMO have several life-sustaining indwelling catheters. In cardiac patients, an open chest, transthoracic cannulation and increased bleeding and clot formation all contribute to an increased infection risk. Other identified risk factors include the number of invasive procedures performed on ECMO. Some centers support daily surveillance blood cultures or antibiotic prophylaxis although no studies have demonstrated improved outcomes with these approaches. Most reports of acquired infection during ECMO are retrospective, single-center audits or are based on ELSO registry data. (4)

4. CONCLUSION

There is high prevalence of sepsis in pediatric patients on ECMO however further studies on larger samples is required to detected correctable risk factors

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