Impact of Extracorporeal Membrane Oxygenation in Orthopaedic Polytrauma Injuries

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INTRODUCTION:

Extracorporeal membrane oxygenation (ECMO) is a technology used to artificially oxygenate a patient's blood before returning it to circulation. Recent advancements in technology have allowed for its increasingly frequent use to improve outcomes in the emergency setting, although it is often a last resort in cardiorespiratory failure. Performing surgery on patients on ECMO is logistically challenging and can be associated with significant morbidity. The purpose of this study is to compare the orthopaedic surgical outcomes of polytrauma patients who required ECMO to patients with similar injury profiles who did not receive ECMO.

METHODS:

Polytrauma patients from two large level 1 trauma centers who were placed on ECMO and required orthopaedic intervention from 2015 to 2022 were included in the study. Each patient was matched with a similar case not requiring ECMO based on sex, age, ASA, BMI, and injury severity score (ISS). Demographics and fracture types were collected. Outcomes included length of stay (LOS), time to definitive fixation, length of follow up, number of revisions, infection, amputation, and nonunion.

RESULTS:

Thirty-two patients who received ECMO were included in the study and were matched to thirty-two patients who did not receive ECMO. In univariate analysis, patients who received ECMO had an increased LOS (43±19 vs. 24±24, $p<0.01$) and number of amputations (7 vs. 0, $p=0.02$). The number of revisions and time to definitive fixation were not different between groups. In multivariate analysis, the marginal probabilities of LOS, revisions, time to definitive fixation, and amputation were significantly increased in patients requiring ECMO.

DISCUSSION AND CONCLUSION:

The complicated surgical care of orthopaedic injuries for patients on ECMO remains an area of debate. Despite no difference in time to fixation, ECMO patients more commonly resulted with increased LOS and unsalvageable limbs. Surgeons may consider amputation earlier for limb salvage that would require multidisciplinary, staged interventions.

This data should help guide orthopaedic surgeons when treating ECMO patients in showing that, while ECMO has quickly become a more stable form of life-saving treatment for extreme injury, it is still associated with higher incidences of adverse outcomes following operative fixation surgery. ECMO can be a lifesaving intervention, but the context of its costs and benefits should be carefully weighed by orthopaedic providers planning surgical interventions on ECMO patients.

Marginal Probabilities

Term	Contrast Estimate	Std. Error	P value
infection	-0.05152	0.1087	0.63551
LOS over 7 days	0.01512	0.002038	**1.21E-13**
LOS over 14 days	0.01519	0.002157	**1.90E-12**
LOS over 30 days	0.01404	0.002065	**1.06E-11**
nonunion	0.09986	0.07348	0.17414
revisions	0.2076	3.50E-13	**2.22E-16**
time to definitive fixation	-0.002074	3.60E-13	**2.22E-16**
amputation	0.4588	0.05716	**1.00E-15**

Outcomes

	ECMO (N=32)	No ECMO (N=32)	Total (N=64)	p-value
Infection				
Yes	3 (9.4%)	4 (12.5%)	7 (10.9%)	1
No	29 (90.6%)	28 (87.5%)	57 (89.1%)	
Amputation				
Yes	7 (21.9%)	0 (0%)	7 (10.9%)	**0.0163**
No	25 (78.1%)	32 (100%)	57 (89.1%)	
Nonunion				
Yes	4 (12.5%)	3 (9.4%)	7 (10.9%)	1
No	28 (87.5%)	29 (90.6%)	57 (89.1%)	
Number of Revisions				
Mean (SD)	0.813 (1.67)	0.469 (1.24)	0.641 (1.47)	0.355
Median [Min, Max]	0 [0, 7.00]	0 [0, 6.00]	0 [0, 7.00]	
Length of Stay				
Mean (SD)	42.9 (19.3)	23.6 (23.3)	32.4 (23.4)	**0.00111**
Median [Min, Max]	40.0 [22.0, 101]	17.5 [2.00, 124]	28.0 [2.00, 124]	
Time to Definitive Fixation (days)				
Mean (SD)	8.63 (9.03)	5.28 (5.23)	6.95 (7.51)	0.0748
Median [Min, Max]	5.00 [0, 35.0]	4.00 [0, 25.0]	4.00 [0, 35.0]	
Length of Follow-Up				
Mean (SD)	408 (553)	210 (145)	303 (401)	0.0553

Matching Criteria

	ECMO (N=32)	No ECMO (N=32)	Total (N=64)	p-value
Sex				
Male	30 (93.8%)	27 (84.4%)	57 (89.1%)	0.423
Female	2 (6.3%)	5 (15.6%)	7 (10.9%)	
Age				
Mean (SD)	30.9 (11.0)	34.0 (12.8)	32.4 (11.9)	0.299
Median [Min, Max]	29.0 [17.0, 54.0]	30.0 [19.0, 64.0]	30.0 [17.0, 64.0]	
ASA				
Mean (SD)	3.75 (0.672)	3.41 (0.499)	3.58 (0.612)	**0.0235**
Median [Min, Max]	4.00 [2.00, 5.00]	3.00 [3.00, 4.00]	4.00 [2.00, 5.00]	
BMI				
Mean (SD)	32.6 (8.05)	34.8 (9.14)	33.7 (8.61)	0.317
Median [Min, Max]	32.6 [20.2, 53.0]	33.6 [21.9, 59.8]	33.0 [20.2, 59.8]	
ISS				
Mean (SD)	27.4 (10.9)	24.9 (11.7)	26.2 (11.3)	0.38
Median [Min, Max]	29.0 [9.00, 57.0]	22.0 [8.00, 50.0]	26.5 [8.00, 57.0]	