Effect of Inter-Hospital Transfer on Nosocomial Infection Rates in Patients Receiving Extracorporeal Membrane Oxygenation

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Abstract

Background
Extracorporeal Oxygenation (ECMO) has been increasingly used as a life support modality for cardiac and pulmonary failure. Due to improved survival in patients treated in high volume ECMO centers, inter-hospital transport of these critically ill patients is on the rise. These patients may be transported via ambulance locally, or by aircraft over long distances. However, potential risks of nosocomial infectious complications associated with transfers has not been reported. We evaluated the impact of transfers on nosocomial infections for patients who received ECMO at Brooke Army Medical Center (BAMC).

Methods
All patients who received ECMO for ≥48 hours at BAMC between May 2012 and October 2019 were included. Chart review was performed to determine transport status, infectious complications while on ECMO, and antimicrobial susceptibility of isolated organisms. Statistical analyses were performed using Chi-squared, Fisher's exact, or Mann-Whitney U tests as appropriate. Factors associated with nosocomial infections were evaluated by multivariate logistic regression.

Results
Compared to patients who were cannulated locally (n=33), patients who underwent cannulation at referral facility and inter-hospital transfer (n=76) had no difference in infections per 1000 ECMO days (33.1 vs. 30.5, p=0.74) or in infections with multidrug resistant organisms (MDRO) (50% vs. 55%, p=1). Of transferred patients, those transferred by aircraft (n=11) had no difference in infection rate (22.4 vs. 31.8 per 1000 ECMO days, p= 0.39) or MDRO incidence (52% vs 75%, p=0.61) compared to those only transferred by ambulance (n=65). Multivariate analysis showed the greatest risk factor for nosocomial infection was time on ECMO (OR 12.2 for longest tertile time on ECMO vs. shortest tertile, p=0.0001); transport was not significantly associated with infection (OR 2.1, p=0.06).

Conclusion
This study did not find a significant difference in nosocomial infection rate or recovery of MDROs between transported and non-transported patients on ECMO, regardless of transport modality. This study suggests that transportation is not the primary driver of nosocomial infections in this cohort.

Introduction

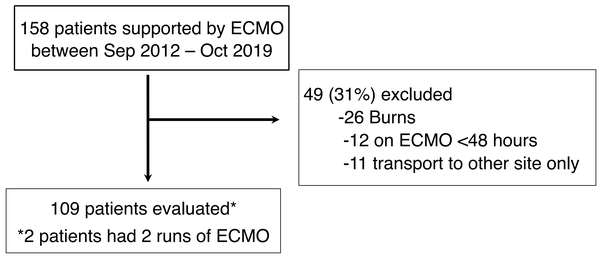
- ECMO is a form of life support for reversible pulmonary and cardiac failure with increased use over the past 10 years.
- Patients on ECMO have increased rates of hospital acquired infections that are associated with longer hospital stays and longer ECMO courses.
- Transport is associated with infection with multidrug resistant organisms (MDRO) in military literature.
- No data has been published on infection rates for patients on ECMO related to transfer.
- We hypothesized that transport will lead to more infections and more MDROs with longer transports having a dose-dependent effect and cause higher infectious rates.

Methods

- Single center retrospective review of patients on ECMO for greater than 48 hours at BAMC and USAISR from 9/1/12-10/31/19
- Burn patients were excluded as they have a known increased risk of infection and none were transported
- Data on demographics, ECMO characteristics, and infectious complications were collected.
- Presence/absence of infection was determined by treatment team's assessment at the time of patient care.
- Statistical analysis performed with Pearson's Chi Squared, Fisher's Exact Test and Mann-Whitney U Tests.

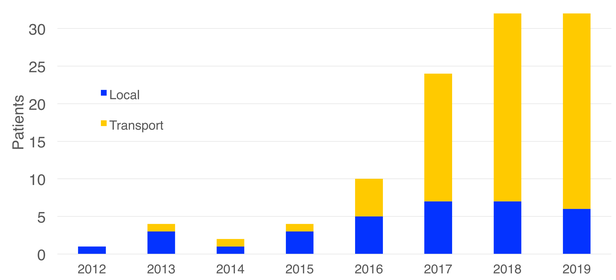
Results

Figure 1.



Flow diagram showing patients at ECMO center meeting inclusion criteria. Both patients that required re-cannulation were treated for analysis as a single ECMO course.

Figure 2.



Bar graph showing number of patients and their cannulation location at ECMO center (local) or at another facility and transported to ECMO center (transport). Note 2019 only has data through October.

Table 1.

	Local Cannulation (n=33)	Interhospital Transport (n=76)	P-value
Male	25 (75%)	54 (71%)	0.61
Median age	43 (33-59)	39 (30-51.5)	0.11
Pre-ECMO Hospital Days	4 (0-12)	4 (2-9.25)	0.53
Median time on ECMO (hr)	161 (93-326)	262.5 (119.25-569.25)	0.04
Survived to discharge	20 (61%)	60 (79%)	0.05
Admission Diagnosis			0.01
Cardiac Diagnosis	5 (15%)	8 (11%)	
Medical Diagnosis	16 (48%)	58 (76%)	
Surgical Diagnosis	12 (36%)	10 (13%)	
Any Infection	9 (27%)	33 (44%)	0.1
Multiple infections	2 (6%)	8 (11%)	0.72
Total Infections/1000 ECMO days	33.1	30.5	0.74
Days to Pos Blood Culture	6 (3-9)	20 (7-22)	0.23
Days to Respiratory Infection	2 (1-4.5)	4 (1-17.5)	0.25
Any MDRO	4/8 (50%)	17/31 (55%)	1

Demographic and infection information for all patients on ECMO shown and organized by transport status. Interquartile range or percentage of patients in that column shown in parentheses.

Table 2

		OR (95% CI)	P Value
Hours on ECMO			
	50 to 100	1	
	100 to 350	5.3 (1.56-25.38)	0.005
	350 to 2200	12.2 (2.5-60.45)	0.001
Admission Diagnosis			
	Medical	1	
	Cardiac	0.61 (0.12-2.61)	0.5
	Surgical	2.95 (1.38-5.98)	0.006
ECMO Setting			
	VV	1	
	VA or VAV	5.87 (1.38-24.32)	0.02
Transport			
	No transfer	1	
	Interhospital Transport	2.17 (0.98-5.35)	0.06

Multivariate analysis using logistic regression to determine risk factors for subsequent nosocomial infection risk. 95% confidence intervals shown in parentheses.

Table 3

	Ambulance Transport Only (n=65)	Fixed wing Aircraft Transport (n=11)	P-value
Any Infection	29 (45%)	4 (37%)	0.75
Multiple infection	5 (8%)	3 (27%)	0.09
Total Infection/1000 ECMO days	31.8	22.4	0.39
Days to Pos Blood Culture	20 (9-22)	22 (11.5-34.5)	0.86
Days to Respiratory Infection	5 (1-15.25)	5 (2.5-29.5)	1
Any MDRO	14/27 (52%)	3/4 (75%)	0.61

Infectious complications of patients transferred organized by type of transfer. Percentages or interquartile ranges shown in parenthesizes.

Conclusions

- This study did not find a statistical difference between infectious or MDRO risk based on where a patient was cannulated.
- There was no difference seen in infection rate based on distance a patient was transported.
- Transport of patients on ECMO is a growing trend and appears safe in this cohort, with decreased mortality seen in transported patients.
- High MDRO rates support need for strong antibiotic stewardship and infection control efforts for patients receiving ECMO regardless of location of cannulation.