Early Mechanical Circulatory Support Verses Usual Standard of Care May Be Associated With Reduced Mortality in Patients with Massive PE

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BACKGROUND

- Massive pulmonary embolism (PE) is the third leading cause of cardiovascular death in the United States. Despite improvements in contemporary management of PE, massive PE continues to be associated with high mortality rates up to 52.4%. Venoarterial extracorporeal membrane oxygenation (VA-ECMO) can be safely and effectively implemented in this population as supportive therapy or as a bridge to other invasive therapies once the patient is more hemodynamically stable. Early implementation of mechanical circulatory support may be beneficial and improve clinical outcomes in massive PE.

METHODS

- Using an institutional VA-ECMO database, we retrospectively reviewed all patients undergoing VA-ECMO over a six-year period for the management of massive PE confirmed by chest CT or pulmonary angiography. Fifty-seven consecutive patients were identified. The population was divided into 3 cohorts: 1) Patients who never had cardiac arrest. 2) Patients who had pre-ECMO cardiac arrest but sustained ROSC prior to cannulation. 3) Patients who had pre-ECMO cardiac arrest and were cannulated as a component of eCPR.

- The primary outcome was survival to hospital discharge. Secondary outcomes included analysis of multiple clinical characteristics which may be predictive of in-hospital mortality.

Variable	Total population (N=57)	Survivors (N=30)	Non-Survivors (N=27)	P-Value
Age	58 (47-67)	64 (47-70)	56 (39-60)	0.078
Gender (male)	34 (59.6)	14 (46.7)	20 (74.1)	0.035
BMI	33.9 (27.8-39.6)	33.5 (27.1-39.6)	34.4 (28.3-43.5)	0.407
CAD	6 (10.5)	4 (13.3)	2 (7.4)	0.467
Hx Stroke	7 (12.3)	5 (16.7)	2 (7.4)	0.288
HTN	29 (50.9)	19 (63.3)	10 (37)	0.047
DM	18 (31.6)	14 (46.7)	4 (14.8)	0.01
Chronic Lung Disease	7 (12.3)	3 (10)	4 (14.8)	0.58
Metastatic Malignancy	5 (8.8)	2 (6.7)	3 (11.1)	0.554
Hx VTE	9 (15.8)	3 (10)	6 (22.2)	0.206
Current Anticoagulation Use	2 (3.5)	2 (6.7)	0 (0)	0.172
Length of ECMO Run (hrs)	52 (24-102)	81 (48-127)	27 (8-74)	0.007
GCS	9 (3-15)	11 (6-15)	3 (3-11)	0.006
Intubated	38 (69.1)	14 (48.3)	24 (92.3)	<0.001
# of Pressors	1 (0-1)	0 (0-1)	1 (0-1)	0.209
Pre-ECMO Arrest	24 (20.7)	5 (16.7)	19 (70.4)	<0.001
Bystander CPR	23 (95.8)	4 (80)	19 (100)	0.046
Slow Flow Time (mins)	38 (20-45)	10 (5-28)	39 (20-50)	0.032
Systemic TPA	8 (14)	1 (3.3)	7 (25.9)	0.014
Catheter-Directed TPA	18 (31.6)	11 (36.7)	7 (25.9)	0.384
Thrombectomy	4 (7)	2 (6.7)	2 (7.4)	0.913
Bleeding	25 (43.9)	10 (33.3)	15 (55.6)	0.091
Access Site Complication	7 (12.3)	4 (13.3)	3 (11.1)	0.799
Limb Ischemia	2 (3.5)	0 (0)	2 (7.4)	0.129

Table 1 Demographics, procedural characteristics, and outcomes of entire patient population. Variables are displayed as median (interquartile range) for continuous variables and as number (column percent) for qualitative variables. *p-values obtained by Chi-square test for qualitative variables and by Student's t-test.

RESULTS

Multivariate	Odds Ratio	Confidence Interval	P-value
Gender (male)	4.84	(0.78 - 30.0)	0.09
HTN	0.44	(0.1 – 1.95)	0.279
GCS	1.06	(0.86 – 1.31)	0.602
Intubated	2.92	(0.26 – 32.68)	0.384
Pre-cannulation Arrest	15.92	(1.98 – 128.34)	0.009
Systemic TPA	3.45	(0.28 – 42.55)	0.334

Table 2 Multivariate for entire patient population. Multivariable logistic regression was performed with inpatient mortality as the outcome and each predictor equally weighted. Model fitting was assessed with the Hosmer and Lemeshow Test, which for this model was p=0.12.

- Pre-cannulation serologic data was only extracted on patients in cohorts 1 and 2.

Variable	Total population (N=43)	Survivors (N=26)	Non-Survivors (N=17)	P-Value
Lactate	3.3 (2.3-6.1)	3 (2.2-4.9)	6.35 (3.2-9.4)	0.025
pH	7.27 (7.16-7.38)	7.37 (7.18-7.42)	7.24 (7.09-7.28)	0.019
PaO2	91 (66-176)	91 (65-141)	161 (78-260)	0.078
PCO2	40 (31-48)	36 (31-46)	45 (37-49)	0.94
Albumin	2.75 (2.4-3.2)	2.75 (2.50-3.20)	2.75 (2-3.15)	0.19
Hepatic Insufficiency	10 (23.3)	5 (19.2)	5 (29.4)	0.44
AST	57 (28-166)	57 (30-120)	69 (27-308)	0.31
ALT	54 (24-129)	50 (22-100)	61 (26-314)	0.2
Bilirubin	0.6 (0.5-0.9)	0.5 (0.4-0.7)	0.8 (0.55-0.95)	0.86
Creatinine	1.23 (1.01-1.58)	1.21 (1.03-1.47)	1.27 (1.01-1.58)	0.52
AKI	14 (32.6)	9 (34.6)	5 (29.4)	0.72

Table 3 Serologic data for patient cohorts 1 and 2 . Variables are displayed as median (interquartile range) for continuous variables and as number (column percent) for qualitative variables. *p-values obtained by Chi-square test for qualitative variables and by Student's t-test.

Multivariate	Odds Ratio	Confidence Interval	P-value
HTN	0.087	(0.007-1.009)	0.051
GCS	0.968	(0.774-1.212)	0.779
Pre-cannulation Arrest	18.793	(0.652-541.658)	0.087
Systemic TPA	3.762	(0.096-147.614)	0.479
Lactate	1.118	(0.81-1.543)	0.497

Table 4 Multivariate for patient cohorts 1 and 2. . Multivariable logistic regression was performed with inpatient mortality as the outcome and each predictor equally weighted. Model fitting was assessed with the Hosmer and Lemeshow Test, which for this model was p=0.96.

DISCUSSION

- We identified a large sample size of patients cannulated for VA-ECMO for management of massive PE at a single center, larger than what has been previously identified in other institutional studies of VA-ECMO in massive PE patients.

- We found that cardiac arrest prior to cannulation for VA-ECMO was the only significant predictor of inpatient mortality. We interpreted this as those more likely to die were more critically ill and had higher prevalence of coma, requiring mechanical intubation, suffering cardiac arrest, and were more likely to need fibrinolytic therapy.

- Serologic data was only extracted for patient cohorts 1 and 2 because we thought pre-cardiac arrest serologic data for patients who were cannulated as a component of eCPR would not accurately reflect their acuity of illness or prognosis at time of cannulation.

- We did not identify any other significant independent predictor of clinical outcome.

- Our findings are consistent with what we expected from our VA-ECMO database.

- There are clinical characteristics that are significantly different between the cohorts, such as GCS and lactate levels, which are not significant in the multivariate model. We suspect this is due to the sample size.

CONCLUSION

- This is a large sample size of patients cannulated for VA-ECMO for management of massive PE from a single center study

- Cardiac arrest prior to cannulation for VA-ECMO is a significant predictor of inpatient mortality, consistent with previous knowledge of our VA-ECMO database.

- Other clinical characteristics, such as lactate, GCS, and intubation are possibly significant in this population, but may require a larger sample size.