

A Risk Stratification Guide for Bridging Patients on ECMO to Heart Transplantation

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BACKGROUND

- VA-ECMO is a critical therapy in the management of patients in refractory cardiogenic shock, and is often employed as a bridge to recovery, decision-making, durable VAD implantation, or heart transplantation (HT).
- The 2018 heart allocation policy resulted in a rapid increase in the use of VA-ECMO as a bridge to transplant (ECMO-BTT).¹
- Patients bridged to HT with VA-ECMO face significantly elevated risk of mortality and have been shown to have worse post-HT outcomes.²
- Specific risk factors for post-transplant mortality in patients bridged to HT from VA-ECMO remain inadequately characterized.
- Therefore, this study sought to identify predictors of post-transplant mortality among ECMO-BTT patients to develop a risk stratification framework to inform clinical decision-making.

METHOD

- Data Source
 - UNOS Registry
 - Included: all adult ECMO-BTT patients between January 2000 and June 2024
 - Excluded: patients <18, multiorgan transplants
- Outcomes of interest
 - Primary Outcome: 1-year mortality
 - Secondary Outcomes: post-transplant dialysis, stroke, pacemaker implant, acute rejection, length of stay
- Determination of Risk Factors
 - Univariable and multivariable cox regression models were performed using baseline cohort characteristics to determine potential risk factors for 1-year mortality.
 - Significant variables from the multivariable model were then re-analyzed in the same multivariable cox regression model to determine final hazard ratios associated with each variable.
- Risk Group Stratification

The cohort was then stratified by the presence of 0 risk factors, 1 risk factor, 2 risk factors, and ≥ 3 risk factors.

Kaplan-Meier analysis was then performed to determine 1-year mortality by risk factor group.

RESULTS

Table 1. Recipient risk factors for 1-year mortality. Significant risk factors included age ≥ 61 , ventilator-dependence, total bilirubin ≥ 3.1 , ICM, and “other etiologies” of HF.

Variable	Univariable	P-value	Multivariable	P-value	Final Model	P-value
Age	1.12 (1.02-1.22)	0.012	1.13 (1.00-1.27)	0.042	1.16 (1.04-1.30)	0.01
BMI	1.30 (1.04-1.62)	0.02	1.21 (0.91-1.62)	0.184		
Diabetes	1.47 (1.11-1.94)	0.007	1.16 (0.82-1.65)	0.4		
Ventilator	2.15 (1.67-2.76)	<0.001	1.84 (1.33-2.53)	<0.001	2.21 (1.63-2.99)	<0.001
Inotropes	1.39 (1.08-1.80)	0.011	1.16 (0.85-1.60)	0.356		
Dialysis	2.83 (2.11-3.79)	<0.001	1.38 (0.75-2.57)	0.31		
Creatinine	1.33 (1.24-1.43)	<0.001	1.17 (0.97-1.40)	0.099		
Total Bilirubin	1.08 (1.05-1.11)	<0.001	1.07 (1.04-1.11)	<0.001	1.09 (1.05-1.12)	<0.001
HF etiology						
NICM	Reference		Reference		Reference	
ICM	1.54 (1.13-2.08)	0.005	1.62 (1.10-2.39)	0.015	1.64 (1.12-2.38)	0.01
Congenital	1.42 (0.72-2.81)	0.313	1.66 (0.76-3.63)	0.204	1.85 (0.87-3.99)	0.111
Restrictive	0.66 (0.31-1.42)	0.287	0.85 (0.34-2.13)	0.731	0.77 (0.31-1.92)	0.576
Other	2.68 (1.95-3.70)	<0.001	2.16 (1.43-3.27)	<0.001	2.65 (1.80-3.88)	<0.001

Table 2. Donor risk factors for 1-year mortality. Significant risk factors included female gender and ischemic times ≥ 4.47 hours.

Variable	Univariable	P-value	Multivariable	P-value	Final Model	P-value
Gender						
Male	Reference		Reference		reference	
Female	1.60 (1.22-2.11)	0.001	1.59 (1.11-2.27)	0.011	1.61 (1.16-2.23)	0.004
Mechanism of Death						
Trauma	reference		Reference			
Drug overdose	0.71 (0.49-1.01)	0.055	0.712 (0.46-1.11)	0.139		
Stroke	1.13 (0.79-1.64)	0.493	0.88 (0.56-1.39)	0.583		
Anoxia	1.14 (0.711-1.83)	0.586	1.33 (0.79-2.25)	0.288		
Cardiac	0.74 (0.45-1.19)	0.213	0.81 (0.47-1.38)	0.43		
Other	1.00 (0.37-2.71)	0.995	0.91 (0.28-2.93)	0.875		
BMI	1.03 (0.83-1.28)	0.796				
Ischemia Time	1.08 (0.96-1.22)	0.176	1.15 (1.00-1.31)	0.049	1.14 (1.00-1.30)	0.048

5-year survival after Heart Transplantation

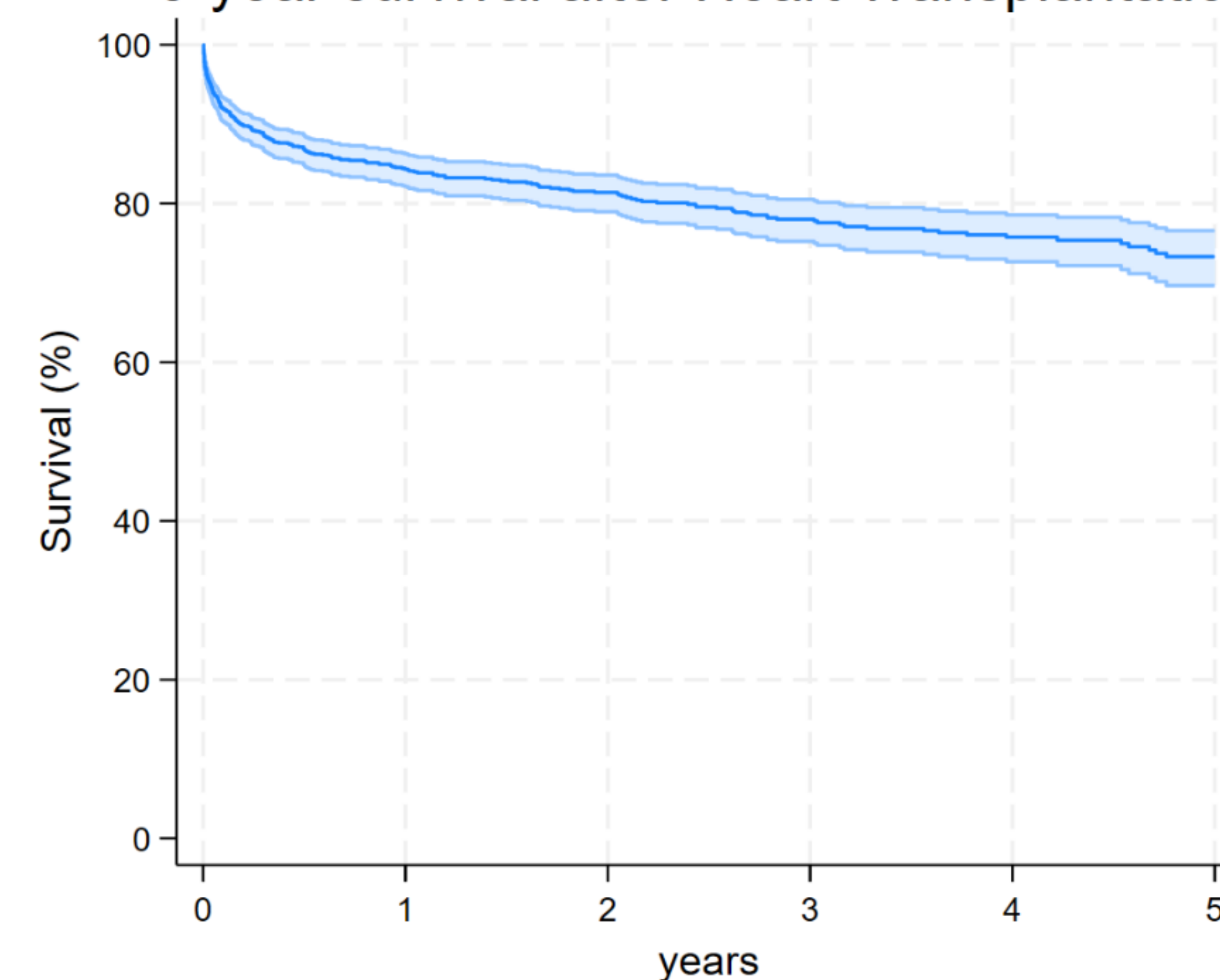
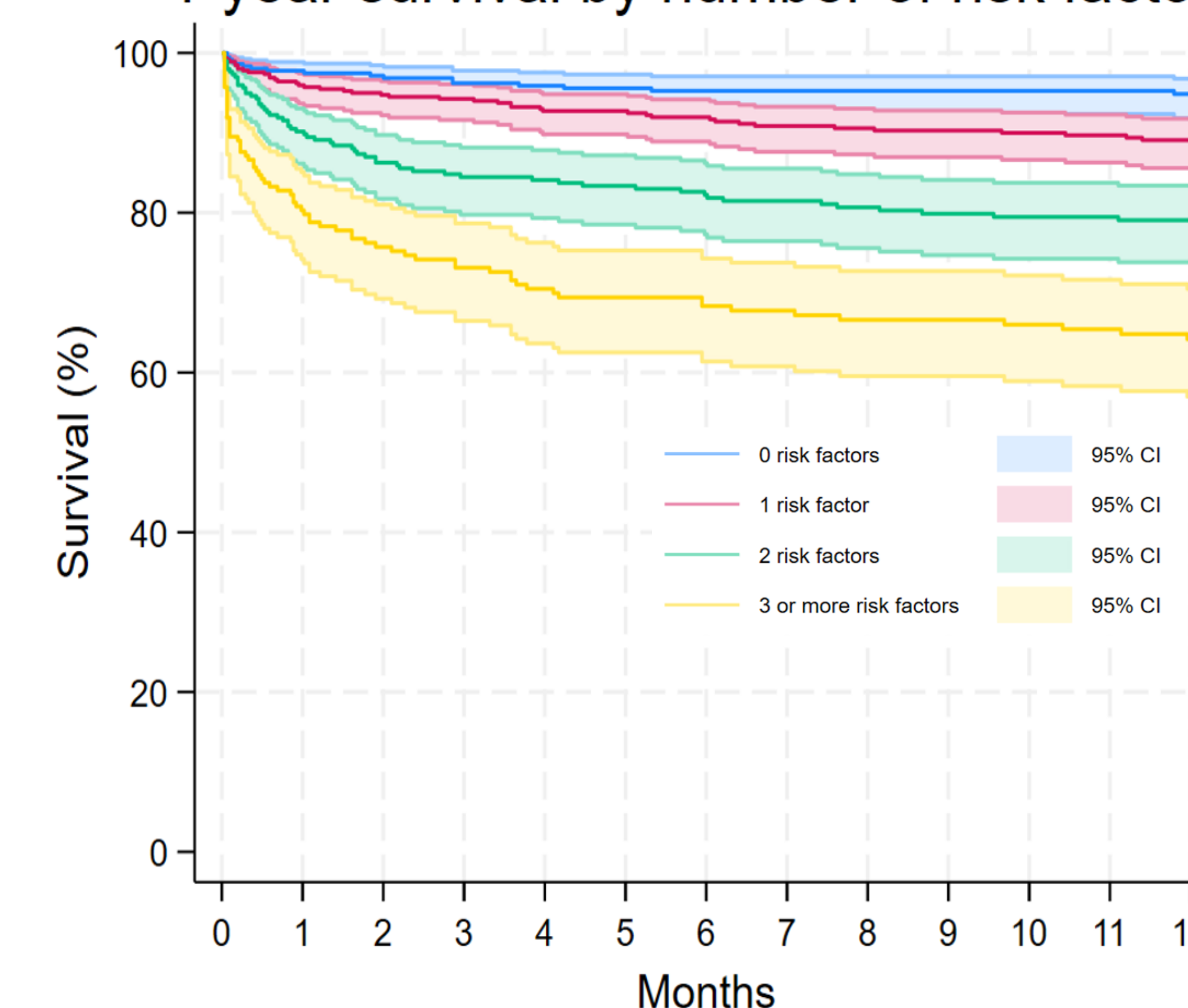


Figure 1. Overall post-transplant survival. Unadjusted survival for all ECMO-BTT patients at 30 days, 90 days, 1-year, and 5-years was 92.73%, 89.26%, 84.33%, and 73.30%, respectively.

1-year survival by number of risk factors



Number at risk	0	1	2	3	4	5	6	7	8	9	10	11	12
0 risk factors	362	328	314	301	300	299	280	263	257	251	250	247	213
1 risk factor	457	402	387	373	364	362	342	322	316	306	305	299	274
2 risk factors	300	259	241	230	229	227	215	207	203	197	196	196	180
3 or more risk factors	210	162	146	138	133	129	123	117	115	113	112	110	100

Figure 2. Post-transplant mortality by number of risk factors. 1-year post-HT survival for patients with 0, 1, 2, or ≥ 3 risk factors was 94.86%, 89.09%, 79.07%, and 64.17%, respectively. The hazard ratio for 1-year mortality for patients with 1, 2, or ≥ 3 risk factors was 2.09 (1.2-3.6), 4.39 (2.6-7.5), and 8.48 (5.0-14.4), respectively.

CONCLUSIONS

- Patients bridged to transplant with VA-ECMO represent a complex patient population with elevated post-transplant mortality.
- We identified the following risk factors for 1-year mortality in ECMO-BTT patients:
 - Age ≥ 61 years
 - Ventilator dependence prior to transplant
 - Bilirubin ≥ 3.1
 - Ischemic and unspecified/mixed cardiomyopathies
 - Donor organ ischemic time ≥ 4.47 hours
 - Female donors
- Patients with 2 or more of the above risk factors should proceed cautiously as this is associated with less than 80% 1-year survival.

REFERENCES

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