The Utilization and Outcomes of Hypoxemic Donors in Combined Heart-Lung Transplantation

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Introduction

Combined heart-lung transplantation (HLTx) is a complex yet life-saving procedure for patients with concomitant end-stage heart and lung failure.

While the ISHLT has found that HLTx recipients who survive the first year have favorable long-term survival with a conditional median survival of 12.8y[1], the impact of donor hypoxemia remains unknown in HLTx.

Prior studies have found that hypoxemic donor lungs, measured as PaO2/FiO2 (PF) ≤300mmHg, do not confer adverse outcomes in lung transplant.[2,3]

However, this has not been investigated in HLTx or since UNOS modified the lung allocation score (LAS) system in 2017.

We aim to analyze the utilization and outcomes of hypoxemic donor lungs in HLTx before and after the modified LAS system.

Methods

We identified all adults (≥ 18yo) with data on donor P/F ratio undergoing HLTx in the US from 1/1/2010 – 4/30/2024.

Donor PF Ratio was used to group recipients into two categories: **≤300mmHg** and **>300mmHg**.

Recipients and matched donors were also stratified by before and after LAS modification: **Era 1** (1/1/10 – 11/24/17) vs. **Era 2** (11/25/17 – 4/30/2024)

Baseline recipient & donor characteristics were compared.

30-day, 1-, and 3-year survival were compared using the Kaplan-Meier method, stratified by both Era and PF Ratio.

Multivariate Cox proportional hazard regression models were used to assess the impact of PF Ratio on mortality.

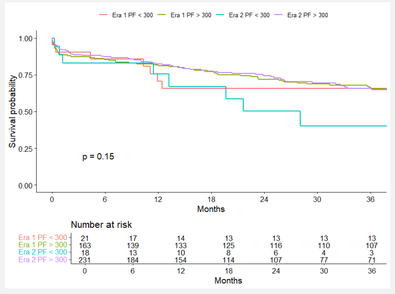
Results

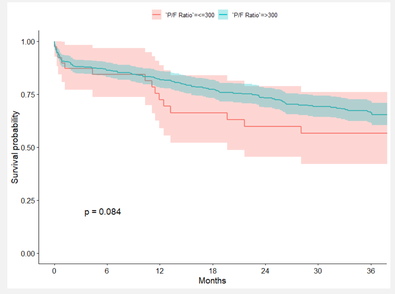
Characteristic	Overall, N = 439[1]	<=300, N = 40[1]	>300, N = 399[1]	p-value[2]
Era				0.2
Era 1	184 (42%)	21 (53%)	163 (41%)	
Era 2	255 (58%)	19 (48%)	236 (59%)	
Donor Distance to transplant	195.71 (187.11)	167.40 (173.42)	198.55 (188.39)	0.3
Recipient Age	45.25 (13.12)	50.43 (12.00)	44.73 (13.13)	0.007
Sex				0.10
F	219 (50%)	15 (38%)	204 (51%)	
M	220 (50%)	25 (63%)	195 (49%)	
Diabetes	76 (17%)	10 (26%)	66 (17%)	0.2
Cigarette Use	144 (33%)	15 (38%)	129 (33%)	0.5
BMI				0.7
<=30	382 (87%)	34 (85%)	348 (87%)	
>30	57 (13%)	6 (15%)	51 (13%)	
BSA	1.78 (0.24)	1.83 (0.28)	1.77 (0.24)	0.2
LVAD explant	3 (0.7%)	1 (2.5%)	2 (0.5%)	0.2
LVAD at transplant	11 (2.5%)	2 (5.1%)	9 (2.3%)	0.3
ECMO at transplant	97 (22%)	8 (20%)	89 (22%)	0.7
ECMO explant	4 (0.9%)	0 (0%)	4 (1.0%)	>0.9
IABP	21 (4.8%)	1 (2.6%)	20 (5.1%)	0.7
Donor Age	32.45 (11.93)	32.45 (13.53)	32.45 (11.78)	>0.9
Lv eject	61.38 (6.82)	62.23 (7.74)	61.30 (6.73)	0.5
Ischemic time	3.78 (1.02)	3.77 (1.09)	3.78 (1.01)	>0.9
Abnormal Chest X Ray	254 (58%)	33 (83%)	221 (56%)	0.001
Abnormal Bronchoscopy	94 (22%)	14 (38%)	80 (21%)	0.015

[1] n (%); Mean (SD)
[2] Welch Two Sample t-test; Pearson's Chi-squared test

A total of 439 patients underwent HLTx (40 hypoxemic vs. 399 normal donors). Hypoxemic donor utilization has remained low between eras (21 cases in era 1 vs. 19 cases in era 2; p=0.2).

Recipients of hypoxemic donors were older (p=0.007). Hypoxemic donors had increased rates of abnormal chest x-ray (p=0.001) and bronchoscopy results (p=0.015) compared to normal donors.





There was no difference in survival between recipients of hypoxemic vs. normal donor lungs (p=0.084), regardless of era (p=0.15). Hypoxemic donors had 90.5, 70.6, and 65.6% survival in era 1, compared to 88.9, 75.4, and 40.2% survival in era 2 at 30-days, 1-, and 3-year intervals, respectively.

Results

Post-HLTx Complications	Era 1 PF < 300, N = 21[1]	Era 1 PF > 300, N = 163[1]	Era 2 PF < 300, N = 19[1]	Era 2 PF > 300, N = 236[1]	p-value[2]
Acute Rejection	3 (14%)	25 (15%)	0 (0%)	28 (12%)	0.3
Length of Stay	34.95 (29.29)	44.13 (56.64)	44.24 (41.24)	49.62 (53.58)	
Pacemaker	0 (0%)	3 (1.9%)	0 (0%)	4 (1.7%)	>0.9
Stroke	1 (5.0%)	9 (5.6%)	1 (5.6%)	11 (4.8%)	>0.9
Dialysis	4 (20%)	48 (30%)	6 (33%)	74 (32%)	0.7
Airway Dehiscence	0 (0%)	1 (0.6%)	0 (0%)	9 (3.9%)	0.2

Post-HLTx Complications	<=300, N = 40[1]	>300, N = 399[1]	p-value[2]
Acute Rejection	3 (7.7%)	53 (13%)	0.3
Length of Stay	39.22 (35.08)	47.36 (54.86)	0.2
Pacemaker	0 (0%)	7 (1.8%)	>0.9
Stroke	2 (5.3%)	20 (5.1%)	>0.9
Dialysis	10 (26%)	122 (31%)	0.5
Airway Dehiscence	0 (0%)	10 (2.6%)	0.6

In both eras, rates of acute rejection, length of stay, pacemaker implantation, stroke, dialysis, and airway dehiscence were similar between HLTx recipients with hypoxemic vs. normal donor lungs.

Covariates	Hazard Ratios	95 % Confidence Intervals	p-value
PF>300	0.64	0.40 – 1.04	0.073
Era 2	1.20	0.85 – 1.70	0.300
Abnormal Chest X Ray	0.62	0.45 – 0.84	0.002
Abnormal Bronchoscopy	0.86	0.59 – 1.26	0.444
Recipient Age	1.00	0.99 – 1.02	0.465

After adjusting for covariates, neither PF>300mmHg (HR 0.64, p=0.073) nor Era 2 (HR 1.20, p=0.300) had an impact on HLTx recipient survival.

Conclusions

Since 2017, hypoxemic donors continue to be underutilized in HLTx despite comparable long-term outcomes to normal donors. However, due to the small number of patients receiving hypoxemic donor lungs in HLTx, further studies are warranted to better interpret these results.

References

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