

Pulmonary Embolism in Lung Transplant Recipients: Data from a Large Nationwide Registry

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Background

- Lung transplant recipients have an elevated risk of developing pulmonary embolism (PE).
- PE can compromise allograft function due to underdeveloped collateral bronchial circulation, potentially limiting survival.
- This study aimed to investigate PE as a cause of death in lung transplant recipients and identify modifiable risk factors.

Methods

- Data from 1987 to 2023 on adult first-time lung transplant recipients were collected from the multicenter UNOS-OPTN database.
- Patients with a history of previous or multi-organ transplants or donors with a history of malignancy were excluded.
- PE data were only available through cause of death records.
- Pre-transplant, intra-operative, and post-operative variables, based on known PE risk factors in lung transplant recipients and available data, were compared between the PE-related mortality and non-PE mortality groups.

Conclusion

- Significant risk factors for PE-related mortality included higher BMI, IPF, and head and neck cancer, while CF and double lung transplantation were associated with reduced risk.
- Post-operative predictors for early PE-related mortality included ECMO, consistent with previous research, and dialysis, both indicating increased illness severity or surgical complexity in lung transplant recipients.
- Addressing these modifiable factors may involve implementing pre- and post-transplant care protocols that include weight management, vigilant preoperative cancer screening, careful patient selection and weaning from ECMO, and strategies to prevent or manage renal dysfunction.

References

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Results

Demographics :

- A total of 46,445 lung transplant recipients were included in the study, of which 22,166 lacked cause of death information (Table 1).

Outcomes:

- Among all lung transplant recipients, the 1-year survival rate was 77.3%, with 53.1% in the PE-related mortality cohort and 74.87% in the non-PE mortality cohort (p < 0.0001).
- Within the PE-related mortality group, 12.4% of patients who developed PE within the first 30 days post-transplant had a median survival of 12 days post-transplant (early PE-related mortality).
- In contrast, patients in the PE-related mortality group who developed PE more than 30 days post-transplant had a median survival of 554.5 days (approximately 18 months) and a 1-year survival rate of 60.61% (p < 0.0001).

Risk Factors for PE-Related Mortality:

- In univariate analysis, significant preoperative predictive factors for PE-related mortality included higher BMI (OR 1.04, 95% CI 1.01-1.07, p = 0.01), history of IPF (OR 1.38, 95% CI 1.06-1.80, p = 0.02), and history of head and neck cancer (OR 4.64, 95% CI 1.12-19.23, p = 0.03).
- Conversely, history of CF (OR 0.45, 95% CI 0.24-0.85, p = 0.01) and double lung transplant (OR 0.76, 95% CI 0.59-0.99, p = 0.04) were associated with a decreased PE-related mortality risk.
- In multivariate models, a history of head and neck cancer (OR 4.64, 95% CI 1.12-19.23, p = 0.03) was an independent predictor of post-transplant PE leading to death.

Risk Factors for Early PE-Related Mortality (≤ 30 Days Post-Transplant):

- For early PE-related mortality, significant preoperative predictive factors in univariate analysis were higher BMI (OR 1.14, 95% CI 1.05-1.25, p = 0.004) and history of lung surgery (OR 5.59, 95% CI 1.62-19.28, p = 0.01).
- Post-operative predictors for early PE-related mortality were ECMO (OR 7.50, 95% CI 1.22-45.96, p = 0.03) and dialysis (OR 4.69, 95% CI 1.47-14.98, p = 0.01).
- Multivariate models found no significant predictors for deaths attributed to early PE.

Table 1 abbreviations: BMI, body mass index; CO, cardiac output; COPD, chronic obstructive pulmonary disease; ECMO, extracorporeal membrane oxygenation; FEV, forced expiratory volume; FVC, forced vital capacity; ICU, intensive care unit; IPF, idiopathic pulmonary fibrosis; LAS, lung allocation score; PAP, pulmonary artery pressure; PCWP, pulmonary capillary wedge pressure; PE, pulmonary embolism; PPH, primary pulmonary hypertension; SD, standard deviation.

Table 1. Demographics and outcomes of recipients with pulmonary embolism as the cause of death post-transplant

Factor	Transplants n	PE mortality	Non-PE mortality	p-value
Age, mean (±SD)	55.42 (12.78)	56.86 (11.23)	55.28 (12.57)	0.06
Gender				0.20
Male	26733 (57.6)	139 (61.5)	13739 (57.1)	
Female	19712 (42.4)	87 (38.5)	10314 (42.9)	
Race or Ethnicity				0.54
White	37956 (81.7)	189 (83.6)	20442 (85.0)	
Black	3929 (8.5)	20 (8.8)	1925 (8.0)	
Hispanic	3367 (7.3)	12 (5.3)	1217 (5.1)	
Asian	878 (1.9)	2 (0.9)	322 (1.3)	
BMI kg/m ² , mean (±SD)	25.19 (4.64)	25.90 (4.84)	25.02 (4.70)	0.01
Performance status				0.30
0-1	10362 (23.8)	60 (28.3)	5616 (25.3)	
≥2	33144 (76.2)	152 (71.7)	16625 (74.7)	
Social history				0.11
Smoking	21105 (59.1)	81 (57.0)	10046 (63.8)	
Medical history				0.57
COPD	12576 (27.4)	69 (30.8)	7754 (32.7)	
IPF	17537 (38.2)	99 (44.2)	8658 (36.5)	0.02
Cystic fibrosis	4473 (9.7)	10 (4.5)	2226 (9.4)	0.01
PPH	1419 (3.1)	5 (2.2)	704 (3.0)	0.69
Diabetes	7245 (16.5)	31 (14.8)	3444 (15.5)	0.85
Infection	3935 (9.1)	23 (10.8)	1949 (8.9)	0.33
Malignancy	3450 (7.5)	15 (6.7)	1573 (6.6)	0.89
Breast cancer	381 (0.8)	0 (0.0)	173 (0.7)	0.42
Digestive cancer	6 (0.0)	0 (0.0)	3 (0.0)	1.00
Genitourinary cancer	439 (1.0)	3 (1.3)	177 (0.7)	0.24
Head and neck cancer	100 (0.2)	2 (0.9)	46 (0.2)	0.07
Hematologic cancer	243 (0.5)	2 (0.9)	127 (0.5)	0.34
Neurologic cancer	8 (0.0)	0 (0.0)	2 (0.0)	1.00
Respiratory cancer	146 (0.3)	1 (0.4)	71 (0.3)	0.49
Skin cancer	1380 (3.0)	4 (1.8)	582 (2.5)	0.67
Hospitalization	3449 (7.5)	15 (6.6)	1447 (6.0)	0.67
ICU	4294 (9.3)	21 (9.3)	1766 (7.4)	0.25
Surgical or procedural history				1.00
Cardiac surgery	1661 (4.5)	7 (4.8)	879 (5.4)	
Lung surgery	2536 (6.9)	15 (10.1)	1442 (8.6)	0.47
Mechanical ventilation	3536 (7.6)	18 (8.0)	1521 (6.3)	0.33
ECMO	771 (1.7)	3 (1.3)	227 (0.9)	0.48
Dialysis	155 (0.3)	1 (0.4)	95 (0.4)	0.59
Medication history				1.00
Inotrope use	35 (0.1)	0 (0.0)	24 (0.1)	
Steroid	19219 (44.4)	89 (42.6)	10515 (47.7)	0.14
LAS, mean (±SD)	47.98 (17.97)	49.26 (19.63)	47.43 (17.71)	0.23
Preoperative				0.29
FEV1, mean (±SD)	39.39 (21.37)	39.54 (21.23)	37.98 (21.38)	
FVC, mean (±SD)	49.87 (18.07)	50.73 (17.34)	49.99 (18.07)	0.55
CO, mean (±SD)	5.35 (1.48)	5.39 (1.45)	5.32 (1.46)	0.57
PAP, mean (±SD)	27.54 (11.39)	27.10 (10.46)	27.47 (11.20)	0.67
PCWP, mean (±SD)	10.75 (5.60)	11.09 (5.28)	10.94 (5.63)	0.72
Induction agent				1.00
Alemtuzumab	1887 (99.6)	7 (100.0)	1049 (99.5)	
Transplant type				0.04
Single lung transplant	16144 (34.8)	115 (50.9)	10607 (44.1)	
Double lung transplant	30301 (65.2)	111 (49.1)	13446 (55.9)	
Donor type				0.29
Deceased donor	46390 (99.9)	225 (99.6)	24017 (99.9)	
Living donor	55 (0.1)	1 (0.4)	36 (0.1)	
Intraoperative				0.70
Mechanical ventilation	3843 (8.3)	18 (8.0)	1752 (7.3)	
ECMO	1674 (3.6)	6 (2.7)	603 (2.5)	0.83
Ischemic time (minutes), mean (±SD)	320.14 (129.86)	294.83 (115.17)	300.58 (115.51)	0.47
Postoperative				0.27
Mechanical ventilation				
≤48 hours	21047 (58.3)	86 (58.9)	8922 (54.8)	
>2 but <5 days	5959 (16.5)	21 (14.4)	2588 (15.9)	
≥5 days	7378 (20.4)	26 (17.8)	3745 (23.0)	
Duration unknown	544 (1.5)	6 (4.1)	362 (2.2)	
ECMO	1712 (8.2)	9 (15.8)	746 (12.0)	0.41
Dialysis	2918 (6.6)	17 (8.0)	2034 (9.1)	0.72
Infection	5247 (21.6)	0 (0.0)	5247 (21.8)	<0.001
Death	27253 (59.3)	226 (100.0)	24045 (100.0)	1.00