

Elective Cardiopulmonary Bypass for Lung Transplantation: Is it Safer than We Think?

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INTRODUCTION/AIMS

The use of cardiopulmonary bypass (CPB) during lung transplantation is controversial. CPB can offer improved visualization, better control of central vasculature, and possibly faster operations. Opponents argue the use of CPB results in higher transfusion requirements, increased rates of primary graft dysfunction (PGD), and more complications such as stroke, acute kidney injury (AKI) and renal failure requiring hemodialysis. In the fall of 2020, our program transitioned to performing all lung transplants on CPB. In this report we describe our intra- and post-operative outcomes for lung transplantation using elective CPB.

METHODS

We performed a single institution case series analysis of consecutively enrolled patients who underwent isolated single or bilateral lung transplantation from 8/2020 present. Our primary outcomes were perioperative outcomes including rates of grade 3 PGD at 72 hours. Parametric outcomes are reported as mean (+/-SD); non-parametric outcomes are reported as median (IQR). One-year survival was calculated using the Kaplan-Meier method on those patients with at least 365 days of follow-up.

RESULTS

We performed 40 consecutive lung transplants on CPB over the study period. Median follow up time was 458 days (300-597). The average donor age was 32.3 ± 11.2 years and the average recipient age was 58.8 ± 13.8 years. The primary indication for transplantation was idiopathic pulmonary fibrosis (67.5%, n=27), and double lung transplantation was performed in 97.5% of recipients (n=39). 7.4% of organs were donated after cardiac death (n=2). Postoperatively, the average PaO₂/FiO₂ at 72 hours was 369.7 ± 121.4, with grade 3 PGD occurring in two patients (5.0%). The median length of mechanical ventilation was 3.63 (IQR 1-2.5) days and the median ICU stay was 13.8 (IQR 5-12) days. The average packed red blood cell transfusion requirement was 221.5 (IQR 0-424.5) mL. Freedom from non-elective re-operation was 82.5% (n=33). Freedom from AKI was 72.5% (n=29) with only two patients requiring hemodialysis (5%) Mortality was 0% at 90-days, and one-year survival was 87.5%.

CONCLUSIONS

Lung transplantation can be safely performed with elective cardiopulmonary bypass support. Excellent short-term survival, minimal rates of primary graft dysfunction, and low rates of peri-operative complications can be achieved with this method of transplantation.

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Table 1. Donor and recipient populations for lung transplants performed on cardiopulmonary bypass from 2020-2022

Donor Variables		N = 40
Age (y)		32.3 ± 11.2
Gender (male)		33 (82.5%)
Smoking (yes)		9 (22.5%)
Positive BAL		12 (30%)
Hepatitis C		2 (7.4%)
Last PF		453.1 ± 74.6
DCD (yes)		2 (7.4%)
Blood Type		
O		24 (60%)
A		12 (30%)
B		4 (10%)
Recipient Variables		
Age (y)		58.8 ± 13.8
Indication		
IPF		27 (67.5%)
COPD		4 (14%)
Bronchiectasis		1 (3.7%)
COVID 19		3 (7.5%)
Sarcoidosis		2 (5%)
CF		1 (3.7%)
Pulmonary HTN		1 (3.7%)
ARDS		1 (3.7%)
LAS		49.2 ± 20.3
Double lung		39 (97.5%)
Gender (male)		32 (80%)
BMI		24.7 ± 4.1
Preop ECLS		5 (12.5%)

Table 2. Intraoperative data and early post-transplant outcomes

Intraoperative Variables		
Incision (Sternotomy)		35 (87.5%)
Significant adhesions		12 (30%)
Bypass time (min)		154 ± 31.9
Ischemia time (min)		315.4 ± 121.5
Blood Transfusion		
pRBC (mL)		562.7 (93.7-727.5)
Platelets (mL)		197 (0-352)
FFP (mL)		135.7 (0-62.5)
Cryoprecipitate (mL)		87.1 (0-125)
Postoperative Variables		
pRBC up to 72h (mL)		221.5 (0-424.5)
P/F at 72 hours		369.7 ± 121.4
Length of MV (days)		3.63 (1-2.5)
ICU stay (days)		13.8 (5-12)
ECLS postoperative requirement		1 (2.5%)
AKI		11 (27.5%)
Dialysis requirement		2 (5%)
Reoperation (bleeding)		7 (17.5%)
90-d mortality		0 (0%)
1 year mortality		5 (12.5%)

Table 3. Variables for recipients requiring re-operation

Age (y)/gender	Diagnosis	CPB (min)	pRB (mL)	Pleural adhesion (s)	ECLS pre/post (t)	P/F 72h	Length of MV (h)	ICU (d)	Notes
57/F	Bronchiectasis	155	2107	Y	Y/N	668	1	5	Chest intentional left open
42/M	Sarcoidosis	250	925	Y	N/Y	ECMO	41	47	Chest intentional left open
71/M	ILD	214	300	N	N/N	366	12	99	
65/M	ILD	190	1100	N	N/N	420	3	51	
35/M	COVID19	190	2300	Y	Y/N	310	4	12	Chest intentional left open
60/M	ILD	142	1826	Y	N/N	330	18	78	Chest intentional left open
67/M	ILD	145	125	N	N/N	567	2	6	
65/F	COPD	136	0	N	N/N	382	1	13	Reoperation 11 days post-tpx for delayed bleed

Figure 1. Kaplan-Meier survival analysis after 12 months post-lung transplantation performed on elective cardiopulmonary bypass.

