Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

classified as alive (n=61) or deceased (n=30). The Kruskal-Wallis and Chi-squared tests were used for data analysis.

Results: Mortality from COVID-19 was high (n=30, 33%). There was no difference in baseline clinical characteristics between alive and deceased patients; age, medical co-morbidities, body mass index, and lung function were similar (Table 1). The vast majority of patients were hospitalized (n=79, 86%), not only for severe illness but also to receive remdesivir, an infusion available only to inpatients. Patients that died were more commonly hypoxemic and admitted to the ICU, more likely to require mechanical ventilation, and had a longer hospital stay. Of the 24 intubated patients, only 4 survived (16.7%); 2 patients were placed on ECMO and both died. Deceased patients had higher peak levels of D-dimer, ferritin, procalcitonin, and lactate dehydrogenase. The vast majority of patients received corticosteroids; deceased patients were more likely to be treated with remdesivir and tocilizumab. Extrapulmonary complications were more common in deceased patients: 33% developed renal failure requiring hemodialysis and 19.2% developed multi-organ system dysfunction. The median time to death was 1.1 (0.63, 3.70) months; 3 patients survived the acute illness but died several months later of complications from post-adult respiratory distress syndrome-fibrosis.

Conclusion: The COVID-19 pandemic has had catastrophic consequences for lung transplant recipients. We hope that high vaccination rates, reduction of immunosuppression in the early disease period, and more effective antiviral therapies can reduce mortality.

Table 1: Characteristics of alive and deceased lung transplant recipients with COVID-19.

Variable	Alive n=61	Deceased n=30	p-Value
Baseline Characteristics			
Age at diagnosis, years	64.3 (57.5, 71.6)	68.4 (61.2, 71.6)	0.549
Gender, male	39, 63.9	18, 60	0.715
Pre-illness BMI, kg/m^2	27.72 (24.4, 32.2)	27.3 (24.8, 32.5)	0.849
Time interval from LT to COVID-19, months	40 (19.93, 59.9)	31.9 (15.4, 51.2)	0.486
Pre-existing medical comorbidities			
Diabetes mellitus	31, 50.8	19, 63.3	0.259
Chronic kidney disease (eGFR<59 ml/min/1.73 m^2)	43, 70.5	23, 76.7	0.535
Maintenance immunosuppression			0.426
Spirometry (most recent test prior to COVID-19)			
FEV_1, % predicted	77 (64.5, 88.5)	73 (53.5, 92.5)	0.458
FVC, % predicted	76 (63.5, 89)	61.5 (59, 81)	0.197
COVID-19			
Hospitalized	49, 80.3	30, 100	**0.009**
Duration of hospitalization, days	5 (1.5, 7.5)	23 (13, 37)	**<0.001**
Hospitalization duration >30 days	3, 4.9	12, 40	**<0.001**
ICU admission	6, 9.8	25, 83.3	**<0.001**
Coinfections (sputum/BAL/blood)	6, 13.3	9, 33.3	**0.043**
Hypoxemia (new or increased use of oxygen)	23, 50	26, 96.3	**<0.001**
Mechanical ventilation	4, 6.6	20, 66.7	**<0.001**
ECMO rescue	0, 0	2, 9.1	0.062
Laboratory values			
Peak of D-dimer, ng/mL	538.5 (284.5, 866)	1074.5 (346, 2168)	**0.028**
Peak of C-reactive protein, mg/L	43.4 (16.8, 122.6)	120.9 (24, 183.6)	0.152
Peak of ferritin, ng/mL	623.5 (243.6, 1079.4)	1329.5 (422.1, 4042.4)	**0.009**
Peak of procalcitonin, ng/ml	0.1 (0.05, 0.43)	0.97 (0.35, 7.34)	**<0.001**
Peak of lactate dehydrogenase, units/L	379 (261, 487)	685 (587, 1009.5)	**<0.001**
Treatment			
Remdesivir	34, 63	28, 100	**<0.001**
Tocilizumab	1, 1.8	5, 18.5	**0.006**
Corticosteroids	39, 78	28, 100	**0.007**
Extrapulmonary complications			
Renal failure requiring dialysis	2, 3.3	10, 33.3	**<0.001**
Multi-organ dysfunction >2 organ systems	2, 3.4	5, 19.2	**0.016**

BMI, body mass index; ECMO, extracorporeal membrane oxygenation; FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity; ICU, intensive care unit; LT, lung transplantation

Purpose: The outcomes of lung transplant (LTx) for COVID-19 related lung disease are continuing to be examined. This study describes our experience in the first 7 cases.

Methods: This study included all patients received double LTx (DLTx) for COVID-19 acute respiratory distress syndrome (ARDS) between November 2020 and October 2021. Patient pre-LTx and perioperative characteristics as well as post-LTx outcomes are presented.

Results: Seven patients underwent DLTx for COVID-19 ARDS. All required mechanical ventilation (MV) pre-LTx. Six patients were male (85%), 5 Hispanic (71%), with a median age of 48 (IQR 40-53) and median body mass index of 23.6 (IQR 21.7-25.6). Six patients (85%) were on veno-venous extracorporeal membrane oxygenation (VV-ECMO) pre-LTx (one conversion from VV to veno-arterial (VA)). Median duration of MV and ECMO pre-LTx was 140 days (IQR 82-165) and 71.5 days (IQR 58-149), respectively. Two patients developed acute kidney injury pre-LTx requiring continuous renal replacement therapy (CRRT). Median time from listing to transplant was 17 days (IQR 10-24). ECMO was discontinued in all but 1 patient post-LTx. Median length of stay in the hospital post-LTx was 30 days (IQR 15-57). All were discharged from the hospital (43% to rehabilitation facility). Two patients on pre-LTx CRRT remained hemodialysis dependent and had multi-drug resistant (MDR) bacterial infections post-LTx. One readmission occurred for presumed rejection, aspiration and infection with MDR Klebsiella now requiring oxygen. All surgical pathology showed diffuse interstitial fibrosis consistent with the fibrotic sequelae of alveolar damage due to COVID-19. At 3-month follow-up, 6 patients (85%) did not need supplemental oxygen and had good pulmonary function.

Conclusion: Lung transplantation for COVID-ARDS is feasible. However, pre-transplant multi-system involvement may be associated with a protracted post-LTx stay and MDR infection. Further studies are needed to assess the long-term outcomes in this cohort.

Table

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7
Sex	Male	Male	Male	Male	Male	Male	Female
Age (years)	56	52	40	53	46	48	38
BMI	23.4	21.4	21.7	23.6	25.6	26.2	24.8
Pre-Tx MV duration (days)	169	85	140	165	154	80	82
Pre-Tx ECMO duration (days)	NA	72	149	58	152	71	33
Days on waitlist	77*	10	11	24	17	10	17
Post-Tx ICU LOS (days)	5	35	20	54	19	8	8
Post-Tx Total LOS (days)	13	57	45	124	30	19	15
Discharge	Home	Acute Rehab	Acute Rehab	Home	Acute Rehab	Home	Home
PostTx complications	None	#Reopeartion for bleeding POD 0 #ACR/AMR #Aspiration #H.parainfluenza and MDR K.pneumoniae bronchitis and pneumonia #ESRD on iHD**	Acute acalculous cholecystitis requiring cholecystectomy	#PGD3 requiring VA and then VV ECMO #Recurrent bleeding and shock #MDR PsA #ESRD on iHD**	#Delayed chest closure due to pulmonary edema	None	None
Post-Tx ECMO	No	No	No	Yes	No	No	No
3 months Post-Tx							
FEV1 L (%)	2.04 (73%)	1.42 (37%)	1.75 (41%)	NA	2.03 (56%)	2.00 (57%)	NA
FVC L (%)	2.29 (63%)	1.48 (30%)	2.09 (40%)	NA	2.68 (58%)	2.07 (46%)	NA
FEV1/FVC (%)	89.30%	95.96%	84.07%	NA	75.61%	96.86%	NA
Oxygen on exertion	Room Air	3LPM	Room air	Room air	Room air	Room air	Room air

BMI=Body Mass Index; MV=Mechanical Ventilation; Tx=Transplant; ICU=Intensive Care Unit; LOS=Length of Stay; ECMO=Extracorporeal Membrane Oxygenation; NA=Not Available; Rehab=Rehabilitation; POD=Post-Operative Day; ACR=Acute Cellular Rejection; AMR=Antibody Mediated Rejection; ESRD=End Stage Renal Disease; iHD=Intermittent Hemodialysis; LPM=liter per minute; PGD=Primary Graft Dysfunction; VA=Veno-Arterial; VV=Veno-Venous; MDR=Multi-Drug Resistance; PsA= Pseudomonas aeruginosa
*this patient was delisted for a while
**patient was on continuous replacement therapy (CRRT) pre-transplant

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Short-Term Outcomes of Lung Transplantation for COVID-19 ARDS: A Single Center Experience

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Gamma-Glutamyltransferase at the Time of Listing May Predict Irreversible Severe Cholangiopathy After Lung Transplantation for COVID19-ARDS

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