Open Access

OBM Transplantation

LIDSEN Publishing Inc.

Case Report

Lung Transplantation from A Donor with Previous SARS-CoV-2 Infection: 1-Year Outcomes

Ashwini Arjuna [1, †, *], Deepika Razia [1, †], Devika Sindu [1, †], Michael T. Olson [1, 2, †], Lara Schaheen [1], Ross M. Bremner [1], Rajat Walia [1], Kendra McAnally [1]

1. Norton Thoracic Institute, St. Joseph's Hospital and Medical Center, Phoenix, Arizona, USA; E-Mails: Ashwini.Arjuna@DignityHealth.org; dr.deepikarazia@gmail.com; devika.sindu@commonspirit.org; michael7olson@gmail.com; lara.schaheen@commonspirit.org; ross.bremner@dignityhealth.org; rajat.walia@dignityhealth.org; kendra.mcanally@commonspirit.org
2. University of Arizona College of Medicine – Phoenix, Phoenix, Arizona, USA

† These authors contributed equally to this study.

* **Correspondence:** Ashwini Arjuna; E-Mail: Ashwini.Arjuna@DignityHealth.org

Academic Editor: Shambhu Aryal

Special Issue: Advances in Lung Transplant

OBM Transplantation
2023, volume 7, issue 1
doi:10.21926/obm.transplant.2301173

Received: October 25, 2022
Accepted: January 03, 2023
Published: January 06, 2023

Abstract

Few reports have described successful lung transplantation from a donor with a history of SARS-CoV-2 infection, and outcomes beyond 3 to 6 months remain unknown. After weighing the urgency and life-saving benefits of lung transplantation against the risk of viral transmission, we successfully performed a bilateral lung transplant from a donor with confirmed SARS-CoV-2 infection with mild symptoms 2 months before donation. At 1 year after transplant, there is no evidence of donor-derived viral transmission, and allograft function is excellent and stable, with FVC of 3.66 L (77% predicted) and FEV_1 of 3.08 L (85% predicted). With careful selection, lung transplantation from a donor with a history of mild SARS-CoV-2 infection was performed safely, with good allograft survival.

Keywords
SARS-CoV-2; COVID-19; lung transplantation

1. Introduction

It has been over 2 years since the emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and its resulting respiratory illness, coronavirus disease 2019 (COVID-19). As of October 2022, over 600 million cases of COVID-19 have been confirmed globally by the World Health Organization [1]. The impact of the ongoing pandemic on organ transplantation has been profound, affecting the management of organ donors, potential candidates, transplant recipients, and clinical teams around the world. Despite an increasing volume of research on COVID-19, questions surrounding its effect on lung transplantation (LTx) remain, including how to balance the risk of donor-derived viral transmission with a limited donor pool, particularly one with an increasing proportion of potential organ donors previously infected with COVID-19. Because the respiratory tract is the primary reservoir for SARS-CoV-2, lung donation from a previously infected donor carries a unique concern. A previous report unfortunately confirmed viral transmission from lung donor to recipient [2]. Although the consensus remains that a history of SARS-CoV-2 infection should not preclude lung donation, it is unclear if the prior infection will affect the quality of the lung allograft and outcomes after transplantation. Successful bilateral LTx from donors previously infected with SARS-CoV-2 has been reported [3, 4], but outcomes beyond 3 to 6 months are unknown. Herein, we report stable allograft function 1 year after bilateral LTx from a donor who recovered from COVID-19 with mild symptoms. To our knowledge, this case reports the longest post-LTx outcomes from a donor with previous SARS-CoV-2 infection in the United States.

2. Case Description

2.1 Recipient

A 63-year-old man with end-stage pulmonary fibrosis, without additional significant medical history, completed LTx evaluation at our center and was listed for bilateral LTx on August 6, 2020, with a lung allocation score of 65.1. Thirteen days after being activated on the list, the patient received a donor offer, with details below. Preoperatively, the recipient tested negative for SARS-CoV-2 by RT-PCR of a nasopharyngeal swab sample, and he denied any recent symptoms or exposure history.

2.2 Donor

The 28-year-old donor was declared brain dead after being injured in a motor vehicle accident. The donor had no significant past medical or smoking history. The family reported that 2 months prior, the donor had a SARS-CoV-2 infection confirmed by RT-PCR of a nasopharyngeal swab sample performed at a local urgent care center. The donor was reported to have been mildly symptomatic with ‘a few days’ of fever, gastrointestinal upset, and a non-productive cough lasting 2 weeks. Detailed retrospective assessment of disease severity was limited, but the disease course was

seemingly mild given a reported lack of dyspnea. The donor family denied any known exposures within 14 days before donation.

As a part of the SARS-CoV-2 donor screening protocol utilized by the organ procurement organization, multiple upper and lower respiratory tract samples were collected from the donor. Two nasopharyngeal swab specimens were collected 24 hours apart, both with a negative RT-PCR result. A lower lobe bronchoalveolar lavage sample taken 48 hours before the lung donation offer was also negative for SARS-CoV-2. Bronchoscopy of the donor lungs did not reveal significant secretions or airway anomalies. A chest radiograph was negative for significant pulmonary infiltrates. Computed tomography of the chest revealed a lower lobe pulmonary embolus and bilateral pneumothoraces with chest tubes in place (Figure 1).

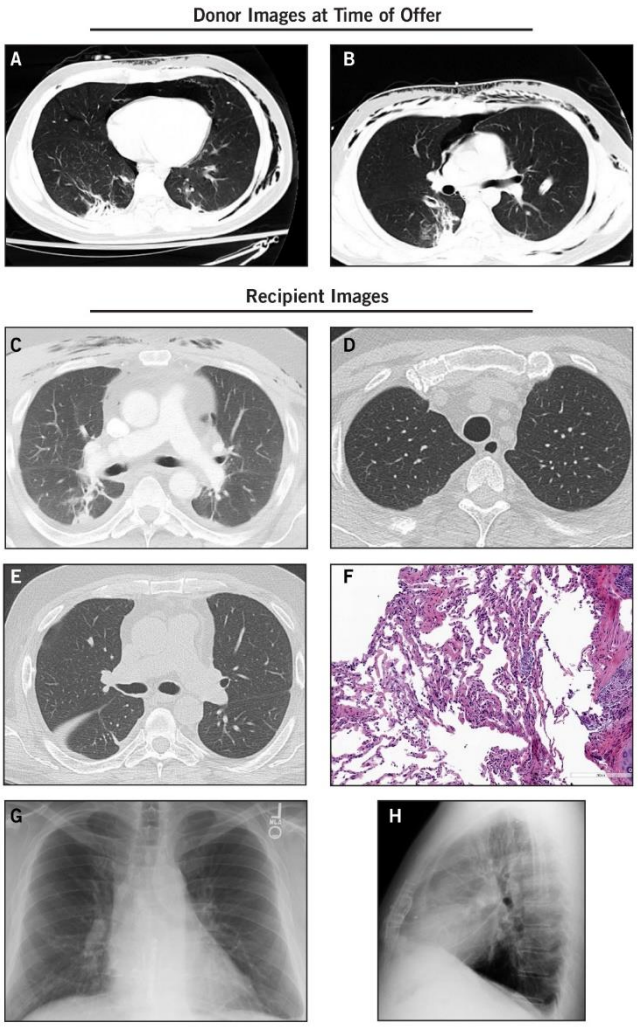

Figure 1 Chest imaging of lung donor (at time of offer) and lung recipient (posttransplant) and transbronchial biopsy. A) Chest computed tomography (CT) of lung window at time of the donor offer. B) Donor chest CT with right lower lobe changes. C) Chest CT of lung window of recipient 1 month after transplant. D) Chest CT of lung window of recipient 3 months after transplant. E) Chest CT of lung window of recipient 6 months after transplant. F) Transbronchial biopsy with no signs of acute rejection 1 year after transplant. G) Posteroanterior view chest X-ray 1 year after transplant. H) Lateral view chest X-ray 1 year after transplant.

An arterial blood gas test on standard challenge settings of FiO_2 of 1.0 and positive end-expiratory pressure of 5 cm H_2O demonstrated a PaO_2 of 417 mmHg (P/F ratio of 417). Based on these results, we considered the lungs acceptable for donation. Subsequently, the detection of SARS-CoV-2 IgG antibodies confirmed prior infection; serum SARS-CoV-2 IgM antibodies were not detected.

2.3 Decision

After extensive multidisciplinary discussions involving pulmonary medicine physicians, infectious disease experts, cardiothoracic surgeons, and transplant administrators, and per International Society for Heart and Lung Transplant criteria, the donor lungs were accepted for transplantation.

2.4 Transplant Course

Pretransplant recipient testing for COVID-19 via nasopharyngeal swab RT-PCR was negative. The donor lungs were deemed suitable for transplant during operative evaluation. The patient promptly underwent bilateral LTx without intraoperative complications. The early postoperative course was significant for grade 3 primary graft dysfunction and brief use of inhaled nitric oxide. The recipient was extubated on the second postoperative day on 2 liters of oxygen via nasal cannula. He was ambulating and transferred to telemetry on postoperative day 3. The retrospective cross-match analysis was negative. Induction therapy included basiliximab and methylprednisolone. He was started on our standard immunosuppressive protocol with tacrolimus, mycophenolate mofetil, and prednisone. He also received opportunistic infection prophylaxis with trimethoprim/sulfamethoxazole, itraconazole, valganciclovir, and inhaled amphotericin B, as per our center protocol. He experienced a relatively unremarkable postoperative course and was discharged to home on postoperative day 8.

2.5 Outcomes

A complete timeline of events, including SARS-CoV-2 testing, radiographic findings, pulmonary function testing, transbronchial biopsy results, and attempts to detect donor-specific antibodies with a mean fluorescence intensity threshold ≥2,000, is reported in Figure 2. Our patient has not required re-hospitalization since his initial discharge. He had 1 episode of known exposure to COVID-19 from an actively infected and symptomatic family member in December 2020; he did not develop symptoms, and 3 consecutive RT-PCR results were negative. He has completed a 2-shot COVID-19 vaccination series with booster immunization, without side effects. At 12 months after transplant, allograft function is excellent and stable, with FVC of 3.66 L (77% predicted) and FEV_1 of 3.08 L (85% predicted).

Donor Covid-19
Symptoms (2 months prior):

- Fever
- Cough (mild)
- GI symptoms

SARS-CoV-2
confirmed at urgent care

Donor Offer Timeline:

- SARS-CoV-2 PCR (–) 2 nasopharyngeal swabs
- BAL SARS-CoV-2 PCR (–)
- Arterial blood gas pH=7.48
- PaO_2 =417 mmHg (FiO_2=1, PEEP=5 cm H_2O)
- CT chest: Left lower lobe pulmonary embolus

Recipient:	Day 0	Day 14	Day 30	Day 90	Day 180	Day 270	Day 360
SARS-CoV-2 nasopharygeal PCR	(–)	(–)	(–)	(–)	(–)	(–)	(–)
SARS-CoV-2 BAL PCR	(–)	(–)	(–)	(–)	(–)	(–)	(–)
SARS-CoV-2 Ig antibodies	(–)	(–)	(–)	(–)	(–)	(–)	(–)
Imaging	Chest X-ray: consistent with PGD-3	CT scan: tiny bilateral pneumo-thoraces/ small plueral effusions	CT scan: moderate plueral effusion/ normal lung parenchyma	CT scan: small bilateral effusions/ normal lung parenchyma	Chest X-ray: expected post-op bilateral-LTx changes	Chest X-ray: expected post-op changes/ trace pleural effusions	Chest X-ray: expected post-op changes/ trace pleural effusions
PFTs FEV_1(% predicted) FVC (% predicted)	 N/A N/A	 2.37 (65) 2.73 (57)	 2.64 (72) 3.08 (64)	 3.10 (86) 3.67 (77)	 3.43 (89) 4.12 (80)	 3.07 (85) 3.57 (75)	 3.08 (85) 3.66 (77)
Transbronchial biopsy (grade)	N/A	N/A	No acute cellular rejection (A0B0)	No acute cellular rejection (A0B0)	No acute cellular rejection (A0B0)	No acute cellular rejection (A0B0)	No acute cellular rejection (A0B0)
Donor-specific antibodies (DSA)	(–)	(–)	(–)	(–)	(–)	(–)	(–)

Figure 2 Lung donor and lung recipient timeline, with posttransplant outcomes through 1 year.

3. Discussion

The COVID-19 pandemic has significantly exacerbated the shortage of donor organs. A descriptive study seeking to analyze the effects of the pandemic on LTx highlighted a 10% decrease in LTx volume in the United States, along with a significant reduction in donor availability, particularly in areas with moderate and high COVID-19 prevalence rates [5]. Thus, it is pertinent to ascertain whether those with a history of COVID-19 can be considered potential lung donors.

A few reports of adverse outcomes from donor-derived infections have prompted most regulatory agencies to issue guidelines to decline or defer organ donation from donors with a confirmed, recent SARS-CoV-2 infection [6]. Another study reported 2 possible lung donations that were not accepted based on donor PCR cycle thresholds of 44 and 39.8 and suspicious radiographic findings, suggesting that viral load assessment could play a role in donor selection for LTx [7].

Recommendations have been evolving as new evidence comes forth. The International Society of Heart and Lung Transplantation has outlined selection criteria for donor organs in the setting of previous SARS-CoV-2 infection or exposure. The document specifies that given a lack of effective, evidence-based treatment for COVID-19, the best practice is to avoid lung transplantation from a PCR-positive donor, particularly due to the potential for deleterious consequences of donor-to-recipient viral transmission. Their guidelines, revised in August 2020, emphasize that the donor should be more than 28 days from symptom onset and outline the requirements to ensure clinical, virologic, and radiographic resolution of prior SARS-CoV-2 infection before the donor organ is

considered for transplant [8]. Effective May 2021, the Organ Procurement and Transplantation Network has also implemented a policy requiring negative SARS-CoV-2 nucleic acid test results of lower respiratory specimens (sputum, tracheal aspirate, bronchial suction, bronchial wash, bronchoalveolar lavage (BAL), or lung biopsy) before LTx [9].

Studies suggest that a notable majority of those with prior infections recover without long-term systemic effects, and solid organ transplants have been cautiously performed from donors with prior mild SARS-CoV-2 infection [10]. One center conducted 12 heart transplants and 2 bilateral lung transplants from 14 donors positive for SARS-CoV-2 by nasopharyngeal swab PCR [11]. Only donors with asymptomatic or past mild COVID-19 without hypercoagulable or hyperinflammatory states were considered. Of note, they had ensured that the donor's lower respiratory tract specimens (2 consecutive BALs) were negative for SARS-CoV-2 prior to the 2 lung transplants. The authors concluded that heart transplants might be safe, but suggested exercising increased caution in LTx in view of SARS-CoV-2 transmission via respiratory secretions. However, the risk of long-term effects from COVID-19 on lung function remains pertinent [12]. Therefore, evidence addressing long-term allograft function after LTx from donors with prior mild COVID-19 is of great significance. Our case report describes LTx carried out per current recommendations and policies, and moreover illustrates good lung allograft function 1 year after bilateral LTx.

In the setting of an ongoing pandemic due to a virus that predominantly affects the lungs, a growing number of organ donors are bound to have a history of SARS-CoV-2 exposure or infection, either symptomatic or asymptomatic, potentially exacerbating the critical shortage of donor organs. The safety and feasibility of transplant of non-lung organs have been documented. Now, our community needs further documentation of long-term lung allograft outcomes after LTx from donors with previous mild SARS-CoV-2 infection, as shown by our case report, to better inform our decisions regarding this practice in LTx. It is therefore imperative to report these long-term posttransplant outcomes to contribute to the growing body of evidence that can help expand the donor pool and optimize donor selection in the COVID-19 era.

4. Conclusion

SARS-CoV-2 testing for our lung donor was performed in accordance with the evidence for best practices when protocols and consensus statements were not yet summarized by the United Network for Organ Sharing or the Organ Procurement and Transplantation Network. Here we report the longest posttransplant outcomes after bilateral LTx from a donor with a history of mild SARS-CoV-2 infection (confirmed with serological testing). This report demonstrates stable allograft function at 1 year after transplant, without significant levels of donor-specific antibodies or acute cellular rejection episodes.

Although a single case cannot definitively answer the complex questions regarding allograft survival in recipients of lungs from previously infected donors, this case adds to the mounting evidence of safety and feasibility. Collectively, our goal should be to strengthen our community's understanding of the impact of prior SARS-CoV-2 infection in lung donors on LTx recipients, as it remains impractical to completely exclude such donors given the vast, global COVID-19 burden and ongoing supply-demand mismatch.

Acknowledgments

The authors thank Kristine Nally for editorial assistance.

Author Contributions

Ashwini Arjuna, Michael T. Olson, Devika Sindu, Deepika Razia, and Kendra McAnally contributed to data collection, drafting and writing. Ashwini Arjuna, Lara Schaheen, Ross M. Bremner, and Rajat Walia participated in critical review and editing.

Funding

This research did not receive any specific grants from funding agencies in public, commercial, or non-profit sectors.

Competing Interests

None of the authors have conflicts of interest or financial ties to disclose.

References

1. World Health Organization. WHO Coronavirus (COVID-19) dashboard [Internet]. 2022. Available from: https://covid19.who.int.
2. Kaul DR, Valesano AL, Petrie JG, Sagana R, Lyu D, Lin J, et al. Donor to recipient transmission of SARS-CoV-2 by lung transplantation despite negative donor upper respiratory tract testing. Am J Transplant. 2021; 21: 2885-2889.
3. Ceulemans LJ, Van Slambrouck J, De Leyn P, Decaluwé H, Van Veer H, Depypere L, et al. Successful double-lung transplantation from a donor previously infected with SARS-CoV-2. Lancet Respir Med. 2021; 9: 315-318.
4. Querrey M, Kurihara C, Manerikar A, Garza-Castillon R, Lysne J, Tomic R, et al. Lung donation following SARS-CoV-2 infection. Am J Transplant. 2021; 21: 4073-4078.
5. Benvenuto L, Snyder ME, Aversa M, Patel S, Costa J, Shah L, et al. Geographic differences in lung transplant volume and donor availability during the COVID-19 pandemic. Transplantation. 2021; 105: 861-866.
6. Kates OS, Fisher CE, Rakita RM, Reyes JD, Limaye AP. Use of SARS-CoV-2-infected deceased organ donors: Should we always "just say no?". Am J Transplant. 2020; 20: 1787-1794.
7. Novysedlak R, Vachtenheim Jr J, Striz I, Viklicky O, Lischke R, Strizova Z. SARS-CoV-2 viral load assessment in lung transplantation. Physiol Res. 2021; 70: S253-S258.
8. International Society of Heart and Lung Tranplantation. Guidance from the International Society Of Heart And Lung Transplantation regarding the SARS CoV-2 pandemic [Internet]. Available from: https://ishlt.org/ishlt/media/documents/SARS-CoV-2_Guidance-for-Cardiothoracic-Transplant-and-VAD-center.pdf.
9. Organ Procurement and Transplantation Network. Lower respiratory SARS-CoV-2 testing for lung donors [Internet]. Available from: https://optn.transplant.hrsa.gov/media/4576/policy_notice_lunglowerrespiratorytesting_20210426.pdf.

10. Neidlinger NA, Smith JA, D'Alessandro AM, Roe D, Taber TE, Pereira MR, et al. Organ recovery from deceased donors with prior COVID-19: A case series. Transpl Infect Dis. 2021; 23: e13503.
11. Eichenberger EM, Coniglio AC, Milano C, Schroder J, Bryner BS, Spencer PJ, et al. Transplanting thoracic COVID-19 positive donors: An institutional protocol and report of the first 14 cases. J Heart Lung Transplant. 2022; 41: 1376-1381.
12. Spagnolo P, Balestro E, Aliberti S, Cocconcelli E, Biondini D, Della Casa G, et al. Pulmonary fibrosis secondary to COVID-19: A call to arms? Lancet Respir Med. 2020; 8: 750-752.