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#### Case Report: Cold Atmospheric Plasma as a Treatment Option for Superficial Wound Healing Disorders after Heart Transplantation

*J. Konertz, A. Bernhardt, B. Sill, H. Reichenspurner and M. Barten. Department of Cardiothoracic Surgery, UHZ, Hamburg, Germany.*

**Introduction:** Superficial wound healing disorders (SWD) after heart transplantation (HTx) remain challenging due to continuous immunosuppression. Cold atmospheric plasma (CAP) is a partially ionized plasma, which has shown to have a beneficial effect on skin regeneration and microbial inactivation. The aim of this case report is to demonstrate an example of successful use of CAP as a supportive treatment for SWD after HTx.

**Case Report:** We present our single-center experience of two female patients (18 and 39 years) with SWD three and eight weeks after HTx. Both patients were transplanted due to dilative cardiomyopathy and immunosuppression consisted of a combination of tacrolimus, mycophenolate mofetil and steroids for both patients. HTx was performed according to institutional guidelines and the early postoperative course was uneventful. Starting on the day of SWD diagnosis, CAP was performed as a standard therapy scheme of 5 minutes per treatment twice weekly for a total of three weeks. Both patients were schooled for adequate wound management including daily change of wound dressings. Both SWD presented as a superficial apical dehiscence of the midline incision and wound swabs showed no growth throughout the treatment. After three weeks of CAP treatment, the wounds were completely epithelialized and showed no more signs of infection without need for additional local or systemic antibiotic or surgical treatment. There were no adverse side effects of CAP therapy observed and the therapy was tolerated well by both patients.

**Summary:** CAP showed to be a safe and feasible treatment option for superficial SWD despite immunosuppressive therapy with no need for further surgery, anti-infective therapy or reduction of immunosuppression. Due to convincing results, CAP could be a safe treatment option for SWD after HTx and should be investigated further.

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#### Penetrating Giant Pseudoaneurysm of the Left Ventricle Complicating a Combined Heart-Liver Transplant

*M. Dela Cruz, and J. Grinstein. Cardiology, University of Chicago, Chicago, IL.*

**Introduction:** Left ventricular pseudoaneurysms (LV PsA) pose significant mortality risk and a paucity of data to guide management. We present a case of a giant LV PsA and its unique challenges to advanced options evaluation.

**Case Report:** A 58-year-old man with a history of heart failure (HF) with reduced ejection fraction, ischemic cardiomyopathy, 3-vessel coronary artery bypass grafting, inferior LV aneurysm repair with a Dacron patch, and hepatic cirrhosis presented for advanced options evaluation given worsening HF symptoms. His course was complicated by 3 prior sternotomies for 1) a mitral valve (MV) repair; 2) a MV and tricuspid valve replacement (TVR) with a Dor-type reconstruction and bovine patch repair of a persistent LV aneurysm, 14 years prior; and 3) a mediastinal abscess exploration with redo TVR/aneurysm repair, 6 years prior. Transthoracic echocardiography showed severely reduced LV performance and a large 1.7-cm defect in the basal-mid inferior wall with to and fro flow concerning for a very large PsA (Fig. A). Computed tomographic angiography of the heart confirmed a gigantic PsA herniating through the diaphragm (Fig. B). Right heart catheterization showed elevated biventricular pressures with low cardiac output. Due to the severity of the LV PsA, the patient was deemed not to be a candidate for implantation of a durable left-ventricular assist device and was listed for dual heart-liver transplant. During the surgery, the LV PsA was noted to have invaded through the diaphragm and into the inferior vena cava and left pleural space from which it was carefully resected and the diaphragm closed (Fig. C). The patient tolerated the procedure and continues to do well 3 months after transplantation.

**Summary:** Giant LV PsA is a rare but serious complication of ischemic disease and prior cardiac surgeries that can drastically alter the advanced management of end-stage HF. Careful evaluation with multi-modality imaging is essential to procedural success.

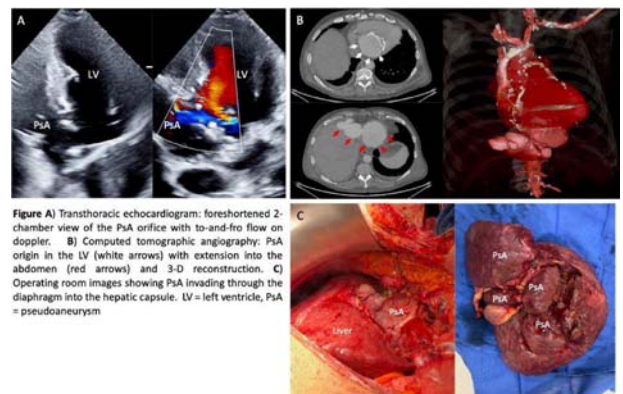


Figure A) Transthoracic echocardiogram: foreshortened 2-chamber view of the PsA orifice with to-and-fro flow on doppler. B) Computed tomographic angiography: PsA origin in the LV (white arrows) with extension into the abdomen (red arrows) and 3-D reconstruction. C) Operating room images showing PsA invading through the diaphragm into the hepatic capsule. LV = left ventricle, PsA = pseudoaneurysm

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#### First Successful Lung Transplantation for Pulmonary Fibrosis Due to Severe COVID-19 Infection in the US

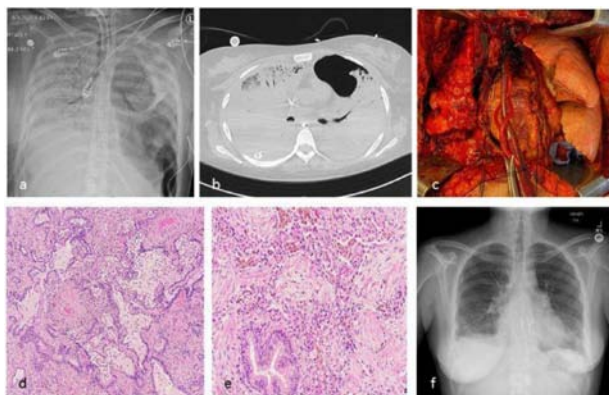
*C. Kurihara, and A. Bharat. Northwestern University Feinberg School of Medicine, Chicago, IL.*

**Introduction:** Lung transplantation can potentially be a life-saving treatment for patients with non-resolving COVID-19 acute respiratory distress syndrome. Concerns limiting transplant include recurrence of SARS-CoV-

2 infection in the allograft, technical challenges imposed by viral-mediated injury to the native lung. Here, we report the first successful lung transplantation in a patient with non-resolving COVID-19 associated acute respiratory distress syndrome in the United States.

**Case Report:** The recipient was a 28-year old female with past medical history of neuromyelitis optica treated with mycophenolate and rituximab who developed COVID pneumonia leading acute respiratory distress syndrome. The patient was intubated for 8 days with prone prior to initiation of VV ECMO. Her ECMO course was complicated by right sided pneumothorax requiring multiple pleural tubes and the development of *Serratia marcescens* pneumonia with left lower lung necrosis, and a liver capsular bleed necessitating emergent exploratory laparotomy. (Figure1a, b) She received antibiotics, remdesivir, hydroxychloroquine, tocilizumab, and convalescent plasma. However there was no signs of recovery and she was listed for lung transplantation after ECMO support for 32 days. Implantation was supported with central VA ECMO, and there was severe dense vascular adhesions bilaterally with severe distortion of hilar. (Figure1c) Explanted Lungs damaged by COVID-19 were free of virus but pathology showed extensive evidence of acute interstitial inflammation with fibrosis which consistency with end-stage pulmonary fibrosis. (Figure1d, e) The patient was decannulated from VV ECMO on POD 17, and was discharged on POD 27. (Figure1f) Four months after transplantation, she is at home with oxygen saturations above 98% on room air.

**Summary:** Our experience suggest that lung transplant is the only option for survival for some patients with severe COVID-19 develop fibrotic lung.



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#### Bilateral Lung Transplantation for End-Stage Respiratory Failure from COVID-19 Pneumonia

*N. Maniar,<sup>1</sup> J. Coster,<sup>2</sup> G. Li,<sup>1</sup> J. Segraves,<sup>1</sup> M. Hemmersbach-Miller,<sup>3</sup> A. Shafiq,<sup>2</sup> K. Liao,<sup>2</sup> A. Matar,<sup>2</sup> G. Loo,<sup>2</sup> and P. Garcha.<sup>1</sup>* <sup>1</sup>Internal Medicine - Pulmonary, Critical Care and Sleep Medicine, Baylor College of Medicine, Houston, TX; <sup>2</sup>Surgery - Cardiothoracic Transplant and Circulatory Support, Baylor College of Medicine, Houston, TX; and the <sup>3</sup>Internal Medicine - Infectious Diseases, Baylor College of Medicine, Houston, TX.

**Introduction:** The SARS-CoV-2 virus is causing severe end-stage fibrosis and respiratory failure in otherwise healthy individuals. Lung transplant (LTX) has been performed internationally in select patients for this indication, but there is limited evidence on its role in COVID-19. We describe a patient who received a bilateral LTX 12 weeks after an initial diagnosis of COVID-19 pneumonia.

**Case Report:** A 51-year-old male with hypertension and presented to an outlying hospital with dyspnea, fever and exposure to SARS-CoV-2. He was hypoxic and a diagnosis of COVID-19 pneumonia was made by nasopharyngeal swab. He was treated with dexamethasone,

remdesivir, and convalescent plasma, mechanical ventilation and eventually femoral VV-ECMO cannulation to maintain oxygenation. He was extubated and was transitioned to a left subclavian dual-limb 30 Fr VV-ECMO cannula for improved rehabilitation. He was then transferred to our center for LTX consideration given refractory ARDS. Evaluation for LTX revealed pulmonary hypertension, negative SARS-CoV-2 PCR and deconditioning but no absolute contraindications. He participated in intensive rehabilitation and progressed to assisted steps despite severe deconditioning and hypoxia. He was listed for a bilateral lung transplant with a lung allocation score of 90 and received a donor offer 7 days after listing and after 82 days on ECMO. He underwent bilateral LTX via clamshell exposure with central VA ECMO support. Intraoperatively, the lungs were densely consolidated with severe hilar adenopathy without peripheral adhesions. Post-operatively, he was transitioned back to his original VV ECMO circuit and then decannulated on post-op day 3. Standard induction with basiliximab and immunosuppression with IV methylprednisolone, mycophenolate and tacrolimus was administered. He had a transient elevation of liver enzymes on post-operative day 1 and an early planned tracheostomy was performed due to deconditioning. He has since, been progressing well on oxygen via tracheostomy collar and is able to speak with a one-way valve and participate in rehabilitation.

**Summary:** For patients with irreversible end-stage lung disease after COVID-19 pneumonia, LTX is a viable option. Timely transfer to a lung transplant center and intensive rehabilitation are essential. Standard established immunosuppression and post-transplant protocols should be followed.

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#### Lung Transplantation in COVID 19 ARDS - Short Term Outcomes

*E. Gok, M. Patel, B.P. Stojkovic, J. Patel, K. Dinh, R. Hussein, B. Akkanti, I. Gregoric and S.S. Jyothula. Advanced Cardiopulmonary Therapies and Transplantation, University of Texas Memorial Hermann Heart and Vascular Institute, Houston, TX.*

**Introduction:** COVID-19 associated severe acute respiratory syndrome rapidly progress to irreversible lung injury, multiple organ failure and death. Lung transplantation is considered as the rescue therapy for these patients. Herein, we reported a case series of two successful life-saving bilateral lung transplantations for COVID-19-associated respiratory failure.

**Case Report:** Case 1: A 69-year-old male was admitted for hypoxia and altered mental status. He was diagnosed with COVID-19 pneumonia by abnormal CT findings and positive PCR result. After receiving a course of dexamethasone, convalescent plasma, remdesivir and broad-spectrum antibiotics, he remained to be profoundly hypoxic, requiring non-invasive ventilation. Following two negative PCR results, he underwent bilateral lung transplantation on day 57. He was discharged to rehab unit on postoperative day 26. No desaturation was observed with the 6-min walk test on 30-day follow-up.

Case 2: A 63-year-old male was presented with cough, and dyspnea. He was hemodynamically stable, SpO<sub>2</sub> was 94%, chest x-ray was normal and tested positive for COVID-19. He was discharged home with dexamethasone and bronchodilators. However, he presented back on day 6 with worsening dyspnea. He was admitted and received a course of dexamethasone, remdesivir, convalescent plasma and broad-spectrum antibiotics. Due to persistent hypoxic respiratory failure, the patient underwent bilateral orthotopic lung transplantation on day 68. His postoperative course was complicated by primary graft dysfunction stage 3 and required open tracheostomy. His condition gradually improved and decannulated. He is currently on room air and able to walk 30 ft using a roller walker.

**Summary:** SARS-CoV-2 recovery is characterized by post inflammatory fibrosis and multi organ dysfunction. Lung transplantation can be successfully performed in patients with final stage respiratory failure of COVID-19 related pulmonary fibrosis.