# Ambulatory Status Improves Outcomes in Patients Bridged to Lung Transplantation with ECMO

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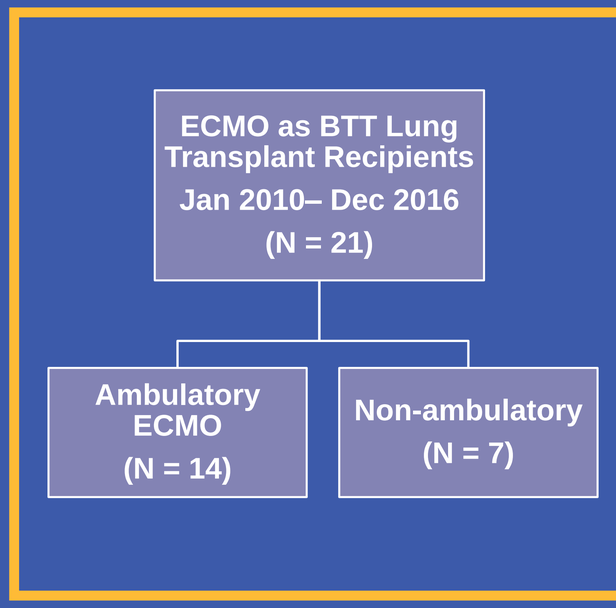
## Background

- Patients with respiratory failure refractory to conventional therapy may undergo extracorporeal membrane oxygenation (ECMO) as a bridge to lung transplantation (BTT).
- However, these patients may have significantly increased post-transplant morbidity with the associated deconditioning from critical illness.
- The purpose of this study was to assess the impact of ambulatory status on patients bridged to transplantation with ECMO.

## Methods

- Retrospective analysis of UCLA's lung transplant database was performed between Jan 2010 and Dec 2016.
- Medical and physical therapy records of all patients who received ECMO as a BTT were reviewed and ambulatory status was queried.
- Differences between groups were assessed via chi-squared and Kruskal-Wallis tests.
- Survival analysis was performed via Kaplan-Meier method, with censoring at 5-year.

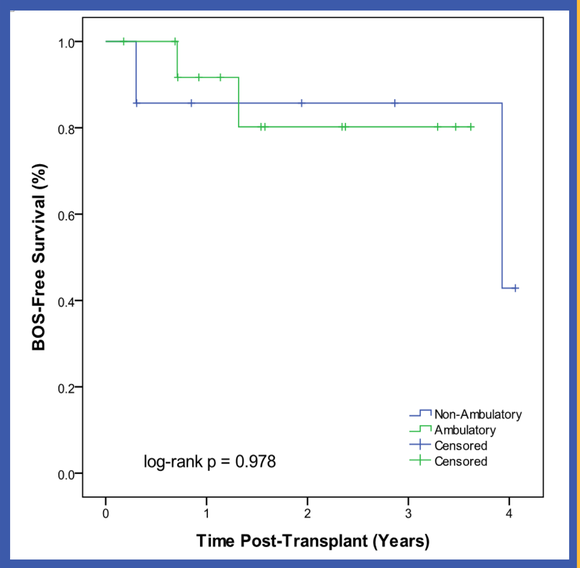



## Results

| Variables | Ambulatory ECMO (N=14) | Non-ambulatory (N=7) | p-value |
|---|---|---|---|
| **Recipient Age (years)** | 48.3 ± 13.6 | 40.3 ± 17.9 | 0.313 |
| **Body Mass Index (kg/m$^2$)** | 23.3 ± 5.2 | 20.2 ± 4.4 | 0.233 |
| **Male Gender** | 50% | 57.1% | 0.562 |
| **Diagnosis Category** | | | 0.127 |
| **A – Obstructive** | 0% | 0% | |
| **B – PPH** | 7.1% | 0% | |
| **C – Cystic Fibrosis** | 7.1% | 42.9% | |
| **D – Restrictive** | 85.8% | 57.1% | |
| **Lung Allocation Score** | 87.2 ± 7.4 | 82.6 ± 14.9 | 0.550 |
| **Wait Time (days)** | 54.3 ± 108 | 54.7 ± 98 | 0.794 |
| **ECMO Duration (days)** | 13.4 ± 9.8 | 14.6 ± 10.0 | 0.794 |
| **Preoperative Comorbidities** | | | |
| **Diabetes Mellitus** | 14.3% | 28.6% | 0.574 |
| **Hyperlipidemia** | 14.3% | 0% | 0.533 |
| **GERD** | 14.3% | 71.4% | 0.017 |
| **Cytomegalovirus Positive** | 64.3% | 57.1% | 0.751 |
| **Immunosuppression** | 57.1% | 42.9% | 0.659 |
| **Preoperative Pulmonary Status** | | | |
| **$FEV_1$ (%)** | 48.9 ± 12.5 | 36.8 ± 18.9 | 0.206 |
| **FVC (%)** | 49.5 ± 9.9 | 41.0 ± 12.3 | 0.133 |
| **DLCO (%)** | 47 ± 17.1 | 31.2 ± 12.2 | 0.079 |
| **Preoperative Heart Catherization** | | | |
| **Systolic PAP (mmHg)** | 60.1 ± 30.1 | 35.2 ± 13.2 | 0.165 |
| **Diastolic PAP (mmHg)** | 27.4 ± 13.5 | 14.5 ± 8.2 | 0.087 |
| **PCWP (mmHg)** | 13.8 ± 6.2 | 5.5 ± 2.4 | 0.016 |
| **Donor Age (years)** | 39.5 ± 13.3 | 28.0 ± 15.0 | 0.097 |
| **Donor Body Mass Index (kg/m$^2$)** | 35.6 ± 7.4 | 22.1 ± 4.3 | 0.064 |
| **Intraoperative Characteristics** | | | |
| **Ischemia Time (min)** | 304 ± 77 | 258 ± 64 | 0.179 |
| **CPB Time (min)** | 179 ± 36 | 169 ± 26 | 0.653 |

Values presented as mean ± standard deviation or percent of population.

CPB = cardiopulmonary bypass; ECMO = extracorporeal membrane oxygenation; $FEV_1$ = forced expiratory volume in one second; FVC = forced vital capacity; GERD = gastroesophageal reflux disease; PAP = pulmonary artery pressure; PCWP = pulmonary capillary wedge pressure; PPH = primary pulmonary hypertension.




BOS-Free Survival by Ambulatory ECMO Use

| Variables | Ambulatory ECMO (N=14) | Non-ambulatory (N=7) | p-value |
|---|---|---|---|
| **PGD @ 0-Hr** | | | 0.682 |
| **0/1** | 78.5% | 85.7% | |
| **2** | 14.3% | 0% | |
| **3** | 7.2% | 14.3% | |
| **PGD @ 24-Hr** | | | 0.299 |
| **0/1** | 76.9% | 85.7% | |
| **2** | 23.1% | 0% | |
| **3** | 0% | 14.3% | |
| **PGD @ 48-Hr** | | | 0.368 |
| **0/1** | 85.7% | 85.7% | |
| **2** | 14.3% | 0% | |
| **3** | 0% | 14.3% | |
| **PGD @ 72-Hr** | | | 0.368 |
| **0/1** | 85.7% | 85.7% | |
| **2** | 14.3% | 0% | |
| **3** | 0% | 14.3% | |
| **Tracheostomy** | 21.4% | 14.3% | 0.694 |
| **Vent Time (days)** | 3 (2-5) | 5 (1-7) | 0.762 |
| **ICU LOS (days)** | 8 (6-15) | 13 (9-30) | 0.135 |
| **Hospital LOS (days)** | 17 (15-28) | 24 (18-44) | 0.155 |

ICU = intensive care unit; LOS = length of stay; PGD = primary graft dysfunction.

## Discussion

- In selected patients, ECMO support as a bridge to transplant may be successfully utilized with excellent short- and intermediate-term results.
- Ambulatory status is associated with trends towards decreased intensive care unit and hospital length of stay despite similar preoperative comorbidities.
- The ideal cannulation strategy for candidates for transplant with respiratory failure remains unknown.
- ECMO strategies to allow for ambulation may allow for continued physical therapy and conditioning while awaiting available donor organs, and may lead to improved outcomes.

**Limitations**:

- Retrospective, single-center design without external validation.
- Small number of ECMO BTT patients limits statistical power of analyses.
- Unable to assess for differences between venoarterial and venovenous ECMO given low power.

## Conclusions

Lung transplantation can be safely performed utilizing ECMO as a bridge to lung transplantation with acceptable outcomes. ECMO strategies that allow for ambulation should be utilized in order to allow for continued work with physical therapy and improved post-transplant outcomes.

Further studies are warranted to identify optimal measures of patient conditioning prior to transplant.

## Disclosures

No authors for this presentation have relevant financial interests to disclose.