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### mHealth to Improve Emergent Frailty after Lung Transplantation

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**Purpose:** Post-transplant frailty is a risk factor for poorer health-related quality of life, rehospitalization, and death. We aimed to evaluate the feasibility, safety, and efficacy of a remote mHealth-supported physical activity pilot intervention to treat frailty in lung transplant recipients following discharge from their index hospitalization.

**Methods:** We screened lung transplant recipients for frailty at the time of discharge at the University of Pennsylvania and UC San Francisco. Frailty was defined as a Short Physical Performance Battery (SPPB) score ≤7 and pre-frail as 8-9 (range 0-12, higher scores reflect less frailty). The primary intervention modality was Aidcube, a customizable app-based platform for home-based pulmonary rehabilitation providing personalized exercise prescriptions, for 8 weeks post-discharge. The primary aims included tolerability, feasibility, and acceptability of use of the mHealth platform. Additional outcome measures were changes in SPPB score and in scores of physical activity and disability measured using the DASI and LT-VLA.

**Results:** No adverse events were reported across the 18 study subjects throughout the 152 subject-week study time. Several themes emerged from weekly subject feedback. Subjects reported that the app was easy to use and that usability improved over time. Subjects also found that app use enhanced motivation to engage in post-transplant rehabilitation. Comments also highlighted the complexities of rehabilitation after lung transplant surgery, including level of functional decline, pain, tremor, and fatigue. At the end of the intervention, SPPB scores improved a median of 5 points (IQR 4, 7; p<0.0001) from a baseline of 4 (IQR 0, 7). Physical activity and patient-reported disability also improved. The DASI improved from 4.5 (IQR 0.0, 10.0) to 19.8 (IQR 15.2, 32.3)) (p=0.001) and LT-VLA score improved from 2 (IQR 1.2, 2.53) to 0.59 (IQR 0.14, 1.18) (p=0.001) at closeout.

**Conclusion:** Utilization of a personalized, app-based rehabilitation platform with participant-specific exercise prescriptions was safe and well received by post-lung transplant recipients. Remote rehabilitation was associated with improvements in frailty, physical activity and disability. Future studies should further evaluate mHealth treatment modalities in larger-scale randomized trials of lung transplant recipients.

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### Differential Outcomes of Lung Transplant Recipients as They Age: Is over 70 Too Old? No!

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**Purpose:** Lung transplantation (LTX) is generally reserved for the young due to perioperative complications & organ utilization. We sought to evaluate the long-term outcomes of LTX in the septuagenarian.

**Methods:** Retrospectively, LTX recipients in the UNOS transplant registry (May 1, 2005 to June 12, 2020) were stratified into 18-59, 60-69, and >=70 years of age. Recipient and transplant characteristics were evaluated for survival, cause of death (COD), length of stay (LOS) and complications. A Kaplan-Meier analysis examined long-term survival for all patients stratified by age, specifically looking at COD.

**Results:** A total of 27,632 recipients met inclusion criteria. As recipients aged, we found a decrease in proportion of cystic fibrosis & an increase in restrictive disease while obstructive disease peaked in the 60-69yo cohort (p<0.001). Recipient to donor age difference significantly increased with older recipients (p<0.001). >=70yo had higher rates of single LTX, male gender and white race (p<0.001). Older recipients had significantly longer recovery distances traveled with paradoxical shorter ischemic times, shorter LOS and were transplanted at higher volume centers. There was no difference with in-hospital mortality (p=0.5). Rejection during initial hospitalization and within 1 year and post-transplant dialysis incidence decreased with age. Graft and pulmonary failure were common COD in younger patients while malignancy and cardio/cerebrovascular diseases were common COD in >= 70yo (Figure).

**Conclusion:** Septuagenarian LTX candidates may be safely transplanted with relatively few complications. Young transplant recipients appear more vulnerable to rejection and die more often of graft failure complications. Malignancy and cardio/cerebrovascular etiologies were more common COD in older recipients. Immuno-senescence and conditions of the aged are likely contributing factors to the less rejection and graft failure observations. The >=70yo should be considered a good LTX candidate.

Operative Characteristics and Postoperative Outcomes

| Variable | Overall | 18-59 (n=13,527) | 60-69 (n=11,841) | >70 (n=2,264) | P-Value |
|---|---|---|---|---|---|
| Type of Transplant | | | | | |
| Bilateral | 19,093 (69.8%) | 11,302 (85.3%) | 6,957 (58.8%) | 834 (36.8%) | |
| Single | 8,269 (30.2%) | 1,955 (14.7%) | 4,884 (41.2%) | 1,430 (63.2%) | |
| Age Difference (Recipient and Donor) | 23 (8, 36) | 13 (0, 27) | 31 (17, 41) | 38 (24, 48) | < 0.001 |
| Center Volume | 42.1 (24.5, 68) | 41 (23.4, 68) | 43.7 (24.5, 68) | 57.7 (34.6, 75.5) | < 0.001 |
| Distance Traveled | 139 (25, 313) | 128 (22, 307) | 144 (25, 315) | 167 (40, 340.2) | < 0.001 |
| Ischemia time | 5.1 (4.1, 6.2) | 5.3 (4.3, 6.4) | 4.9 (3.9, 6) | 4.6 (3.8, 5.8) | < 0.001 |
| Length of Stay (Days) | 16 (11, 27) | 17 (12, 28) | 16 (11, 27) | 16 (11, 26) | < 0.001 |
| Postoperative Dialysis | 1,781 (6.6%) | 972 (7.4%) | 693 (5.9%) | 116 (5.2%) | < 0.001 |
| Postoperative Stroke | 601 (2.2%) | 295 (2.3%) | 249 (2.1%) | 57 (2.6%) | 0.445 |
| Postoperative Airway Dehiscence | 408 (1.5%) | 207 (1.6%) | 174 (1.5%) | 27 (1.2%) | 0.383 |
| In Hospital Mortality | 1,233 (4.6%) | 581 (4.5%) | 544 (4.7%) | 108 (4.9%) | 0.501 |
| Acute Rejection Before Discharge | | | | | < 0.001 |
| Yes & Treated with Immunosuppresent | 1,964 (7.3%) | 1,061 (8.1%) | 767 (6.6%) | 136 (6.1%) | |
| Yes & Not Treated with Immunosuppresent | 298 (1.1%) | 163 (1.2%) | 116 (1%) | 19 (0.9%) | |
| No | 24,769 (91.6%) | 11,903 (90.7%) | 10,796 (92.4%) | 2,070 (93%) | |
| Rejection Treatment Within One Year | 5,580 (26.6%) | 2,953 (28.2%) | 2,249 (25.2%) | 378 (24.3%) | < 0.001 |
| Cause of Death | | | | | < 0.001 |
| **Graft Failure** | **2,165 (20.6%)** | **1,165 (24.3%)** | **885 (18.2%)** | **115 (13%)** | |
| **Malignancy** | **1,281 (12.2%)** | **451 (9.4%)** | **677 (14%)** | **153 (17.3%)** | |
| **Cardio/Cerebrovascular** | **1,175 (11.2%)** | **469 (9.8%)** | **579 (11.9%)** | **127 (14.4%)** | |
| Pulmonary | 2,121 (20.1%) | 1,048 (21.8%) | 897 (18.5%) | 176 (19.9%) | |
| Infection | 2,016 (19.1%) | 862 (18%) | 999 (20.6%) | 155 (17.5%) | |
| Other | 1,777 (16.9%) | 806 (16.8%) | 813 (16.8%) | 158 (17.9%) | |

Table: Operative Characteristics and Postoperative Outcomes

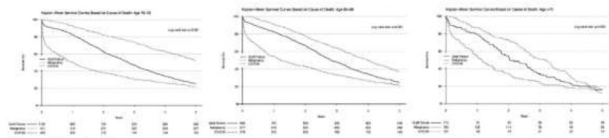

Figure: Survival by age group

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### Single Lung Transplant Remains a Viable Alternative to Double Lung Transplantation for the Patients with Severe Secondary Pulmonary Hypertension

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**Purpose:** Whereas double lung transplantation (LTx) is a preferred surgical option for the patients with secondary pulmonary arterial hypertension (SPH: defined as a mean pulmonary artery pressure (mPAP) above 25 mmHg), our institutional experiences have demonstrated the unique values of single LTx for SPH. Here, we review our experiences prioritizing single LTx for SPH in an attempt to optimize their opportunities and decrease mortality while waiting.

**Methods:** A retrospective review of the LTx database was used to identify patients who underwent single LTx. SPH patients were stratified into mild SPH (mPAP: 25-40 mmHg) and severe SPH (mPAP > 40 mmHg). Recipients without PH transplanted over the same time period were used as controls. Data are reported as severe SPH vs. mild SPH vs. controls.

**Results:** Three hundred eighteen patients received single LTx between January 2017 and December 2019. There were 217 patients with mild SPH (mPAP of 32 mmHg), 59 patients with severe SPH (mPAP of 46 mmHg) and 42 patients without PH (controls). There were no significant differences among the groups in their patients' characteristics except higher pulmonary vascular resistance noted in severe SPH group and morbid obesity noted in mild and severe SPH groups. While severe SPH group required more intraoperative cardiopulmonary support (37.3% vs. 11.1% vs. 5.0%, $p < 0.05$), there were no significant differences in major postoperative complications including postoperative duration mechanical ventilation and incidences of severe primary graft dysfunction. Actual survival at 1 year