SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Proxies of Ischemia Time Do Not Predict 1-Year Posttransplant Survival in Lung Recipients

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Introduction

- The Organ Procurement and Transplantation Network (OPTN) is working to modify the organ allocation system to a continuous allocation framework.
- This framework will remove hard boundaries precipitated by discrete classification groups and allocate organs based on one score.
- That score will be developed using weighted factors agreed on by each organ-specific committee.
- One factor proposed for use in a lung continuous allocation score is predicted posttransplant survival.
- There is concern that increases in distances between donors and recipients could increase total ischemia time and compromise posttransplant survival.
- Some experts have recommended using travel distance or time as a proxy for ischemia time in a prediction of posttransplant survival.
- To assess the appropriateness of that strategy, we examined the associations of total ischemia time with each of ***three proxies: straight-line distance between donor and recipient hospitals, travel distance, and travel time***.
- We also examined the relationships of each of these individual predictors with 1-year posttransplant outcomes.

Methods

- Using SRTR data, we constructed a cohort of adult (age ≥18) lung transplant recipients, January 1, 2015-December 31, 2018.
- Recipients of donor lungs that underwent perfusion were excluded; it was unclear how perfusion would have been accounted for in total ischemia time.
- Using geolocation and a Google application programming interface, we estimated travel time and travel distance between donor hospitals and recipient transplant centers.
- Both of these measures included driving time and distance to nearby airports when flying was thought to have occurred.
- We computed straight-line distance using each facility's latitude and longitude values.
- We computed Pearson linear correlation coefficients (ρ) and percent of variability explained (ρ^2) among total ischemia time and the three distance and time measures.
- To assess effects of ischemia time and proxies on 1-year posttransplant survival, we fit six Cox proportional hazards models.
- Each model included the same donor and recipient factors, as well as one of each of the following: linear ischemia time, ischemia time linear splines with a knot at 4 or 6 hours, travel time, travel distance, and straight-line distance.
- Factors in the model included donor race, donor-recipient weight ratio, recipient age, steroid use, bilirubin, dialysis, serum creatinine, LAS, cardiac output, PCO_2, and CVP.

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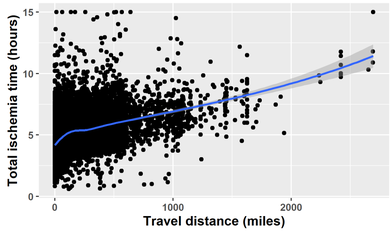

Figure 1: Ischemia time vs travel distance

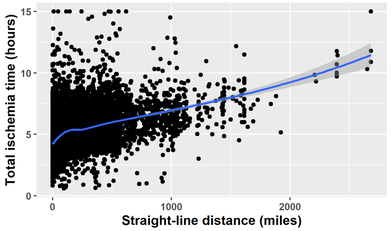

Figure 2: Ischemia time vs straight-line distance

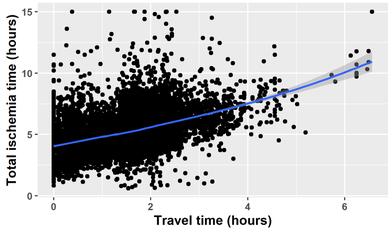

Figure 3: Ischemia time vs travel time

	Total ischemia time: ρ (%)	Travel time: ρ (%)	Travel distance: ρ (%)	Straight-line distance: ρ (%)
Total ischemia time (hours)	1 (100)	0.441 (19.4)	0.416 (17.3)	0.413 (17.0)
Travel time (hours)		1 (100)	0.897 (80.5)	0.887 (78.8)
Total distance (miles)			1 (100)	0.999 (99.9)
Straight-line distance (miles)				1 (100)

Table 1: Linear correlation coefficients (ρ) and percent of variability explained

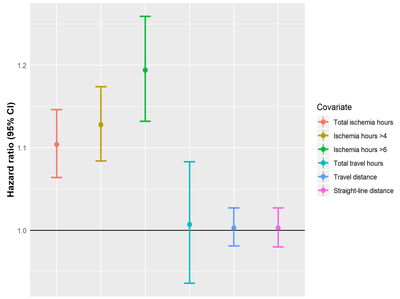

Figure 4: Effect of ischemia time and proxies on 1-year posttransplant survival

Results

- Our cohort included 8803 adult transplant recipients, 927 of whom died within the first posttransplant year.
- Table 1 shows that all three proxies of ischemia time were correlated with ischemia time, with correlations ranging from 0.413 for straight-line distance to 0.441 for travel time. All correlations were statistically significant at $P<.0001$.
- Only 17.0% to 19.4% of the variability in total ischemia time is explained by proxies, however. This means that over 80% of variability in ischemia time is explained by factors other than travel time or distance.
- Figures 1-3 graph the relationship of ischemia time with proxies. In each case, there was a clear pattern of increase in ischemia time with increases in travel time or distance.
- It is also clear that variation in ischemia time was large. At travel distances of 0 miles and travel times of 0 hours, total ischemia time ranged from roughly 0 to 15 hours (Figures 1-3).
- Figure 4 summarizes the effects of ischemia time, travel hours, travel distance, and straight-line distance, adjusted for donor and recipient factors.
- Only ischemia time was a significant predictor of 1-year posttransplant survival. All ischemia time variables were significant predictors at $P<.0001$.

Results (cont'd)

- The hazard ratio for ischemia time as a linear predictor of death was 1.10, a 10% increase in risk of death for each additional hour of ischemia time.
- Hazard ratio for ischemia time >6 hours was 1.19, a 19% increase in risk of death for each hour of ischemia time above 6 hours.
- Hazard ratio for ischemia time >4 hours was 1.13, a 13% increase in risk of death for each hour of ischemia time above 4 hours.
- Travel time, travel distance, and straight-line distance were not modeled using linear splines because when we examined the hazards of these covariates over the range of ischemia time, they were flat. There were no reasonable inflection points to consider.

Summary and Conclusions

- Relationships between total ischemia time and time/distance proxies were weak.
- Ischemia time was a significant predictor of 1-year posttransplant survival, but neither travel time nor travel distance nor straight-line distance improved the model of adjusted 1-year posttransplant survival.
- If we wish to use predictors of ischemia time to predict outcomes, we need to better understand which factors in addition to travel time drive changes in ischemia time.

Authors have no conflicts of interest to disclose.