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ORIGINAL CLINICAL SCIENCE

Insurance status by region at the time of heart transplantation: Implications for survival

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KEYWORDS:

heart transplantation;
region;
health insurance;
survival

BACKGROUND: Heart transplantation outcomes differ by health insurance status and geographic region of the United States. We hypothesized that heart transplantation survival would be affected by health insurance status within certain United Network for Organ Sharing (UNOS) regions.

METHODS: We used data from the UNOS thoracic database to classify health insurance status into private or public (private/self-pay or Medicare/Medicaid) for all first-time heart transplant recipients between July 2006 and September 2013. We applied Cox proportional hazards regression to estimate hazard ratio (HR) and 95% confidence interval (CI) for the influences of health insurance status on 1-year and long-term survival in heart transplant recipients by UNOS region.

RESULTS: Mean survival time among 10,474 patients was 942 days \pm 704. All key demographic and clinical variables varied significantly across UNOS regions. With respect to 1-year survival, patients in Region 2 had a higher hazard of mortality (HR, 1.49; 95% CI, 1.03, 2.15) if they had public vs private insurance. When we restricted the analysis to be conditional on 1-year survival, 2 contiguous regions, Region 10, including Indiana, Ohio, Michigan (HR, 2.30; 95% CI, 1.23, 4.28), and Region 11 (HR, 1.85; 95% CI, 1.15, 2.97), including the upper South, had poor survival associated with public vs private insurance.

CONCLUSIONS: The data we present invite targeted efforts by certain UNOS regions to improve the standard of care and/or eligibility thresholds for heart transplant recipients.

J Heart Lung Transplant ■■■■:■■■-■■■

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Racial and socioeconomic disparities account for much of the variation in cardiovascular disease (CVD) mortality that exists in the United States.¹ Availability of health insurance and access to

care are considered key mechanisms for the influence of social and economic characteristics on patient outcomes in CVD. These mechanisms are especially salient in cases of advanced heart disease, when patient survival hinges on the provision of complex medical care, including heart transplantation.

Reflecting the role of health insurance status in stratifying patient outcomes in advanced heart disease, higher mortality was observed following percutaneous coronary intervention

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among patients with no insurance and patients with Medicaid coverage compared with patients with private insurance.² Differences exist in post-transplantation survival of heart transplant recipients based on health insurance status.³ Allen et al³ reported 10-year post-transplant survival as lowest among patients with Medicaid, higher among patients with Medicare, and highest among patients with private insurance. Although short-term survival (≤ 1 year) may expose threats to mortality that manifest in acute post-transplant care, long-term outcomes, conditional on surviving to 1 year, can represent mortality hazards accumulating after the initial follow-up window.

Survival implications of insurance status for patients with advanced heart disease may vary across geographic areas secondary to state and regional differences in public insurance program eligibility, differences in care availability for participants in public insurance programs,⁴ and differences in overall outcomes for patients with advanced heart disease. In the case of heart transplantation, outcomes may differ by state and organ procurement region.⁵ Conceptually, the greatest disparities in patient outcomes across insurance status should be evident in areas where overall outcomes are acceptable (reflecting adequate care provided to patients using private insurance), but public insurance participants are either adversely selected for characteristics predicting high mortality or are faced with unusually high barriers to accessing the care needed to treat advanced heart disease.

Prior research has shown that geographic region of residence influences the rate of CVD mortality among whites and blacks in the United States, with particularly high mortality rates in areas including the Mississippi and Ohio river valleys.⁶ Regional patterns of poor cardiovascular outcomes have also been seen for in-hospital cardiac arrest,⁷ myocardial infarction,^{8,9} heart failure,⁹ and stroke.⁹ An investigation into geographic patterning of CVD risk factors and mortality showed the burden of disease to be clustered in the southern states of the United States.¹⁰ Similarly, Jencks et al⁴ quantified state rankings on 22 Medicare performance measures for acute and chronic health conditions and identified areas of the Southern and Midwestern United States that had consistently low performance on key quality indicators.

Given the evidence supporting geographic disparities in cardiovascular risk factors, care, and mortality as well as geographic disparities in access to transplant-related care among participants in public insurance programs, we hypothesized that the influence of insurance status on survival among heart transplant recipients would vary by region of the United States. If insurance-related disparities in survival of heart transplant recipients are indeed exacerbated in some regions of the United States, there may be a need for more targeted efforts by region to improve the standard of care or revise insurance eligibility thresholds for heart transplant candidates.

Methods

Data collection

This study was approved with a waiver of the need for individual consent (IRB14-00716) by the Institutional Review Board at

Nationwide Children's Hospital. Our primary objective was to examine the regional differences in survival by health insurance status among heart transplant recipients. We retrospectively evaluated data from the United Network for Organ Sharing (UNOS) thoracic database with a query for all first-time heart transplant patients who received a heart from a cadaveric donor between July 2006 and September 2013.¹¹ The analysis was limited to patients whose heart transplant was funded by private insurance (or self-pay), Medicare, or Medicaid as reported at the time of the transplant.

Health insurance status was classified into private or public (private/self-pay or Medicare/Medicaid). We collapsed Medicare and Medicaid into 1 category, but in sensitivity analyses, we considered whether there were any differences in patient survival between Medicare and Medicaid insurance after multivariable adjustment. Geographic areas were classified according to the 11 UNOS regions as follows: Region 1, Connecticut, eastern Vermont, Maine, Massachusetts, New Hampshire, Rhode Island; Region 2, Delaware, District of Columbia, Maryland, New Jersey, Pennsylvania, West Virginia; Region 3, Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Puerto Rico; Region 4, Oklahoma, Texas; Region 5, Arizona, California, Nevada, New Mexico, Utah; Region 6, Alaska, Hawaii, Idaho, Montana, Oregon, Washington; Region 7, Illinois, Minnesota, North Dakota, South Dakota, Wisconsin; Region 8, Colorado, Iowa, Kansas, Missouri, Nebraska, Wyoming; Region 9, New York, western Vermont; Region 10, Indiana, Michigan, Ohio; and Region 11, Kentucky, North Carolina, South Carolina, Tennessee, Virginia.¹²

The outcome of interest for this analysis was time to death after transplant. A landmark analysis was performed, with end-points including survival to 1 year and conditional survival past 1 year (among patients surviving at least 1 year post-transplant).³ Of 12,823 adults (≥ 18 years old) who underwent transplantation during this era, we excluded 2,076 who were ≥ 65 years old, as few patients above the Medicare age eligibility threshold reported paying for the transplant with Medicaid. This exclusion left 10,747 patients for descriptive analyses. After excluding 44 patients who survived < 1 day and 1,789 patients missing data on covariates (educational attainment, diabetes history, creatinine, and ischemic time), multivariable analysis of 1-year survival analysis included 8,914 cases, and multivariable analysis of conditional survival included 6,377 cases (excluding cases with death or censoring within 1 year of transplant).

Covariates used in the analysis included donor and recipient sex, donor-recipient sex matching, recipient race (white, black, or any other), donor race (white, black, or any other), recipient educational attainment (high school or less, some college, or college degree), history of diabetes in the recipient, recipient obesity (body mass index ≥ 30 kg/m²), ischemic cardiomyopathy, pre-transplant mechanical ventilation, recipient age, donor age, creatinine (mg/dl), and ischemic time (hours). The sample for the multivariable analysis was constructed from cases with complete data on all covariates. Compared with patients with complete data, patients excluded from the estimation sample because of missing data on covariates did not differ on insurance type ($p = 0.194$), sex ($p = 0.819$), or race ($p = 0.270$) but tended to be older (50.9 years ± 10.8 vs 49.4 years ± 12.0 ; $p < 0.001$).

Statistical methods

All analyses were performed using Stata/IC 13.1 (StataCorp LP, College Station, TX). Descriptive statistics for continuous variables are presented as mean (SD), and descriptive statistics for categorical

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