Lung Cancer Diagnostic and Treatment Intervals in the United States

A Health Care Disparity?

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Introduction: Lung cancer diagnostic and treatment delays have been described for several patient populations. However, few studies have analyzed these intervals among patients treated in contemporary health care systems in the United States. We therefore studied the timing of lung cancer diagnosis and treatment at a U.S. medical center providing care to a diverse patient population within two different hospital systems.

Methods: We performed a retrospective analysis of consecutive patients diagnosed with non-small cell lung cancer stage I to III from 2000 to 2005 at public and private hospitals affiliated with the University of Texas Southwestern Medical Center. We recorded patient and disease characteristics; dates of initial radiograph suspicious for lung cancer, diagnosis, and treatment; and overall survival. Associations between these factors were assessed using univariate analysis, multivariate logistic regression, and Kaplan-Meier survival analysis.

Results: A total of 482 patients met criteria for analysis. In univariate analyses, the image-treatment interval was significantly associated with race, age, income, insurance type, and hospital type (76 days for public versus 45 days for private; $p < 0.0001$). In multivariate analysis, only hospital type remained significantly associated with the image-treatment interval; patients in the private hospital setting were more likely to receive timely treatment (hazard ratio 1.85; 95% confidence interval, 1.37–2.50; $p < 0.001$). In univariate analysis, the image-treatment interval was not associated with disease stage ($p = 0.27$) or with survival ($p = 0.42$).

Conclusion: Intervals between suspicion, diagnosis, and treatment of lung cancer vary widely among patients. Health care system factors, such as hospital type, largely account for these discrepancies. In this study, these intervals do not appear to be associated with clinical outcomes.

Key Words: Non-small cell lung cancer, Disparities, Timing, Intervals, Diagnosis.

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Disparities characterize several aspects of lung cancer. For instance, clinical stage at presentation, treatment selection, and overall survival have been associated with patient race and ethnicity.[1–4] For lung cancer and other malignancies, the degree to which such differences reflect individual versus institutional factors remains unclear. To address these disparities, considerable attention has been directed toward the issue of access to care, including efforts to bring individuals into the health care system and then optimize their management once they are within it.

The nature of these efforts is likely to reflect the clinical scenario. In some instances, cancer management is a relatively straightforward procedure. For colorectal cancer, colonoscopy may encompass detection, diagnosis, and prevention in a single setting. In contrast, the evaluation and treatment of patients with suspected lung cancer is a complex process. Patients may require percutaneous or bronchoscopic biopsy, mediastinal lymph node sampling, evaluation for extrathoracic disease, and assessment of medical fitness for surgery. Given the challenges of planning and organizing lung cancer therapy, several studies have evaluated factors affecting the timing of disease diagnosis and treatment. However, the overwhelming majority of these studies have been conducted abroad,[5–14] in patient populations and health care systems distinct from those in the United States. Of the few U.S.-based studies, a number have been performed within the Veterans Affairs (VA) Health System,[15–17] a single-payer structure that does not represent the wider American medical system. The other U.S. studies have focused on specific demographic subgroups, including Asian immigrants[18] and Native Hawaiians.[19]

Contemporary health care in the United States is a complex system encompassing tremendous patient, provider, payer, and institutional diversity. Therefore, to examine the predictors and impact of the timing of lung cancer care in this context, we examined diagnostic and treatment intervals at a large American medical center providing care to a diverse patient population within two different hospital systems.

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PATIENTS AND METHODS

Study Setting

Patients treated at three hospitals associated with the University of Texas (UT) Southwestern Medical Center—Parkland Health and Hospital System, University Hospital-St. Paul and University Hospital-Zale Lipshy—and at UT Southwestern outpatient clinics were included in this study. Parkland Health and Hospital System, a 968-bed inpatient hospital and associated outpatient clinics, is the only public medical facility in Dallas county. Dallas county is the ninth most populous county in the United States, with an estimated 2,345,815 people in 2006. It represents a diverse, urban population with 21.1% blacks, 37.7% Hispanics, and 36.1% non-Hispanic whites.[20] University Hospital—St. Paul is a 271-bed facility and University Hospital—Zale Lipshy is a 144-bed facility. These hospitals serve as the primary private medical and surgical referral hospitals for UT Southwestern.

Data Extraction

This study was approved by the UT Southwestern Institutional Review Board. We collected data on patients with newly diagnosed stage I to III non-small cell lung cancer (NSCLC) from 2000 to 2005 from the UT Southwestern (which includes patients seen at UT Southwestern outpatient clinics, University Hospital—St. Paul and University Hospital—Zale Lipshy) and the Parkland Health and Hospital System Tumor Registries (which includes patients seen at Parkland inpatient and outpatient facilities). These American College of Surgeons-approved registries identify cancer cases through review of all surgical pathology reports and hospital discharge patient lists. We obtained further information, as needed, from electronic and paper medical records. Year 2000 U.S. Census data was used to obtain median household income and education levels based on subject residence zip codes,[21] as previously performed.[22] If not otherwise available, subject date of death was obtained from the Social Security Death Index (http://ssdi.rootsweb.ancestry.com).

We limited our study population to stage I to III and excluded stage IV disease to focus on subjects treated with potentially curative intent. Additionally, this represents a relatively homogeneous patient group, as imaging and diagnostic studies are generally focused on thoracic disease. The time period 2000–2005 was selected because (1) adequate data were first recorded by the tumor registries in 2000 and (2) the 2005 cutoff provided sufficient follow-up time for survival outcomes.

Recording and Definition of Variables

We recorded the following subject data: age at diagnosis, gender, race/ethnicity, tumor histology and stage, insurance type, hospital type (public versus private), and residence zip code. For each zip code, we recorded the median household income and percentage of adult residents with a high school degree. Disease stage was based on the most definitive data available (i.e., surgical staging was used preferentially over clinical staging). We recorded the dates of the following events: initial suspicious radiographic study, tissue diagnosis, initiation of treatment, and death. Initial suspicious imaging was classified as the first plain radiograph, computed tomography (CT), or other imaging study report that documented a lesion suspicious for malignancy. Date of tissue diagnosis was defined as the date of final pathology report. In most patients, tissue was obtained through bronchoscopic or percutaneous needle biopsy. A minority of patients were taken directly to surgery after the suspicious imaging study and therefore had the same date of diagnosis and treatment. Date of treatment was defined as the date of surgery, initial date of chemotherapy, or initial date of radiation therapy, whichever occurred first. Invasive staging procedures, such as mediastinoscopy or endobronchial ultrasound, were not considered treatment. Cause of death (cancer related versus other) was not available.

Statistical Analysis

Descriptive statistics (medians/means for continuous variables and percentages for discrete variables) were generated for baseline demographic and clinical characteristics. Median household income and percentage with high school diploma were categorized by quartiles based on our population of patients. Comparisons of baseline demographic and clinical characteristics between the two hospital groups (public and private) were performed using χ^2 analysis for categorical variables and Wilcoxon test for continuous variables.

We used both univariate and multivariate Cox regression models to explore the association between time intervals and patient demographic and clinical characteristics. The intervals included in this analysis were image to diagnosis, diagnosis to treatment, image to treatment, and diagnosis to death. Patients who went directly from imaging to surgery were not included in the image-diagnosis and diagnosis-treatment intervals but were included in the overall image-treatment interval. In multivariate data analysis, we included age, gender, race, hospital type, and insurance type as covariates in the model. The outcome variable for the multivariate models is time to event, "event" being diagnosis, treatment, or death depending on the analysis. Therefore, the hazard ratio (HR), which indicates the likelihood of having an event at any specific time point, is greater than 1 for shorter intervals. These models were specified before the analysis to address potential confounding problems.

A Cox regression model was used to analyze the association between the image-treatment interval and survival time. Survival time was defined as the interval between the date of treatment and the date of death or censoring. The standard definition of survival time from date of diagnosis to date of death or censoring was not used to avoid overlap between survival time (the dependent variable) and the diagnosis-treatment interval (the independent variable).

The image-treatment interval was categorized as a continuous variable, dichotomized by the median interval, analyzed by 30-day intervals, and dichotomized by formally recommended image-treatment interval values. Cancer stage was included as a covariate in the analysis.

All statistical analyses were performed using SAS 9.1 in Microsoft Windows.

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