Original Study

Disparities in Access and Regionalization of Care in Testicular Cancer

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Abstract

We evaluated the roleof race, socioeconomic status, andregionalization in the disparities in testicular cancer care using retrospectiveanalysis of a large hospital-based cohort. We found that underinsured and nonwhite patients experiencegreater disparity. This could be mediatedby regionalization of care.

Introduction: Timely mobilization of specialized resources are needed to achieve optimal outcomes in testicular cancer. We used the National Cancer Database to investigate the hospital and demographic features driving disparity. **Patients and Methods:** We identified adult men with testicular tumors diagnosed from 2004 to 2013. We a priori examined the association among race/ethnicity, socioeconomic status (SES), travel burden, hospital characteristics, and indicators of delays in testicular cancer care. The outcomes included large primary tumor, stage III at diagnosis, orchiectomy delay, and mortality. The analyses included multivariable Cox proportional hazards regression for time-dependent outcomes and logistic regression for categorical outcomes. **Results:** Of 31,964 men, 29% had a large primary tumor, 17% presented with stage III disease, 10% experienced an orchiectomy delay, and 6% died. Black race or Hispanic ethnicity, low SES, and underinsurance were associated with poorer outcomes ($P < .001$ for all). Higher hospital volume, cancer center status, and lower travel burden were associated with improved outcomes ($P < .001$ for all). **Conclusion:** Nonwhite race/ethnicity, low SES, and underinsurance were associated with diminished access to testicular cancer care. Insurance status, a marker of SES, had the most consistent association with poor outcomes. This finding highlights the oncologic imperative to improve access to adequate health insurance. Regionalization of subspecialty care might, paradoxically, improve outcomes but also create additional barriers in the form of an added travel burden.

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Introduction

Testicular cancer is often curable, with 99% disease-specific survival for clinically localized disease.[1] Even metastatic patients can be salvaged, with 70% disease-specific survival.[1] Therapy for advanced testicular cancer includes some combination of surgery, radiation, and chemotherapy, depending on the stage and histologic features.[2] These modalities are associated with significant short- and long-term toxicity[3] and must be seamlessly coordinated across subspecialties and health care settings. Although testicular cancer is highly curable, its curability depends on timely access to high-quality multimodal care. Studies have demonstrated that referral to a high-volume "center of excellence" can improve outcomes in complex multidisciplinary care, henceforth referred to as regionalization.[4,5]

Although testicular cancer is most common in middle-class white men, race, ethnicity, and socioeconomic status (SES) have been hypothesized to affect access to testicular cancer care. With testicular cancer, Hispanic and black men have tended to present at higher cancer stages.[6] Furthermore, testicular cancer patients are typically young and at risk of being underinsured or uninsured. Underinsurance represents a state of simultaneous health coverage but exposure to financial risk.[7] Uninsurance and underinsurance are likely to increase delays in testicular cancer care.[8] Given these financial and demographic drivers of disparity in access, the Affordable Care Act (ACA) funded and implemented patient-centered delivery of care

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and systematic methods of tracking health-related outcomes by race, ethnicity, and SES.[9] ACA implementation has been associated with increased access to primary care for young patients.[10] However, it remains to be seen whether these gains in primary care have translated to cancer care, which is increasingly being delivered at regional centers with specialized resources and infrastructure.[11]

We therefore analyzed the processes of care and resultant outcomes for a large population of men with testicular cancer. Our goals were twofold. First, we sought to clarify the demographic and socioeconomic factors associated with disparate care. Second, we wished to identify the system-wide processes that can affect access such as regionalization of care.

Materials and Methods

Cohort Selection

The present analysis was deemed institutional review board exempt owing to patient de-identification. The individuals were selected from the National Cancer Database (NCDB) with testicular cancer diagnosed from 2004 to 2014. The NCDB is a collaboration between the American College of Surgeons and the Commission on Cancer (CoC) and captures ~70% of cancer cases in the United States.

We included adults with seminoma (codes 9061, 9062), spermatocytic seminoma (code 9063), choriocarcinoma (code 9100), yolk sac tumor (code 9701), embryonal carcinoma (code 9070), teratoma (codes 9080, 9081), and mixed germ cell tumors (codes 9065, 9085, 9101). Those missing stage, histologic type, and survival status were excluded.

Subgroups and Covariates

We developed several a priori hypotheses and exposure variables of interest based on the data collected by the NCDB. For example, we hypothesized that race, ethnicity, and SES would be associated with access disparities. Travel distance, cancer center status, and annual testicular cancer volume were hypothesized to be markers of regionalization of subspecialty care. All other covariates were included as potential confounders and included year of diagnosis, urban/rural status, and oncologic and comorbidity data as detailed in subsequent paragraphs. The subgroups were stratified by the variables listed in Table 1.

The cohort was divided into 2 periods (2004-2009 and 2010-2013) for 2 reasons. This cutoff divided the population cohort nearly equally into each period. This also straddled the enactment of the ACA in 2010, which could have affected the associations. Age, race, and ethnicity were categorized as listed in Table 1. Rural was defined as a nonmetropolitan population of $< 20{,}000$, as previously described.[12]

Income was determined by the median annual income of the patient residential zip code at diagnosis in quartiles from 2008 to 2012: $<$ \$38,000, \$38,000 to \$47,999, \$48,000 to \$62,999, and $\geq$ \$63,000.[13] The zip code level educational attainment was determined in proportions for those obtaining a high school diploma or equivalent as follows: $<$ 79%, 79% to 87%, 87.1% to 93%, and $>$ 93%.[13] Insurance coverage was classified as private, Medicare, Medicaid, and uninsured (with the latter 2 considered underinsured). Veterans Affairs coverage is unavailable in the NCDB, and those with insurance classified simply as "other government" were excluded. These represented $<$ 1% of the screened cohort.

Cancer stage was determined using the American Joint Committee on Cancer (AJCC), 7th edition.[14] Tumor size was classified into quartiles as $\leq$ 2, 2.1 to 4, 4.1 to 6, and $>$ 6 cm. We also ascertained lymphovascular invasion status (yes vs. no) and histologic type (seminoma vs. nonseminomatous germ cell tumor).

Comorbidities were enumerated using the Charlson-Deyo method, classified as 0 or $\geq$ 1 given the limited noncancer comorbidities in the cohort.[15] The travel distance to the treating center was calculated according to the zip code of residence at diagnosis and the zip code of the center of treatment.[16] A travel distance of $\geq$ 50 miles (vs. $<$ 50 miles) was considered burdensome in accordance with previous similar analyses.[17] Center volume was determined using encrypted facility codes and presented as the median annual number of testicular cancer cases during the study period in tertiles ($<$ 4, 4-9, and $>$ 9 cases annually). The referral pattern was grouped into cases diagnosed at a CoC facility, with treatment in whole or part elsewhere (referred out), cases diagnosed at a CoC facility, with treatment at the CoC facility (internal), and cases diagnosed elsewhere, with referral to a CoC facility for treatment (referred in).

Study Outcomes

We assessed the following outcomes selected a priori: large tumor size at diagnosis, AJCC stage $\geq$ IIIA at diagnosis, delay to orchiectomy, and overall mortality. A tumor presenting with a greatest quartile size ($>$ 6 cm) was considered likely to be palpable and, as such, a marker of a delay in care. Similarly, we considered presentation with AJCC stage $\geq$ IIIA to be indicative of a delay in presentation and an important prognostic threshold. Finally, in the NCDB, most patients underwent orchiectomy within several days of the diagnosis. Using the observed time between diagnosis and orchiectomy, the highest quartile of a delay in care corresponded to a 2-day delay. Thus, we classified the 90th percentile (11 days) as delayed orchiectomy. Those undergoing initial chemotherapy were excluded from analysis of delayed orchiectomy. Survival time was computed by comparing vital status to the date of death or last follow-up examination.

Statistical Analysis

We assessed differences in patient characteristics and unadjusted rates of our study outcomes using χ^2 analysis statistics. Factors associated with all-cause mortality were determined using unadjusted and multivariable Cox proportional hazards regression. We identified factors associated with a large tumor size, AJCC stage $\geq$ IIIA at diagnosis, and delayed orchiectomy using multivariable logistic regression. Statistical analyses were performed using STATA, version 13 (StataCorp, College Station, TX).

Sensitivity and Post Hoc Analyses

Because a large proportion of the potential cohort was lost owing to missing stage data, a sensitivity analysis was performed to assess the association between sociodemographic characteristics and missing stage. Based on the universal association between poor outcomes and underinsurance in all models, we performed a post hoc stratification comparing the baseline differences between the privately and underinsured patients to generate hypotheses about the factors driving these trends.