Impact of insurance status and race on receipt of treatment for acoustic neuroma: A national cancer database analysis

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Acoustic neuroma (AN) management involves surgery, radiation, or observation. Previous studies have demonstrated that patient race and insurance status impact in-hospital morbidity/mortality following surgery; however the nationwide impact of these demographics on the receipt of each treatment modality has not been examined. The National Cancer Data Base (NCDB) from 2004 to 2013 identified AN patients. Multivariate analysis adjusted for several variables within each treatment modality, including patient age, race, sex, income, primary payer for care, tumor size, and medical comorbidities. Patients who were African-American (OR = 0.7; 95%CI = 0.5–0.9; p = 0.01), elderly (minimum age 65) (OR = 0.4; 95%CI = 0.4–0.6; p < 0.001), on Medicare (OR = 0.6; 95%CI = 0.4–0.7; p = 0.005), or treated at a community hospital (OR = 0.4; 95%CI = 0.2–0.7; p = 0.007) were less likely to receive surgery. Patients on Medicaid (OR = 1.2; 95%CI = 0.8–1.8; p = 0.04) or treated at an integrated network (OR = 1.2; 95%CI = 0.9–1.6; p = 0.004) were more likely to receive surgery. Patients who were elderly (OR = 2.2; 95%CI = 1.7–2.9; p < 0.001) or treated in a comprehensive cancer center (OR = 1.5; 95%CI = 1.3–1.9; p = 0.02) were more likely and Medicaid patients (OR = 0.8; 95%CI = 0.5–1.2; p = 0.04) were less likely to receive radiation. Patients who were elderly (OR = 2.2; 95%CI = 1.7–2.7; p < 0.001), African-American (OR = 1.5; 95%CI = 1.1–2.0; p = 0.01), on Medicare (OR = 1.8; 95%CI = 1.4–2.3; p = 0.003), or treated in a community hospital (OR = 3.0; 95%CI = 1.6–5.6; p = 0.0007) were more likely to receive observation. Patients on Medicaid (OR = 0.8; 95%CI = 0.5–1.2; p = 0.04) or treated in an integrated network (OR = 0.8; 95%CI = 0.6–1.0; p = 0.001) were less likely to receive observation. African-American race, elderly age, and community hospital treatment triaged towards observation/away from surgery; age also triaged towards radiation. Conversely, integrated networks triaged towards surgery/away from observation; comprehensive cancer centers triaged towards radiation. Medicaid insurance triaged towards surgery/away from radiation/observation; this may be detrimental since lack of private insurance is a known risk factor for increased in-hospital postoperative morbidity.

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1. Introduction

First described postmortem in 1777, acoustic neuroma (AN) (also known as vestibular schwannoma) is defined as a benign tumor arising from Schwann cells, usually of the superior vestibular nerve [10,17]. The incidence of AN in the United States (US) is approximately 1 per 100,000 per year; nearly 2500 new cases are diagnosed annually [1,3]. An increasing number have been identified due to the advent of magnetic resonance imaging (MRI), as prior to MRI many were too small to be detected on imaging studies [18]. The MRI era has also contributed to a decrease in the size of AN at diagnosis over the past decade, with the percentage of AN in the US between 0–2 cm increasing from 38.3% to 50.7% and those between 0 and 1 cm increasing from 12.3% to 20.8% between 2004 and 2011 alone [4].

Typically presenting with unilateral sensorineural hearing loss, tinnitus, and/or imbalance, these lesions require precision and delicacy as they arise near important structures (adjacent cranial nerves, brainstem) and tend to grow within the first two years of diagnosis [12]. 12–19% of patients have signs of trigeminal dysfunction, and 17% have facial nerve involvement manifesting as facial neuropathy [9]. Comprehensive evaluation involves audiometric and vestibular testing and gadolinium-enhanced MRI [9].

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Following evaluation, if AN is suspected, there are four major treatment options: observation with serial MRIs, microsurgical excision, fractionated stereotactic radiotherapy (FSRT), and stereotactic radiosurgery (SRS). Due to the lack of Level 1 evidence, patient choice of treatment modality choice is greatly influenced by physician bias [16]. However, there has been a general shift over the last decade away from microsurgery and towards radiation for AN, with the overall rate for observation remaining stable [13].

Previous studies involving a nationwide inpatient database have demonstrated that African-American patients and patients without private insurance have significantly increased in-hospital morbidity and mortality following surgery for AN [8,14]. The adjusted in-hospital mortality relative risk for African-Americans following AN surgery is 10.6 compared with Caucasian patients [7]. Another recent nationwide study has shown that despite having larger AN tumors at diagnosis, African-Americans are half as likely to receive surgery and twice as likely to receive conservative management compared with Caucasian patients [3].

To date, there has been limited attention paid to the role of race and insurance status on the receipt of surgery, radiation, or observation for AN. This study was performed to address this void by using a national cancer registry over a recent 10-year period.

2. Methods

2.1. Data source

The data source for this study was the National Cancer Data Base (NCDB). The NCDB is a hospital-based cancer registry sponsored jointly by the American College of Surgeons and the American Cancer Society. Comprised of more than 1,400 facilities accredited by the American College of Surgeons’ Commission on Cancer, the NCDB contains de-identified data on 70% of all newly diagnosed cancers in the United States (US) [2]. The NCDB includes data on radiation therapy (i.e., dosage, technique, target) not contained in the Surveillance, Epidemiology, and End Results (SEER) database, and unlike SEER is able to distinguish single-fraction SRS from stereotactic radiotherapy [2,15]. However, as in SEER, nonmalignant central nervous system tumors (such as AN) have only been included since January 1, 2004. Consequently, this study utilized data from the most recent dataset, spanning 2004 through 2013.

2.2. Inclusion and Exclusion criteria

Using the International Classification of Diseases for Oncology (ICD-O-3) codes, patients with “neurilemoma” and “neurora” were selected using their corresponding ICD-O codes (9560 and 9570, respectively). From this group, patients were retained whose tumor primary site was listed as the “acoustic nerve”, represented by ICD-O topography code of C72.4. Those patients retained comprised the primary cohort for this study. Any patients who were not active follow-up cases were excluded, in order to eliminate the possibility of analyzing patient data recorded from death certificates or at autopsy.

Treatment was categorized based on NCDB’s site-specific surgery, radiotherapy, and radiation-surgery sequence variables. The “Surgery” group involved microsurgery defined as gross or subtotal resection. The “Radiation” group was defined as patients without microsurgery who had a radiation code indicating that beam radiation had been performed at either a medical oncology center or a hospital inpatient radiation treatment center. The “Observation” group included all AN patients who did not receive microsurgery or radiation therapy.

2.3. Data collection

Demographic data for age, race, gender, income, geographic location, facility type (academic/research facility, comprehensive cancer center, community, integrated network), primary payer (Medicare, Medicaid, other government, private, no insurance), type of county (metropolitan or non-metropolitan), education (≥13 high school graduates in the region), region of the United States (East/Atlantic, Central, West), income (median household income at least $48,000 or not), medical comorbidities (the overall comorbidity burden was calculated using the Deyo comorbidity index, an adapted Charlson comorbidity index), and tumor size were analyzed in this study [6,11].

2.4. Statistical analysis

The characteristics of patients and hospitals were summarized by descriptive statistics. Three separate multivariable logistic regression models were performed in order to determine the independent factors associated with receipt of surgery, radiation, and observation for the treatment of AN. Each model controlled for age, gender, race, primary payer, income, education level, region of the United States, type of county, type of hospital, medical comorbidities, and tumor size. The results were expressed as an odds ratio (OR) and a 95% confidence interval (CI). Significance was defined as a p value less than 0.05.

3. Results

3.1. Demographics of AN population

The NCDB contained 11,614 AN patients in the US from 2004 through 2013 (Table 1). The mean age of these patients was 51 years, and 46% of patients were men. 87% were white, and 4% were African-American; the remaining 9% were categorized as “other”. 73% had private insurance, 15% had Medicare, 5% had Medicaid, 2% had other government insurance, and 3% had no insurance (Table 1). Two-thirds of patients had median household income of at least $48,000, and more than 70% of patients lived in an area of at least 250,000 people. The majority of patients were treated at an academic/research facility type (54%), with 20% treated at comprehensive cancer centers, 6% treated at an integrated network, and 1% treated at community hospitals.

The mean and median tumor sizes were 3.3 cm and 2.1 cm, respectively (Table 1). 10,136 patients (87%) received surgery only, 623 patients (5%) received radiation only, and 399 patients (3%) received observation only; the remaining 456 (4%) received surgery and radiation and these patients were excluded from subsequent analyses.

3.2. Impact of patient Demographics on receipt of AN surgery

Patients who were African-American (OR = 0.7; 95%CI = 0.5–0.9; p = 0.01), at least age 65 (OR = 0.5; 95%CI = 0.4–0.6; p = 0.0001), had Medicare insurance (OR = 0.6; 95%CI = 0.4–0.7; p = 0.0003), or treated at a community hospital (OR = 0.4; 95%CI = 0.2–0.7; p = 0.006) were less likely to receive surgery. Patients who had Medicaid insurance (OR = 1.2; 95%CI = 0.8–1.9; p = 0.04), a Charlson/Deyo score of one (OR = 1.8; 95%CI = 1.4–2.3; p = 0.003), residence in the central United States (OR = 1.6; 95%CI = 1.4–1.9; p = 0.002), or treated at an integrated network (OR = 1.2; 95%CI = 0.9–1.6; p = 0.003) were more likely to receive surgery (Table 2).
3.3. Impact of patient Demographics on receipt of radiation for AN

Patients at least age 65 (OR = 1.7; 95% CI = 1.4–2.2; p < 0.0001) or treated in a comprehensive cancer center (OR = 1.5; 95% CI = 1.3–1.8; p = 0.001) were more likely to receive radiation. Patients with a Charlson/Deyo score of one (OR = 0.6; 95% CI = 0.5–0.7; p = 0.003) or residing in the central United States (OR = 2.3; 95% CI = 1.8–2.9; p = 0.003) were less likely to receive radiation. Patient gender, race, insurance status, level of education, income or tumor size did not impact receipt of radiation (Table 3).

3.4. Impact of patient Demographics on receipt of observation for AN

Patients who were at least age 65 (OR = 1.8; 95% CI = 1.5–2.3; p < 0.0001), African-American (OR = 1.4; 95% CI = 1.1–1.8; p = 0.03), or treated in a community hospital (OR = 2.2; 95% CI = 1.2–3.9; p = 0.01) were more likely to receive observation. Patients with a Charlson/Deyo score of one (OR = 0.6; 95% CI = 0.5–0.7; p = 0.0008) or treated in an integrated network (OR = 0.8; 95% CI = 0.6–1.0; p = 0.0001) were less likely to receive observation (Table 4).

4. Discussion

Management of AN is challenging and complex, spanning the disciplines of neurosurgery, otolaryngology, and radiation oncology. Although AN grows slowly, morbidity and mortality has the

There are several important results from our findings regarding access to care for patients with AN. One is that elderly patients (age ≥65) were less likely to receive surgery, more likely to receive radiation, and more likely to receive observation than patients younger than age 65. Similarly, African-Americans were less likely to receive surgery and more likely to receive observation, but were not more likely to receive radiation. These findings regarding elderly patients and African-Americans are similar to a previous SEER analysis, which also concluded that larger tumor size increased the likelihood of surgery [3]. Regarding facility type, comprehensive cancer centers were more likely to triage patients to radiation, community hospitals were more likely to triage patients to observation and away from surgery, while integrated networks were more likely to triage patients to surgery and away from observation; these findings are novel and not previously reported by either the SEER or NIS analyses [3,5,8,14]. Patients with Medicare were more likely to be triaged away from surgery and towards observation; however patients on Medicaid were more likely to be triaged towards surgery. Triaging towards radiation occurred independent of race or insurance status. It is important to note that the median AN tumor size in this study (2.1 cm) allowed for true clinical equipoise between the choice of surgery, radiation, and observation.

Given that the adjusted relative risk for in-hospital mortality of AN surgery for African-Americans is 10.6 compared with Caucasians [7], and that private insurance reduces in-hospital and perioperative morbidity by 42% compared with non-private insurance [14], these findings indicate that while it may be beneficial for African-American and Medicare insurance patients to be steered away from surgery, it is likely detrimental for Medicaid insurance patients to be triaged towards AN surgery.

4.1. Limitations

The limitations of this study include its retrospective nature and the possibility of incomplete/biased data reporting and/or miscoding during data submission to NCDB. Furthermore, there has been no verification that the NCDB data is representative of the AN population nationwide. While NCDB contains several important details, important aspects of outcome (local control, distant intracranial control, extracranial control, toxicities) were not available, nor were other important treatment variables (volume of irradiated brain, treatment isodose lines, Karnofsky performance status). Finally, as with all AN cases involving observation or radiation, the rare possibility of a facial nerve schwannoma indistinguishable from an AN on imaging cannot be excluded.

5. Conclusions

In a nationwide examination of the receipt of surgery, radiation, and observation for AN, African-American race, elderly age, and treatment at a community hospital independently predicted triaging towards observation and away from surgery; age also predicted triage towards radiation. Conversely, integrated networks triaged towards surgery and away from observation; comprehensive cancer centers triaged towards radiation. Medicaid insurance predicted triaging towards surgery, but did not influence triage towards radiation or observation. Given the increased in-hospital morbidity previously demonstrated for AN surgery patients without private insurance, it may be detrimental for Medicaid patients to be triaged towards AN surgery.

Disclosures

No author has any conflict of interest.
References
