Overview

There is no consensus on the ideal treatment protocol for stereotactic radiosurgery of benign intracranial tumors such as meningioma and acoustic neuroma. There are site and physician-specific preferences that have evolved over time. This project investigates radiation treatment patterns for benign intracranial tumors from the National Cancer Database.

Introduction

There is no agreed upon protocol for treatment of benign intracranial tumors. Most commonly meningiomas or neuromas, these tumors tend to be slow growing and cause symptoms by mass effect on surrounding structures. Although they tend to grow slowly, without treatment they tend to increase in size until they become symptomatic. Historically, they were discovered at this late stage as only large tumors would be able to be seen on pre-MRI imaging or would be found at the time of surgical exploration. Increasingly tumors are being found incidentally as more patients are imaged for a variety of reasons. Discovery of small, asymptomatic tumors presents a dilemma. Surgery often relies on significant morbidity, traditional external beam radiation exposes normal cranial structures to unnecessary radiation exposure, and monitoring tumors can lead to further growth and increased impact of treatment down the road. More recently, stereotactic radiosurgery has emerged as a method for treating benign tumors with minimal radiation sequela and good tumor control rates. The method of delivery and total radiation dose is no agreed upon and has changed over time.

This study uses the large tumor database of the National Cancer Database (NCDB) to investigate trends in treatment of benign intracranial tumors over time and across centers. The NCDB is a nationwide database that includes patient, tumor, and treatment variables along without outcomes such as 30 and 90 day, and overall survival.

Different institutions have different practice patterns as it relates to treatment of these tumors. Many include neurosurgery, radiation oncology, and otolaryngology depending on the location of the tumor. Each specialty brings unique background and experience to help shape the treatment plan and parameters, and help with long-term follow up and treatment of complications. Finally, appropriate analysis of large databases requires the expertise and experience of a trained biostatistician.

Methods

The NCDB was queried for cases present in the CNS (C70.0, C70.9, C71.0, C71.1, C71.2, C71.3, C71.4, C71.5, C71.6, C71.7, C71.9, C72.2, C72.3, C72.4, C72.5, C72.9) from 2004 to 2014. The NCDB was established in 1989 and includes data from more than 1,500 commission-accredited cancer programs, which in aggregate manages approximately 70% of newly-diagnosed cancer cases in the United States. The International Classification of Diseases for Oncology definitions for topography (primary site) and morphology (histology) are used by the NCDB for cancer identification purposes. The authors note that the NCDB is a joint project of the Commission on Cancer of the American College of Surgeons and the American Cancer Society. The NCDB and the hospitals reporting data to the NCDB are the source of the data used in the paper, but they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions drawn in this study. This study was determined to be exempt by the Institutional Review Board of our institution. Race was grouped as white, black, and other.

Cases were included if they had behavior codes of 0 or 1, had final follow up date and final vital status. Cases with surgery at distant sites or those diagnosed and treated at more than one center were excluded. Demographic information including socioeconomic variables, tumor characteristics, treatment information, and final follow up timing and status were extracted.

Descriptive statistics are presented as frequencies for categorical variables and means with standard deviation (SD) for continuous variables. Overall survival was the primary outcome of interest. Individual variable correlation with survival was analyzed using univariable and multivariable Cox proportional hazards models. The final multivariable model included the following variables: age, sex, race, hispanic, treatment facility type, insurance status, income, education, tumor size, treatment, comorbidity score, and year of diagnosis. Logistic regression modeling with the same variables (except treatment) was used to evaluate which factors had an impact on the inclusion of radiation as part of primary treatment. In logistic model analyses, incomplete cases were removed.

The subset of patients who underwent radiation as part of their primary treatment was then analyzed. A multivariable model with the above variables plus type of radiation was utilized to evaluate how socioeconomic and demographic characteristics of subjects correlated with treatment decisions including radiation as part of treatment, and type of radiation used.

All data processing and analysis was performed with R v. 3.4.4 (https://cran.r-project.org) via R Studio v. 1.1.442 (R Studio, Boston, Massachusetts). This study was determined to be exempt by the Institutional Review Board of the Hospital of the University of Pennsylvania.

Results

250,208 subjects met inclusion criteria and were included in this analysis. Patient, tumor, and treatment characteristics are summarized in Table 1.

Median overall survival was 157 months with survival percentages at 12, 24, 36, 60 and 120 months equal to 92%, 88%, 85%, 80%, and 67%, repectively. Multivariable analysis found significant impacts on overall survival for age, race, comorbidities, type of treating facility, insurance status, race, tumor location, behavior code, \*\*\* Table 2.

12.2% of subjects underwent radiation as part of their primary treatment, with a majority of these having Gamma Knife (36%), followed by stereotactic radiosurgery NOS (19%), IMRT (12.7%), photons (9%), and linac (7%).

\*\*\*Note – I’m still adjusting models and the tables for results are in the process of being finalized.