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Case report

Impact of academic facility type and volume on post-surgical outcomes following diagnosis of glioblastoma

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ABSTRACT

Objective: To identify if facility type and/or facility volume impact overall survival (OS) following diagnosis of glioblastoma (GBM). We also sought to compare early post-surgical outcomes based on these factors.
Methods: The National Cancer Database was queried for patients with GBM diagnosed from 2004 to 2013 with known survival. Patients were grouped based on facility type and facility volume. Multivariable analyses were performed to investigate factors associated OS following diagnosis and Chi-square tests were used to compare early post-surgical outcomes.
Results: 89,839 patients met inclusion criteria. Factors associated with improved OS on multivariable analysis included younger patient age, female gender, race, lower comorbidity score, higher performance score, smaller tumor size, unifocal tumors, MGMT hypermethylation, fully resected tumors, radiotherapy, and chemotherapy (each $p < .001$). Also, OS was improved among patients treated at centers averaging at least 30.2 cases per year (HR 0.948, compared to <7.4 cases/year, $p < .001$), and patients treated at Academic/Research programs had improved survival compared to those treated at Comprehensive Community Cancer programs (HR 1.069, $p < .001$) and Integrated Network Cancer programs (HR 1.126, $p < .001$). Similarly, Academic/Research programs and high volume centers demonstrated improved 30- and 90-day morality as well as 30-day readmission rates ($p < .001$).
Conclusions: This study suggests that patients treated in Academic/Research programs and high patient-volume centers have increased survival and more favorable early-postsurgical outcomes. The extent to which differences in patient populations, socioeconomic factors, and/or provider expertise play into this cause will be areas of future research.

1. Introduction

Glioblastoma (GBM) is the most common malignant primary brain tumor in adults, and usually conveys a dismal prognosis. It is defined as a Grade IV astrocytoma by the World Health Organization (WHO) and is considered one of the most aggressive primary brain neoplasms, with median survival times generally measuring 1–2 years [1]. The current standard of care for GBM is maximum safe surgical resection followed by adjuvant radiotherapy with concurrent and adjuvant temozolomide [1,2]. There are several therapeutic challenges to face when treating patients with GBM, and they require advanced multidisciplinary care and access to a robust health care team. Different treatment settings provide care to variable patient populations and patient volumes, and some have disparate access to clinical trials, expertise, and academic research.

Other disease sites have demonstrated a difference in outcomes based on the location of therapy. A recent study examining the National Cancer Database (NCDB) found that patients with Acute Myelogenous Leukemia (AML) treated at academic centers vs. non-academic had significantly lower one-month mortality and increased overall survival (OS) [3]. Similarly in GBM, studies by Mak et al. and Rhome et al. using the NCDB have reported improved OS for patients with GBM treated at academic centers when compared to community programs (hazard ratio, HR 0.76,

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$p < .0001$, and HR 0.86 $p < .01$, respectively) [4,5]. However, based on their study design, these studies are somewhat limited in that they were restricted to only patients receiving radiotherapy, and with known radiotherapy details [4,5]. Such a study design could bias reporting in favor of those centers with robust reporting of data, which is perhaps confounded by facility type.

Additionally, facility volume was not analyzed in these studies, and others have found high facility volumes to be associated with a lower mortality risk for patients with multiple myeloma [6] and non-Hodgkin lymphoma [7]. It stands to reason that in a complex disease process like GBM, provider expertise could be tied to patient outcome, and perhaps facility type.

Due to these variations in outcomes based on facility type and patient volume that have been reported in the literature, we sought to identify if facility type and/or facility volume impacted OS. We also sought to compare early post-surgical outcomes in GBM across groups.

2. Methods and materials

2.1. Data source and cohort selection

The NCBD is a nationally recognized clinical oncology database and is sponsored by the American College of Surgeons and the American Cancer Society. Established in 1989, it collects data from more than 1,500 facilities accredited by the Commission on Cancer and contains information on treatments and outcomes for patients with malignant disease. The current database gathers more than 70% of new cancer diagnoses in the US and contains more than 34 million historical records [8].

Data was obtained from the NCDB for patients diagnosed with central nervous system (CNS) cancers between 2004 and 2013 (448,453 patients). Patients excluded included those with non-GBM histology or unknown survival (358,614 total excluded, Fig. 1). The remaining 89,839 patients were then grouped based on cancer program category as defined by the NCDB: academic/research program, community cancer program, comprehensive community cancer program, or integrated network cancer program [9].

Cancer program categories are defined by the NCDB based on facility type, program structure, provided services, and number of cases per year [9]. A community cancer program accessions between 100 and 500 new cancer diagnoses per year and participates in clinical research related to cancer. A comprehensive community cancer program is similar but accessions more than 500 new cancer diagnoses per year. An integrated network cancer program is a network of multiple facilities which together provide integrated care. Lastly, an academic/research program has post-graduate medical education in 4 or more areas and accessions over 500 new cancer diagnoses per year [9].

2.2. Statistical analyses

The primary outcome measured for this study was OS measured from date of diagnosis. Further, we defined secondary endpoints as 30- and 90-day post-surgical mortality as well as 30-day readmission following surgery. In order to prevent bias based on sites with underreporting of data and improve result validity, all patients meeting these inclusion criteria were evaluated, even if they contained other missing data elements.

Facility volume was defined as the number of patients included in the analysis that were treated at that patient's facility. Facility volume was then grouped into quartiles for analysis. OS was evaluated via the Kaplan-Meier method and compared using the log-rank test. Univariable and multivariable analyses (Cox proportional hazards models) were performed to investigate factors associated with OS. Potentially prognostic variables in the multivariable models were chosen through purposeful selection and univariable analysis to investigate significance. Factors associated with a $p < .10$ on univariate analysis were included in the multivariable Cox regression models. Post-surgical mortality and readmission was evaluated visually with histograms and analytically using the Chi-square test. All statistical analyses were performed using the SPSS program (SPSS, version 24.0; SPSS Inc., Chicago, IL) and $p < .05$ on multivariable analysis were considered statistically significant.

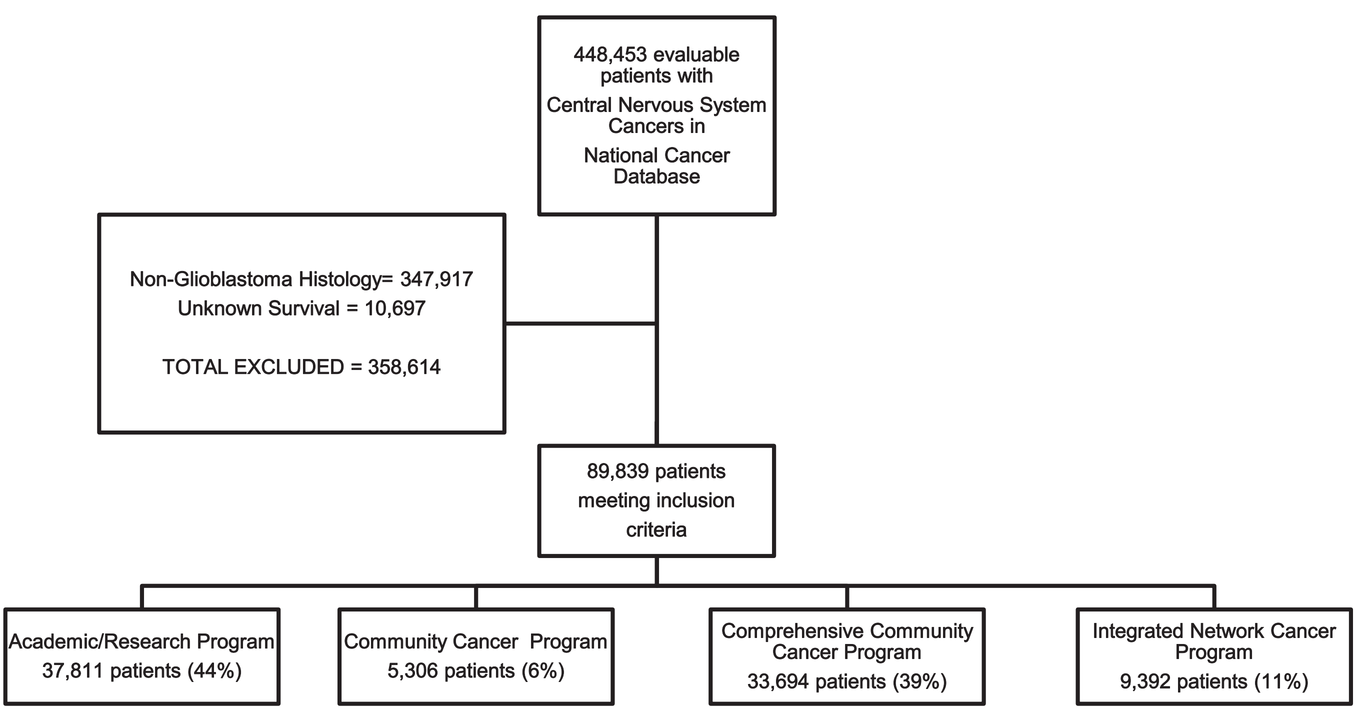

Fig. 1. Cohort selection diagram.

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