Utilization and cost of health care services associated with primary malignant brain tumors in the United States

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Abstract

Objectives To evaluate the economic burden of primary malignant brain tumors in a commercially insured population in the United States, and to identify the primary drivers of health care resource use and cost.

Patients and methods A retrospective cohort analysis was performed using a 1998–2000 database containing inpatient, outpatient, and pharmacy claims for employees, their dependents, and early retirees of over 50 large US employers with wide geographic distribution. Patients were followed from first brain tumor diagnosis until death, termination of health benefits coverage, or study end. Controls without any cancer diagnosis were matched at a 3:1 ratio by demographic characteristics and length of follow-up.

Results Patients with malignant brain tumors \((n = 653)\) had significantly greater health service utilization and costs for hospitalizations, emergency room visits, outpatient office visits, laboratory tests, radiology services, and pharmacy-dispensed drugs (all \(P < 0.05\)) than did controls \((n = 1959)\). Regression-adjusted mean monthly costs were $6364 for brain tumor patients, compared with $277 for controls \((P < 0.0001)\). The primary cost driver was inpatient care ($4502 per month). Total costs during the study period were $49,242 for those with brain tumors and $2790 for controls \((P < 0.0001)\).

Conclusion Patients with malignant brain tumors accrued health care costs that were 20 times greater than demographically matched control subjects without cancer. The costs for inpatient services were the primary drivers of total health resource use. Despite their low incidence, primary malignant brain tumors produce a substantial burden on the US health care system. There is a marked need for improved and new approaches to treatment to reduce the resource use and to offset health care costs associated with this disease.

Keywords Brain tumors · Health care resource use · Health care costs

Introduction

Each year, approximately 18,500 new cases of primary malignant brain tumors are diagnosed in the United States [1]. Despite the relatively low incidence and prevalence (about 1.5% of all cancers), brain tumors cause substantial morbidity and are associated with high rates of mortality (5-year survival, 3.3%) [1, 2]. Estimating the dollar magnitude of the burden of illness associated with brain tumors is useful for several reasons; it can provide a benchmark for comparing economic evaluations of treatment interventions as well as the input for those evaluations. Although the
burden of brain tumors is considerable, few studies have estimated the attendant costs of care for affected patients [3]. Silverstein et al. [4] found that the mean total direct medical charges from diagnosis to death for US patients with high-grade astrocytomas were $67,887. Other studies have highlighted the economic burden of brain tumors in Sweden, Canada, and the United Kingdom [5–7]. However, the published estimates have a number of limitations: study samples were small and confined to selected geographic regions [4, 7], or multiple data sources were used, including different diagnostic [6] and epidemiological databases [4]. These deficiencies, combined with the paucity of comprehensive economic data, make it difficult to grasp the full magnitude of the economic burden of this disease.

We have conducted a retrospective cohort study using a single, longitudinal database of administrative insurance claims of patients distributed across all geographic regions of the United States and all age ranges to estimate the economic burden of primary malignant brain tumors and the primary drivers of cost. The data presented here are part of a larger database study that included direct and indirect costs associated with seven types of cancer from 1999 to 2000 [8].

Materials and methods

Data source

This study used the MarketScan® Commercial Claims and Encounters and Medicare Supplemental and Medicare Supplemental and Coordination of Benefits databases, which contained the inpatient, outpatient, and outpatient pharmacy-dispensed drug claims for more than 3 million individuals covered by many large US employers [8]. Both Medicare and employer-covered payments were included in the database for patients above age 65.

Primary malignant brain tumor patients and control selection

The study populations consisted of patients newly diagnosed with primary malignant brain tumors [International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) = 191.xx] between January 1, 1999, and November 30, 2000, as described by Chang et al. [8]. Controls (subjects without any cancer diagnosis) were matched 3:1 with brain tumor patients for age, gender, geographic region, type of insurance plan, and length of enrollment.

Study outcomes

Resource utilization and direct costs were summarized for patients and controls as monthly means and the total amount over the follow-up period. Medical services were classified as inpatient hospitalizations and lengths of stay, emergency room visits, office visits, outpatient laboratory procedures, radiology (diagnostic and therapeutic) procedures, and outpatient pharmacy-dispensed medications. The cost of chemotherapy and other drug treatments was included in the cost of office visits or hospital stays, unless those medications were dispensed from an outpatient pharmacy. A Charlson Comorbidity Index (CCI) score was calculated to adjust for major comorbid health conditions [9]. Cancer staging was determined using Disease StagingTM software [10]. Mild or moderate brain tumors (stage I or II) included those with central nervous system neoplasia and cranial nerve deficits, while advanced tumors (stage III or IV) included those with central nervous system neoplasia and hemiparesis, hemiplegia, paraplegia, paraparesis, grand mal seizures, metastases, coma, decerebrate rigidity, or respiratory failure. These severity designations correspond to American Joint Committee on Cancer (AJCC) stages I and II (mild to moderate severity) and AJCC stages III and IV (advanced severity) [10].

Statistical analysis

To determine statistically significant differences ($P < 0.05$) between malignant brain tumor and control groups, 2-sided $t$-tests were used for continuous variables, and chi-square tests were used for categorical variables. Regression-adjusted total direct costs per month and across the study period were estimated with multivariate modeling that controlled for gender, age, health plan type, geographic region, CCI, length of follow-up, and in-hospital mortality. Ordinary least squares regression was the best fit for cancer costs, and 2-stage models fit the best for control costs [8]. The log-predicted values were transformed into actual costs via exponentiation and application of a smearing estimate [11].

Results

This study included 653 new cases of primary malignant brain tumors and 1959 matched controls without cancer. Table 1 contains the demographic characteristics of the study population.