Quality of Life after Surgery for Intracranial Meningioma

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Abstract

Background—Limited data exist on long-term quality of life (QOL) for patients diagnosed with intracranial meningioma.

Methods—The data are on 1722 meningioma cases diagnosed among residents of Connecticut, Massachusetts, California, Texas, and North Carolina from May 1, 2006 through March 14, 2013 and 1622 controls frequency matched to the cases by age, sex and geography. These individuals were participants in a large, population-based case/control study. Telephone interviews were used to collect data on QOL at time of initial diagnosis or contact, using the Medical Outcomes Study (MOS-36). QOL outcomes were compared by case/control status.

Results—Patients diagnosed with meningioma report levels of physical, emotional, and mental health functioning below those reported in a general healthy population. Case participants and controls differed most significantly in the domains of physical and social functioning, role-physical, role-emotional and vitality.

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Conclusions—Patients with meningioma experience statistically significant decreases in quality of life compared to a healthy control of similar demographic breakdown, though these differences vary in clinical significance.

Precis:

Patients with meningioma experience statistically significant decreases in quality of life compared to a healthy control of similar demographic breakdown, most notably in the domains of physical and social functioning, role-physical, role-emotional and vitality. These differences, however, vary in clinical significance.

Keywords

meningioma; quality of life; case-control studies; SF-36; brain tumors

Introduction

Within the United States, meningioma is the most frequently diagnosed primary brain tumor in adults[1,2]. While generally defined histologically as benign, these lesions are frequently associated with neurological complications and decreased quality of life (QOL).[3–5] Despite this, few studies, all of which include relatively small numbers of patients, have explicitly examined quality of life among meningioma patients.[6–13]

As the use of imaging throughout the United States has intensified, so has the number of persons diagnosed with meningioma, with up to 1% of the general adult population estimated to have such a lesion,[1] although many of those patients will remain asymptomatic. For those patients who present with symptoms or with brain imaging that is clinically concerning, surgical resection remains the most commonly selected intervention, with a much smaller number receiving radiation therapy as first course of treatment. Thus, both presentation and treatment may affect patient quality of life. Although numerous studies report decreased quality of life for patients with malignant brain tumors,[6–13] it is of interest to examine outcomes specifically for meningioma patients to better define whether similar post-treatment counseling strategies are needed relative to patients with malignant brain tumors such as glioma and metastatic lesions, as these patients generally receive both radiation and chemotherapy in addition to surgery as part of treatment. Our analysis represents the largest effort to date to describe the symptoms and quality of life for a population-based series of meningioma patients treated with surgical intervention, examining these variables in a sample that is almost ten-fold larger than any prior work.[17]

Materials and Methods

Study Population

Case patients eligible for the study included all persons diagnosed between May 1, 2006 and March 14, 2013 with a histologically confirmed intracranial meningioma among residents of the states of Connecticut, Massachusetts, and North Carolina, and several counties in California (Alameda, San Francisco, Contra Costa, Marin, San Mateo, and Santa Clara) and Texas (Brazoria, Fort Bend, Harris, Montgomery, Chambers, Galveston, Liberty, and

Waller). Case patients were diagnosed between the ages of 20–79 and were identified through the Rapid Care Ascertainment systems and state tumor registries at their respective study site. Controls were obtained through random-digit dialing performed by an outside consulting firm (Kreider Research and Consulting) and were frequency matched with case patients by 5-year age interval, sex, and state of residence. Patients with a prior history of meningioma and/or a brain lesion of unknown pathology were not eligible for inclusion. The study, consent forms, and questionnaire were approved by the institutional review boards at Yale University School of Medicine, Brigham and Women's Hospital, University of California at San Francisco, MD Anderson Cancer Center, and Duke University School of Medicine. The study was also approved by the State of Connecticut Department of Public Health Human Investigation Committee, with some data directly obtained from the Connecticut Tumor Registry in the Connecticut Department of Public Health as well as the Massachusetts Tumor Registry.

Data Collection

Physicians for eligible case patients were contacted to obtain permission to approach the patient about participation in the study. Case patients receiving permission from their physician and potentially eligible patients identified by Krieder Research were sent an introductory letter. Within 1–2 weeks, these letters were followed up with a phone call by a trained interviewer, who described the study and administered the interview by telephone. Interviews took an average of 52 minutes. The questionnaire asked both cases and controls detailed questions regarding their demographics, family history with cancer, pregnancy and menstrual history, exogenous hormone history, medical history, and quality of life.

Physicians of 94% of eligible cases consented to (or did not deny) patient contact (n=2923); an additional 8 cases were self-referred. Of these, 361 did not have a current telephone number or address. There were thus 2,570 eligible cases with current contact information and physician consent or self-referral. Of those, we interviewed 1,722 (12 by proxy) (67%); 271 (10.5%) could not be reached; 544 (21.2%) refused; and 31 participated in other portions of the study, but were not interviewed. Among controls, 151 (5.8%) did not have a current telephone number or address. There were thus 3,254 controls with current contact information and of those, we interviewed 1,622 (50%); 493 (15%) could not be reached; 10 (<1%) withdrew; and 1,129 refused. The majority of cases were interviewed within one year from time of initial surgery, with a median (mean) time between surgery and interview of 0.59 (0.93) years, respectively. The sample used in this analysis includes data from 1722 cases and 1622 controls.

Statistical Analysis

Health-related quality of life (QOL) was measured using the Medical Outcomes Study 36-item short form version (MOS-SF-36).[14] This instrument includes eight individual scales for physical functioning, role function-physical, bodily pain, social functioning, mental health, role function-emotional, vitality and general health perceptions. Each scale is scored from 0 to 100, with 100 representing the best score. The SF-36 also has two summary scales-the Physical Component Summary Scale (PCS) and the Mental Component Summary Scale

(MCS). The summary scales are standardized to a reference healthy population with a mean score of 50 and a standard deviation of 10.

Statistical analysis included descriptive statistics and were computed using the R version 3.2.3 and Statistical Analysis Software SAS (VERSION 9.4). T-tests, chi-square, and Fisher's exact tests as well as unadjusted odds ratios (OR) with 95% confidence intervals (CI) were used to examine whether descriptive characteristics of the study population differed between cases and controls while generalized linear models (GLM) were used to provide adjusted estimates of outcome risk. The effect of multiple comparisons was controlled for using a Bonferroni correction to make pairwise comparisons across the two study groups. Estimates of MOS SF-36 means were adjusted for the effects of age (continuous), race (white/nonwhite), comorbid conditions (myocardial infarction, stroke, cancer), education (some college or more/no college), sex, menopausal status (females only), radiation therapy (cases only), and case/control status. The MOS SF-36 variables were coded according to the guidelines presented in Ware et al.[14]

Results

Summary statistics are given in Table 1. The majority of study subjects were female, White, and had attended some college. Cases and controls did not differ significantly by mean age (57.6 years for cases versus 57.3 for controls), sex, residence or number of comorbid conditions. Control participants were more likely than cases to be white (p = 0.02) and to have completed their education beyond the high school (p < 0.01). Approximately 11% of cases received radiation therapy in addition to surgery. Female cases were more likely than controls to report a surgical menopause, possibly due to the known association between uterine fibroids and meningioma.[17] Among cases, tumors were evenly divided between the right and left hemispheres.

Symptoms reported by case participants at time of diagnosis are presented in Table 2. The most common presenting symptoms were: headache (35.4%), visual disturbance (20.2%), seizures (16.3%), numbness/tingling (13.0%) and weakness/motor deficit (11.1%). In general, patients with right-sided tumors reported higher rates of symptoms than did those with left-sided tumors. This difference was most noticeable for visual disturbance (p = 0.04), headache (p < 0.01), nausea/vomiting (p = 0.01), and weakness or motor deficit (p < 0.01). As expected, patients with left-sided tumors had higher rates of difficulty with speech (p < 0.01).

The adjusted mean levels of the MOS SF-36 health domains are presented in Table 3. Statistically lower scores were reported for cases versus controls in all health domains except bodily pain. In fact, all domains had p-values less than 0.001 with the exception of bodily pain (p = 0.132). The greatest differences between the controls and cases occurred in Role-Physical (17.96 points), Role-Emotional (9.32 points), and Social Functioning (7.88 Points) domains. Patients who received radiation therapy reported significantly lower scores for vitality, role-physical, and social functioning relative to patients who only received surgery. Despite these differences, the majority of both cases (82.7%) and controls (90.6%) reported having good/very good/excellent health.

Discussion

This is the largest study to examine health related quality of life for patients with meningioma, being tenfold larger than prior reports. [6–13] Our study benefits from a large, population-based sample of patients and controls.[17] The instruments used in this study (MOS SF-36) have been previously validated and have population norms.[14]

Our study identified statistically lower scores for cases than for controls in seven of the eight SF-36 domains. Prior studies (Table 4) [6–13,] (using both the SF-36 as well as other QOL instruments) have reported a variety of case/control differences; One study found no significant quality of life differences between cases and controls[9] while, later studies found significant differences in General Health and Vitality[13], and Physical Role[10]. Of note, the 2013 case-control study performed by Waagemans et al.[13] found case scores to be lower than control scores in all eight SF-36 scales, but most differences were not statistically significant due to the small sample size (n=21). One study that did find impaired executive functioning correlated with significant differences in seven of the eight scales[6], but drew no conclusions between case and control group means. Our ability to consistently detect such variation between cases and controls is likely due to the large sample size.

Cases who reported undergoing radiation treatment (generally used to treat lesions that are not entirely removed by surgery or lesions that are viewed as being more aggressive histologically) reported statistically lower scores in vitality, role physical, and social functioning than did cases who did not receive radiation therapy. Although radiation therapy for meningioma is more focused than for treatment of other brain tumors such as glioma, our results highlight the presence of the radiation-related side effect of fatigue at least in the time period close to treatment.

The extent to which the observed differences between the cases and controls are regarded as clinically significant varies across domains. Within the literature, the magnitude of difference regarded to be clinically significant are those in which groups are separated by greater than one half of a standard deviation.[15,16] The most clinically significantly differences among the eight SF-36 domains are in Vitality, Physical Functioning, Social Functioning, Role-Emotional, and Role-Physical. While the difference between the patient and control groups in the Mental Health scale begins to border on clinical significance, the differences in the General Health scales were each less than one-half the theoretical standard deviation of 5 points. Our results seem to indicate that meningioma patients compared to controls report lower physical and emotional health, and were more likely to report that their physical and social roles were reduced, at least within a year from time of surgery.

In examining tumor laterality, our results seem to indicate, with the exception of speech disturbance, that cases with right-sided lesions reported more symptoms than patients with left-sided lesions. Our symptom frequency results differ from the one prior study that examined laterally, in which patients with left-brain tumors reported a higher symptomology;[8] it is difficult to compare the two results given the prior study included only 29 cases. More recent study found no association between tumor laterality and QOL[12] and suggested that clinicians underestimate the importance of the right brain.

Caveats to our study include variation in response rate by demographic characteristics. Patients and controls did not differ by sex, age, or geographical site but did differ with respect to race and education, with controls more likely to report being white and college-educated than cases, suggesting a greater willingness among persons of higher socioeconomic status to participate in epidemiology research. Although these variables were adjusted for in all analyses, such differences in socioeconomic status, a factor likely related to quality of life, may lead to bias in estimating the clinical significance of differences between case and control group means. Given the racial/ethnic background of our study population, our results are applicable primarily to a white population. Histological confirmation was obtained for all patients, suggesting that these results may only be applicable to lesions that are deemed in need of surgery rather than conservative management. As QOL data were collected at only one point in time, the analyses are not able to control for baseline psychosocial status nor for status at a time distant from surgery.

Patients with meningioma experience significant decreases in quality of life compared to a healthy control of similar demographic breakdown. The lower QOL for meningioma patients compared to controls is most clinically significant within the domains of physical and emotional role, physical and social functioning, and vitality. The findings suggest that at least within the time period close to treatment, patients may benefit from additional support for these domains.

Acknowledgments

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Table 1:

Population Summary Table

Characteristic	Meningioma Group (n = 1722)		Control Group (n = 1622)		
	No.	%	No.	%	P-Value
Age at initial onset/interview, years					
20–39	137	8.0	131	8.1	
40–49	323	18.8	310	19.2	
50–59	480	28.0	482	29.8	**0.3907**
60–69	515	30.0	435	26.9	
70+	261	15.2	257	15.9	
Average Age	57.6		57.3		
SD	11.8		12		
Sex					
Male	476	27.6	454	28.0	**0.8225**
Female	1246	72.4	1168	72.0	
Race					
White	1433	83.3	1396	86.1	**0.0245**
Non-White	287	16.7	225	13.9	
Education					
Grade School/Some High School	91	5.3	47	2.9	
High School Graduate	467	27.2	304	18.8	**<0.0001**
Some College	406	23.7	347	21.4	
College Graduate/Higher	750	43.8	921	56.9	
Menipausal Status [*]					
Premenopausal	288	23.2	281	24.0	
Perimenopausal	163	13.1	144	12.3	**0.0089**
Postmenopausal (nonsurgical)	643	51.8	650	55.7	
Postmenopausal (surgical)	148	11.9	93	8.0	
Marital Status					
Single/Never Married	160	10.1	170	11.7	
Married	1068	67.3	941	64.7	
Separated	23	1.5	21	1.4	**0.5930**
Divorced	210	13.2	189	13.0	
Widowed	107	6.7	113	7.8	
Living with Partner	18	1.1	20	1.4	
Comorbidity [**]					**0.2521**
One or More	378	21.9	383	23.6	
Radiation [***]					
No Radiation	1517	89.1	--	--	
Radiation	185	10.9	--	--	

Characteristic	Meningioma Group (n = 1722)		Control Group (n = 1622)		P-Value
	No.	%	No.	%	
Tumor Laterality ***					
Right Hemisphere	748	49.6	--	--	**0.7574**
Left Hemisphere	761	50.4	--	--	

*
Women Only

**
Other Cancers, Myocardial Infarction, and Stroke

***
Cases only

Sample Sizes Vary due to Missing Values

Table 2:

Symptom Frequency Table

Symptom	Meningioma Group (n = 1722)		Tumor in Left Hemisphere (n = 761)		Tumor in Right Hemisphere (n = 748)		Difference Between Right and Left Hemispheres
	No.	%	No.	%	No.	%	P-Value
Headache	603	35.4	244	32.1	287	38.6	p = 0.0087
Visual Disturbance	343	20.2	130	17.1	158	21.2	p = 0.0432
Seizures	276	16.3	119	15.7	128	17.2	p = 0.4248
Numbness/Tingling	201	13.0	99	13.0	99	13.3	p = 0.8963
Weakness or Motor Deficit	190	11.1	65	8.6	105	14.1	p = 0.0007
Difficulty Remembering New Facts	168	9.9	81	10.7	64	8.6	p = 0.1740
Difficulty Getting Words Out	137	8.0	89	11.7	39	5.2	p < 0.0001
Personality Change	133	7.8	46	6.1	65	8.7	p = 0.0494
Nausea/Vomiting	122	7.2	42	5.5	66	8.9	p = 0.0129
Difficulty Remembering Old Facts	109	6.4	61	8	35	4.7	p = 0.0079
Excess Sleepiness	95	5.6	42	5.5	44	5.9	p = 0.7512

*
Sample Sizes Vary due to Missing Values

MOS SF-36 Adjusted Group Means

MOS SF-36 Health Domain	Adjusted* Control Mean (n = 1449)	Adjusted* Case Mean (n = 1544)	P-Value
Physical Functioning	77.02	70.50	<0.001
Role-Physical	64.48	46.52	<0.001
Bodily Pain	67.96	66.56	0.132
General Health	69.90	67.06	<0.001
Vitality	58.85	51.74	<0.001
Social Functioning	78.58	70.7	<0.001
Role-Emotional	75.71	66.39	<0.001
Mental Health	76.77	72.79	<0.001

*
Means adjusted for age (continuous), race (white vs. non-white), sex, menopausal status (for females), case/control status, use of radiation, education (college grad/no college), and other comorbid conditions (stroke, myocardial infarction, and other cancers)

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Table 4:

Literature Review Table

Case/Control Studies

Authors & Year	No. Cases	QOL Method(s)	Statistically Significant MOS SF-36 Health Domains
Staplers et al (2007)	95	SF-36	Not Reported (Abstract Only)
van Nieuwenhuizen (2007)	18	SF-36, EORTC-BCM20, KPS, BADLI	None
Waagemens et al (2011)	89	SF-36	Role Physical
van Nieuwenhuizen (2013)	21	SF-36	General Health, Vitality

Case Series

Authors & Year	No. Cases	QOL Method(s)	Statistically Significant Health Domains
Chan et al (1984)	257	KPS	N/A
Mohsenipour et al (2001)	82	IHD(NS), NHP	N/A
Santos et al (2011)	29	IHD(NS), NHP	NHP: Pain, Emotional Reactions, Sleepiness, Physical Abilities [*] IHD(NS): Physical Condition, Independence, Physcological Condition [*]
Drewes et al (2016)	248	EQ-5D-3L	None

[*] Significance between patients before and after surgery

Quality of Life Method Glossarry

BADLI Barthel Activities of Daily Living Index

EORTC-BCM20 European Organization for Research and Treatment of Cancer–Brain Cancer Module-20 Questionnaire

EQ-5D-3L EuroQol Five Dimension Questionnaire

IHD(NS) Innsbruck Health Dimensions Questionnaire for Neurosurgical Patients

KPS Karnofsky Performance Scale

NHP Nottingham Health Profile

SF-36 Medical Outcomes Study Short Form 36 Questionnaire