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Authors

Jette, Nathalie
Morgenstern, Rachelle
Agarwal, Parul
et al.

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Palliative Care Referral across the Disease Trajectory in High-Grade Glioma

Rita C. Crooms, MD MPH[1,2], **Jennie W. Taylor, MD MPH**[3], **Nathalie Jette, MD MSc**[1,4], **Rachelle Morgenstern, MPH**[1], **Parul Agarwal, PhD MPH**[1,4], **Nathan E. Goldstein, MD**[2], **Barbara G. Vickrey, MD MPH**[1]

[1]Department of Neurology, Icahn School of Medicine at Mount Sinai, New York, NY, USA

[2]Brookdale Department of Geriatrics and Palliative Medicine, Icahn School of Medicine at Mount Sinai, New York, NY, USA

[3]Departments of Neurology and Neurological Surgery, University of California, San Francisco, San Francisco, CA, USA

[4]Institute for Healthcare Delivery Science, Department of Population Health Science and Policy, Icahn School of Medicine at Mount Sinai, New York, NY, USA

Abstract

PURPOSE: Patients with high-grade glioma (HGG), WHO grade III or IV, have substantial palliative care needs. Our aim was to determine occurrence, timing, and factors associated with palliative care consultation (PCC) in HGG at one large academic institution.

METHODS: HGG patients receiving care between 08/1/2011 and 01/23/2020 were identified retrospectively from a multicenter healthcare system cancer registry. Patients were stratified by any PCC (yes/no), and timing of initial PCC by disease phase: diagnosis (before radiation), during initial treatment (first-line chemotherapy/radiation), second-line treatment(s), or end-of-life (after last chemotherapy).

RESULTS: Of 621 HGG patients, 134 (21.58%) received PCC with the vast majority occurring during hospital admission (111 (82.84%)). Of the 134, 14 (10.45%) were referred during the diagnostic phase; 35 (26.12%) during initial treatment; 20 (14.93%) during second-line treatment; and 65 (48.51%) during end of life. In multivariable logistic regression, only higher Charlson Comorbidity Index was associated with greater odds of PCC (OR 1.3 [95% CI 1.2 – 1.4], p<.01); but not age or histopathology. Patients who received PCC prior to end of life had longer survival from diagnosis than those referred during end of life (16.5 [8, 24] months vs 11 [4, 17]; p<0.01).

CONCLUSION: A minority of HGG patients ever received PCC, which primarily occurred in the inpatient setting, and nearly half during the end-of-life phase. Thus, only about one in ten patients in the entire cohort potentially received the benefits of earlier PCC despite earlier referral having an association with longer survival. Further studies should elucidate barriers and facilitators to early PCC in HGG.

Corresponding author: Rita C. Crooms, MD MPH. caroline.crooms@mssm.edu.

The investigators have no conflicts of interest to disclose.

Keywords

Glioma; palliative care; quality of life; care trajectories

Introduction

WHO Grade III and IV gliomas (high-grade glioma; HGG) are aggressive, primary malignant brain tumors that have a devastating impact on patients and their caregivers due to debilitating neurologic symptoms,[1] cognitive and functional decline,[2, 3] and universally poor prognosis.[4] HGG has an annual incidence of roughly 4 per 100,000 in the United States,[4] and is disproportionately burdensome with respect to illness intrusiveness, intensity of treatment, and health care costs.[5] Older adults with HGG in particular have significantly reduced health-related quality of life (HRQOL), due to worse prognosis and potentially lower tolerance of treatment.[6] Along with improving survival and disease-free progression, HRQOL is an important area of research for HGG.[7]

Early, interdisciplinary palliative care yields improvements in HRQOL in multiple cancer populations, through physical and psychological symptom management and psychosocial and spiritual support, including for caregivers.[8] Thus, the American Society for Clinical Oncology (ASCO) and National Comprehensive Cancer Network (NCCN) recommend early referral (within 8 weeks of diagnosis) for all patients with aggressive cancer, concurrent with cancer-directed treatment.[9, 10] This recommendation for early, concurrent palliative care management includes HGG, though the benefits of specialty palliative care (i.e. involving specialists with advanced training in the field) for this specific population have not yet been determined in clinical trials.[11–13]

Extant literature shows that only a minority of HGG patients ever receive specialty palliative care consultation (PCC), and those who do are typically referred much later than the recommended 8 weeks (or less) after diagnosis.[14, 15] One potential barrier to referral is the misperception that specialty palliative care is incompatible with cancer-directed and life-sustaining treatment and that referral will decrease hope on the part of the patient.[16] Yet factors other than proximity to diagnosis may drive palliative care referral – and lack of referral – in this population.[17] To assess potential referral triggers in current practice, and whether these differ for older compared to younger adults, we sought to: 1) determine the occurrence and timing of PCC among adults with HGG, relative to key milestones in their disease trajectory; 2) identify patient characteristics associated with any PCC and with timing of consultation; 3) compare adults with HGG over age 65 years with those under 65 with respect to occurrence, timing, and predictors of palliative care referral; and 4) compare overall survival from diagnosis, based on receipt of palliative care.

Methods and Materials

Data source

A retrospective cohort study was conducted in a large, multicenter New York health system using data from the Mount Sinai cancer registry and the Mount Sinai Data Warehouse

(MSDW). The cancer registry contains data abstracted from the electronic medical record (EMR) regarding diagnosis, treatment, health care utilization, and outcomes for all cancer patients (identified through International Classification of Diseases (ICD) diagnosis codes and tissue pathology) receiving care in the Mount Sinai Health System (MSHS).[18] The MSDW holds clinical and operational data, including details of consultation, from the MSHS EMR. Data from the registry and warehouse were linked using patients' MSHS medical record numbers. Targeted manual EMR look-ups were conducted (by RCC) to verify palliative care status and timing and fill in missing observations for tumor location, treatment information (including dates), comorbidities, and date of death.

Cohort selection

Adults aged 18 years or older at the time of HGG diagnosis and treated in the MSHS from August 1, 2011 (the date of EMR availability) to January 23, 2020 (date data analysis began), were identified from the cancer registry utilizing International Classification of Diseases for Oncology codes 9440 for glioblastoma (GBM), 9401 for anaplastic astrocytoma, and 9451 for anaplastic oligodendroglioma.

Outcome measures

Our primary variable of interest was receipt of any specialty PCC, identified by linking the cancer registry cohort to the MSDW, which records consultation details, including provider specialty. Among patients who received PCC, an additional outcome was timing of initial PCC classified by disease phase using treatment dates from the cancer registry. The date of first contact as defined by the cancer registry (the date of first neuroimaging study showing the tumor) was the onset of disease.

Disease phases

Disease phases were defined as: 1) diagnosis (date of first contact until first date of radiation and/or chemotherapy); 2) initial treatment (date of beginning first-line chemotherapy and/or radiation until last date of first-line chemotherapy); 3) second-line treatment, if any (date of beginning second-line chemotherapy to last date of chemotherapy); or 4) end-of-life (after last date of chemotherapy). Initial surgery was considered as within the diagnosis phase (which begins with date of first contact, prior to surgery) in our analysis – as has also been done by others [19] - rather than within the initial treatment phase. Although tumor debulking plays an important role in treatment for many patients, biopsy (with or without debulking) is part of the diagnostic process; additionally, surgery is typically followed by radiation and/or chemotherapy regardless of extent of debulking.[20, 21] Timing of palliative care was also categorized as a binary variable: earlier (before end-of-life) and end-of-life (after last chemotherapy). Survival from time of diagnosis to death was also evaluated for patients with a known date of death.

Independent variables

Demographic characteristics included in the analyses were age, sex, race, ethnicity, marital status, and language. Clinical characteristics were tumor histopathology, tumor location, and lifetime Charlson Comorbidity Index (CCI), defined utilizing previously validated ICD

codes; higher numerical CCI (range: 0 to 37) means greater/more comorbidity.[22] Hospital characteristics were discharge status and date of final inpatient admission to death, given a high rate of hospitalization in the final month of life for patients with HGG.[23] Among patients who received PCC, setting of consultation (inpatient and/or outpatient), days from diagnosis to first PCC, and days from first PCC to death were analyzed.

Statistical analysis

Baseline patient characteristics at diagnosis were described using mean with standard deviation or median with interquartile range [IQR] for continuous variables, and frequencies with percentages for categorical variables.

To determine the occurrence and timing of PCC for patients who were referred, frequencies and percentages were reported for timing of initial consultation by phase and for setting of consultation. Days from diagnosis to first palliative care encounter and from first palliative care encounter to death were described as median with IQR.

To identify patient characteristics associated with PCC, patients who did receive a consultation were compared to those who did not using rank-sum scores, Chi-square tests, and Fisher exact tests on the independent variables as above. To evaluate trends in palliative care referral over time, incidence rate ratios (IRR) of PCC were calculated using log-linear Poisson models. Due to small numbers of patients receiving PCC in each year prior to 2013, the years 2011–2013 were combined and used as the reference. IRR was calculated individually for each subsequent year. On inspecting these data, there were apparent inflection points in 2014 and 2018 and further analysis confirmed there was no significant difference in incidence rate of PCC for any of the years from 2014 to 2017 or between 2018 and 2019. Thus, to account for these inflection points in the final model, IRR was calculated for 2014–2017 and 2018–2019, relative to 2011–2013. Univariable and multivariable logistic regressions were fitted to identify predictors of PCC. When developing a regression model to determine predictors of PCC, age and marital status were significantly associated with each other, as were tumor location and histopathology. Since age was a more robust variable than marital status and histopathology was more significantly associated with PCC compared to tumor location, marital status and tumor location were excluded from the model to prevent multi-collinearity. CCI, which was significantly associated with PCC (p-value ≤ 0.1) in univariable regression, and clinical variables of interest (age and tumor grade, hypothesized a priori to have an association with palliative care referral) were included as covariates in the multivariable models. Regression analyses were also conducted to evaluate predictors of earlier (before the end-of-life phase; the first three phases were categorized as “earlier” for the purpose of these analyses due to small numbers in each phase) relative to later (during end-of-life) palliative care referral.

To compare palliative care referral among older adults (over age 65 years) with HGG with those younger than age 65, bivariate tests of demographic and clinical variables were conducted as described above. Univariable and multivariable logistic regressions were fitted to identify predictors of PCC for each of the two age groups.

To compare overall survival from diagnosis based on receipt of palliative care, Kaplan-Meier curves were plotted, with log-rank test to compare curves stratified by receipt of PCC and earlier vs later referral. The proportional hazards assumption was met, and a Cox proportional hazards model was fitted to identify predictors of survival time from diagnosis in the total cohort, stratified by receipt of palliative care; in patients who received PCC, stratified by earlier vs later referral; and comparing earlier referral vs no PCC and later referral vs no PCC. These models were adjusted for age, sex, tumor grade, and CCI score, as these variables were significant in bivariate analyses. P-value < .05 was considered significant. SAS software version 9.4 (SAS Institute Inc., Carey, NC) was used for statistical analyses.

Standard Protocol Approval

This study was reviewed and approved by the Institutional Review Board at the Icahn School of Medicine at Mount Sinai (protocol 20–00097). A waiver of informed consent was obtained as most patients were expected to be deceased at the time of record review and participation posed minimal risk.

Results

Study cohort

Six-hundred twenty-one patients with HGG were identified. Of these, 134 (21.6%) ever received a PCC. Baseline characteristics of the cohort are in Table 1. The mean age of the overall cohort was 59.4 (± 14.1) and 55.1% were male. With respect to race, 64.1% were White, 13% were Black/African-American, 6.8% were American Indian/Alaskan Native/ Asian/Pacific Islander, and 16.1% were of unknown or other race. The majority (81.2%) were non-Hispanic. Mean CCI score was 2.83 (± 3). Glioblastoma was the most common tumor histopathology (83.7%).

Occurrence and Timing of Palliative Care Consultation

Details of PCC are in Table 2. Of the 134 patients who received a PCC, 14 (10.5%) were referred during the diagnostic phase; 35 (26.1%) during initial treatment; 20 (14.9%) during second-line treatment; and 65 (48.5%) in the end-of-life phase. Most patients received consultation exclusively in the inpatient setting (82.8%) and fewer had encounters in the outpatient setting (13.4%) or in both inpatient and outpatient settings (3.73%). Median [IQR] number of days from diagnosis to palliative care encounter was 153 [36, 363] among all patients who received PCC; 93 [27, 211] among patients referred before the end-of-life phase; and 283 [74, 451] among patients referred during the end-of-life phase. Median [IQR] days from initial PCC to death was 74 [15, 277] among all patients who received PCC, 261 [163, 489] among patients referred before the end-of-life phase, and 23 [7, 48] among patients referred during the end-of-life phase.

Predictors of palliative care consultation

Bivariate analyses comparing patients who did and did not receive PCC are shown in Table 1. Mean age for HGG patients with a PCC was 61.1 years compared to 58.9 years for those without a consultation (*Wilcoxon sum-rank* p = 0.1). Just over half (55%)

were male in both groups. The racial, ethnic, and language distributions were similar between groups, but the palliative care cohort had a lower proportion of married/civil union patients (12.7% vs 31.6%) and a higher proportion of single (56.7% vs 38.4%) and divorced/separated (27.6% vs 22%) patients (*Fisher's exact* p<.01). Clinically, patients who received PCC had more comorbidities as reflected in higher mean CCI scores (p<.01); greater proportion of glioblastoma histopathology (89.6% vs 82.1%, *Fisher's exact* p = .04); and greater proportion of infratentorial tumors (4.5% vs 1.9%, p<.01). Regarding discharge status, a higher proportion of the palliative care group died in-hospital (22% vs 3.1%) or were discharged to hospice (33.1% vs 22.3%), and a lower proportion underwent routine discharge to home (8.5% vs 34%) or with home health services (13.6% vs 18.4%, *Chi-square* p<.01).

With respect to trends in palliative care referral over time, relative to the first two years of the study (2011–2013) the rate of PCC increased in the period from 2014–2017 (IRR 3.4 [9% Confidence Interval (CI) 2.0, 6.0]) and again in the period from 2018–2019 (IRR: 9.8 [95% CI 5.5, 17.5]). This is also reflected by increasing volume of PCC over time, with 22 (17.1%) of 128 newly diagnosed HGG patients referred between 2011–2013 and 19 (35.9%) of 53 newly diagnosed HGG patients referred in 2019. Results of the multivariable regression are shown in Table 3. Adjusting for age and tumor grade, higher CCI score was significantly associated with higher odds of PCC (Odds Ratio (OR) 1.3 [95% CI 1.2, 1.4]). However, among the 134 patients who did receive a PCC, none of the included variables (age, CCI score, and histopathology) were associated with earlier PCC (prior to the end-of-life phase).

Comparison of older and younger adults

Two hundred twenty-one patients (35.6% of the total cohort) were older than 65 years at the time of HGG diagnosis. Baseline characteristics of patients stratified by age (over 65 years vs 65 years or younger) are in Table 4. Across these groups, the proportion of patients who received PCC did not differ significantly (25.8% for older vs 19.3% for younger group, chi-square p = 0.06). The distribution of referral timing by disease phase was also similar: diagnostic phase (14% vs 7.8%); initial treatment (28.1 vs 24.7%); second-line treatment (8.8% vs 19.5%); and end-of-life (49.1% vs 48.1%; *Fisher's exact* p= 0.27). The two age groups were similar with respect to most demographic and clinical factors, as well as discharge disposition from the final hospitalization. They differed significantly only in race (the older cohort had a higher proportion of White patients (73.8% vs 58.8%, *Fisher's exact* p<.01) and, expectedly, of glioblastomas (92.3% vs 79%, *Fisher's exact* p<.01)). To determine predictors of palliative care referral in the older and younger groups, the final model as above was fitted with each group (over 65 years and 65 or younger). In both, CCI score remained the only variable associated with higher odds of PCC (adults older than 65: OR 1.4 [95% CI: 1.2, 1.6]; adults 65 and younger: 1.3 [95% CI 1.2, 1.4]).

Survival analyses and PCC

Kaplan-Meier survival curves comparing patients who did and did not receive PCC and comparing early to late palliative care are shown in Figure 1. The median [IQR] time from diagnosis to death was 14 [5, 21] months for patients who did receive PCC and 12 [4, 22]

months who did not. There was no significant difference in survival stratified by receipt of PCC (*Log rank* p = 0.34). There was no significant difference in the hazard rates by PCC ($p = 0.23$); age ($p = 0.1$); sex ($p = 0.06$); tumor grade ($p = 0.16$); or CCI score ($p = 0.29$). Among the subset of 134 patients who were ever referred to palliative care, the unadjusted mortality probability was significantly lower in patients referred during the end-of-life phase versus during diagnosis or treatment (median survivals from diagnosis of 11 [4, 17.5] months vs 16.5 [8, 24] months, Log odds test p<.01). When a Cox proportional hazards model was fitted stratified by timing of palliative care, patients receiving palliative care during the end-of-life phase had a significantly higher hazard of death from time of diagnosis than those referred earlier (HR: 1.7 [95% CI: 1.2, 2.5], p<.01) adjusting for sex and age. Relative to patients who never received PCC, those referred during the end-of-life phase had significantly higher hazard of death from time of diagnosis (HR: 1.34 [95% CI 1.03, 1.76], p = 0.03), but those referred earlier had no different hazard of death (HR: 0.92 [95% CI 0.7, 1.2], p = 0.6).

Discussion

In this analysis of eight years of cancer registry data from a large, urban, multi-center health system, only about 20% of patients with HGG were referred to specialty palliative care at any point in their illness trajectory. This reflects the low referral rates seen in other studies, ranging from 15–40%.[14] Notably, referral rates increased over time, which is also consistent with other studies in glioma and cancer more broadly.[15] Along with greater acceptance and accessibility of palliative care on a national level,[24, 25] the inflection points in 2013 and 2018 may be related to institutional changes during those years. In 2013, the palliative care department established both a supportive oncology clinic and an inpatient program of standardized criteria for identifying patients appropriate for PCC while admitted to the solid tumor oncology service. The latter program was associated with increased palliative care utilization for patients on this service and may promote earlier PCC for patients with brain tumors.[26, 27] The second inflection point in 2018 merits further investigation, as there were no similar systems-level changes during this period.

More granular analysis of referral stratified by disease phase reveals that nearly 50% of referrals occurred during the end-of-life phase, after discontinuing cancer-directed therapy, and a quarter in the final two weeks of life. While these patients may benefit from palliative care expertise in end-of-life planning and care, these late referrals do not meet ASCO and NCCN guidelines, and patients likely do not receive the benefits of early, concurrent specialty palliative care. One potential barrier to earlier referral is the perception that palliative medicine specialists lack the neurologic expertise to manage common tumor-related symptoms such as headache and seizures. Yet they do commonly treat adverse effects of chemotherapy, including those of temozolomide, the usual first-line agent in HGG. The need for symptom management may carry over from the first-line to the second-line treatment phase, which is also an opportunity to begin addressing goals of care. To achieve earlier referrals, greater emphasis on outpatient palliative care – which was received by few patients in this cohort – is likely needed. While HGG patients are routinely hospitalized at the time of diagnosis for surgical resection and nearly half may be hospitalized at least once during initial chemoradiation,[28] supportive care needs in the outpatient setting are high

for this population.[29] Compared to inpatient consultation, outpatient PCC has additional benefits such as longitudinal management concurrent with neuro-oncology, rapport-building, reduced hospitalizations, and greater opportunities for symptom management.[30, 31]

Along with optimal timing of palliative care referral, it is not yet clear how HGG patients are identified as appropriate for referral. In this cohort, only greater comorbidity was associated with higher odds of any referral, and none of the available variables predicted earlier referral (before the end-of-life phase). Given that higher comorbidity is predictive of worse overall survival and progression-free survival,[32] this further suggests that palliative care referral was driven by worse prognosis. While older age and higher tumor grade, which are associated with poor prognosis,[33, 34] did not predict receipt of PCC in our cohort, we note that a relatively small proportion of patients with non-glioblastoma (ie lower grade) tumors were seen in our sample, and that other prognostic factors such as molecular markers and extent of tumor debulking were not available in our dataset. Indeed, patterns of referral were similar between older and younger adults, despite older age being predictive of worse prognosis, lower likelihood of undergoing all available cancer-directed therapies, lower HRQOL, and potentially more adverse effects from treatment and, therefore, heightened palliative care needs.[6, 33–36] Further research on patient, tumor, and treatment factors associated with palliative care referral and identifying patients who are most likely to derive benefit is needed.

Among several likely key factors driving patterns of palliative care referral in current practice is the views of the referring provider and the patient (and/or caregiver) toward palliative care.[37, 38] If palliative care is perceived as end-of-life care incompatible with cancer-directed therapy, it may also be equated to shorter survival, making clinicians reluctant to pursue referral. However, patients in this cohort who received PCC had similar overall survival to those not referred. Indeed, compared to end-of-life consultation, earlier PCC was associated with longer overall survival, contradicting the perception that PCC leads to shorter life span in this population. The group receiving PCC at the end of life also had shorter overall survival compared to those not ever receiving PCC, further supporting the hypothesis that poor prognosis is a driver of referral.

This study has several notable limitations, including its use of retrospective data and inclusion of a single study site. Additionally, the decision to refer to palliative care may be driven by discussions between clinician and patient, as well as other patient factors (e.g. appointment burden during early treatment, lack of education about palliative care); clinician factors (e.g. lack of education on the multiple domains of palliative care) and health system factors (e.g. cost of additional specialist visits); which were not captured in registry data.[16] Finally, this study addresses only specialty palliative care (delivered by teams with advanced training) and not primary palliative care – that is, elements of palliative care (symptom management, psychosocial support, and goals of care discussions) provided by neuro-oncology teams. Given the unique neurologic context of HGG and the expertise of neuro-oncologists in addressing aspects of the palliative care needs of this population, more formal training of neuro-oncologists in primary palliative care may also be needed.[39–42]

Conclusion

Despite a high level of need across palliative care domains for patients with HGG, only a minority (in this study, about one in ten patients) are referred to specialty palliative care prior to the end stages of illness. Ultimately, the optimal model for delivering palliative care in HGG – including timing, setting, and which patients to refer – has yet to be determined and tested in clinical trials for their impact on HRQOL, patient and caregiver experience of care, existential distress, and alignment of care plans with patient goals and values.

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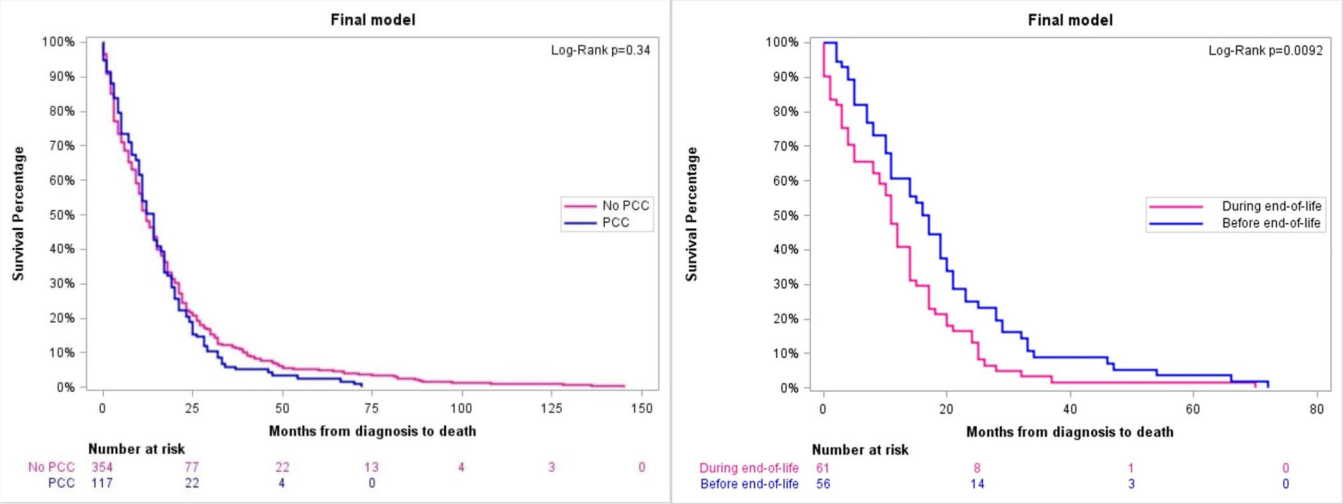

Figure 1A.

Kaplan-Meier survival curves were not significantly different amongst patients in the entire cohort who did and did not receive a palliative care consultation (p = 0.34) with a median time from diagnosis to death of 14 [5, 21] months and 12 [4, 22] months, respectively.

Figure 1B. Among the 134 patients receiving palliative care consultation, Kaplan-Meier survival curves in patients who received an initial consultation during the end-of-life phase was lower (worse) than those who received it during the diagnosis or treatment phase, with median time from diagnosis to death of 11 [4, 17.5] months vs 16.5 [8, 24] months, respectively (p<.01).

Table 1.

Baseline characteristics of high-grade glioma patients stratified by receipt of palliative care consultation.

Characteristic	Total Cohort (N = 621)	Palliative Care Consult N = 134 (21.6%)	No Palliative Care Consult N = 487 (78.4%)	P-Value
Age at cancer diagnosis, yrs.	59.4 (± 14.1)	61.1 (± 13.1)	58.9 (± 14.4)	0.1
Sex				
Male	342 (55.1)	74 (55.2)	268 (55)	0.97
Female	279 (44.9)	60 (44.8)	219 (45)	
Race				
White	398 (64.1)	86 (64.2)	312 (64.1)	
Black/African-American	81 (13)	16 (11.9)	65 (13.4)	0.96
American Indian/Alaskan Native/Asian/Pacific Islander	42 (6.8)	10 (7.5)	32 (6.6)	
Unknown/Other	100 (16.1)	22 (16.4)	78 (16)	
Ethnicity				
Non-Hispanic	504 (81.2)	111 (82.8)	393 (80.7)	0.63
Hispanic	93 (15)	20 (14.9)	73 (15)	
Unknown	24 (3.9)	3 (2.2)	21 (4.3)	
Marital status				
Single	263 (42.4)	76 (56.7)	187 (38.4)	
Married/Civil Union	171 (27.5)	17 (12.7)	154 (31.6)	**<.01**
Divorced/Separated/ Widowed	144 (23.2)	37 (27.6)	107 (22)	
Unknown	43 (6.9)	4 (3)	39 (8)	
Language				
English Speaker	517 (90.2)	124 (92.5)	393 (89.5)	0.3
Non-English Speaker	56 (9.8)	10 (7.5)	46 (10.5)	
Charlson Comorbidity Index score * (mean)	2.83 (± 3)	4.71 (± 3.5)	2.21 (± 2.5)	**<.01**
Histopathology				
Glioblastoma multiforme	520 (83.7)	120 (89.6)	400 (82.1)	**0.04**
Anaplastic astrocytoma	68 (11)	12 (9)	56 (11.5)	
Anaplastic oligodendroglioma	33 (5.3)	2 (1.5)	31 (6.4)	
Tumor location				
Supratentorial	583 (93.9)	128 (95.5)	455 (93.4)	**<.01**
Infratentorial	15 (2.4)	6 (4.5)	9 (1.9)	
Unknown	23 (3.7)	0 (0)	23 (4.7)	
Discharge status from final hospitalization				
Routine (Home Without Services)	97 (25.9)	10 (8.5)	87 (34)	
Home Health Services	63 (16.8)	16 (13.6)	47 (18.4)	**<.01**
Home Hospice/Hospice	96 (25.7)	39 (33.1)	57 (22.3)	

Characteristic	Total Cohort (N = 621)	Palliative Care Consult N = 134 (21.6%)	No Palliative Care Consult N = 487 (78.4%)	P-Value
Other Facility	84 (22.5)	27 (22.9)	57 (22.3)	
Died in Hospital	34 (9.1)	26 (22)	8 (3.1)	

* Charlson Comorbidity Index ranges from 0 to 37 points, with higher scores indicating more comorbidity

Table 2.

Details of palliative care consultations.

Characteristic	**N (%) N = 134**
Phase at initial consultation	
Diagnosis	14 (10.45)
1st Line of treatment	35 (26.12)
2nd Line of treatment	20 (14.93)
End-of-life	65 (48.51)
Palliative care setting	
Inpatient only	111 (82.84)
Outpatient only	18 (13.43)
Both inpatient and outpatient	5 (3.73)
Days from diagnosis to first palliative care encounter, median (IQR)	153 (36, 363)
Days from first palliative care encounter to death, median (IQR)	74 (15, 277)

Table 3.

Multivariable logistic regression model of the odds of receiving a palliative care consultation for the total cohort and in older and younger adults, as well odds of receiving palliative care consultation prior to the end of life vs during the end-of-life phase.*

Variables	Total cohort (N = 539)	Age > 65 (N = 190)	Age ≤ 65 (N = 349)	Palliative Care Recipients** (N = 134)
	OR (95% CI)			
Age (years)	1.0 (1.0, 1.0)	N/A	N/A	1.02 (1.0, 1.1)
Charlson Comorbidity Index score (mean)	1.3 (1.2, 1.4)	1.4 (1.2, 1.6)	1.32 (1.2, 1.4)	1.0 (0.9,1.1)
Histopathology** (Grade IV vs Grade III glioma)*	1.0 (0.3, 3.1)	3.8 (0.7, 20.8)	1.7 (0.8, 3.3)	0.9 (0.3, 2.7)

* Model is the same (adjusted for age, Charlson Comorbidity Index, and Histopathology) for all analyses based on variables significant in univariable regression and on a priori hypotheses about clinically significant variables

** The outcome for this analysis is palliative care consultation prior to the end of life (from diagnosis through the end of second-line treatment) vs during the end-of-life phase and includes only patients who were ever referred to palliative care

*** Grade IV glioma: glioblastoma; Grade III glioma: anaplastic astrocytoma and anaplastic oligodendroglioma

Table 4.

Baseline characteristics of high-grade glioma patients stratified by age.

Characteristic	Age > 65 Years N = 221 (35.6%)	Age ≤ 65 Years N = 400 (64.4%)	P-Value
Palliative Care Consultation			
Present	57 (25.8)	77 (19.3)	0.06
Absent	164 (74.2)	323 (80.8)	
Phase at initial consultation			
Diagnosis	8 (14)	6 (7.8)	
1st Line of treatment	16 (28.1)	19 (24.7)	0.27
2nd Line of treatment	5 (8.8)	15 (19.5)	
End-of-life	28 (49.1)	37 (48.1)	
Sex			
Male	119 (53.9)	223 (55.8)	0.65
Female	102 (46.2)	177 (44.3)	
Race			
White	163 (73.8)	235 (58.8)	
Black/African-American	21 (9.5)	60 (15)	**<.01**
American Indian/Alaskan/Asian/Pacific Islander	8 (3.6)	34 (8.5)	
Unknown/Other	29 (13.1)	71 (17.8)	
Ethnicity			
Non-Hispanic	176 (79.6)	328 (82)	0.24
Hispanic	39 (17.7)	54 (13.5)	
Unknown	6 (2.7)	18 (4.5)	
Marital status			
Single	42 (19)	102 (25.5)	
Married/Civil Union	90 (40.7)	173 (43.3)	**0.04**
Divorced/Separated/Widowed	67 (30.3)	104 (26)	
Unknown	22 (10)	21 (5.3)	
Language			
English Speaker	179 (88.2)	338 (91.4)	0.22
Non-English Speaker	24 (11.8)	32 (8.7)	
Charlson Comorbidity Index score * (mean)	2.9 (±3)	2.8 (± 3)	0.6
Histopathology			**<.01**
Glioblastoma multiforme	204 (92.3)	316 (79)	
Anaplastic astrocytoma	14 (6.3)	54 (13.5)	
Anaplastic oligodendroglioma	3 (1.4)	30 (7.5)	
Tumor location			
Supratentorial	210 (95)	373 (93.3)	0.19
Infratentorial	2 (0.9)	13 (3.3)	

Characteristic	Age > 65 Years N = 221 (35.6%)	Age ≤ 65 Years N = 400 (64.4%)	P-Value
Unknown	9 (4.1)	14 (3.5)	
Days from final inpatient admission to death, mean	251.1 (±349.4)	286.5 (±362.7)	0.65
Discharge status from final hospital admission			0.11
Routine	25 (20)	72 (28.9)	
Home Health Services	19 (15.2)	44 (17.7)	
Home Hospice/Hospice	31 (24.8)	65 (26.1)	
Other Facility	37 (29.6)	47 (18.9)	
Died in Hospital	13 (10.4)	21 (8.4)	

* Charlson Comorbidity Index ranges from 0 to 37 points, with higher scores indicating more comorbidity